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Morbidity Reporting in Local Areas [1]

II. The Problem of Measuring the Completeness of Reporting

MARGARET D. WEST, *Public Health Analyst, Public Health Service*

A first step in improving morbidity data is the measurement of the completeness of reporting. Only on the basis of such measurements can the present status of reporting be determined and the effectiveness of measures taken to improve reporting be evaluated. Since the source of most morbidity reports is the local health department, there is particular need for a method which can be used to measure the level of reporting in local health jurisdictions.

Two general approaches have been made to the problem in the past: (1) comparison of disease incidence as reported to the health department with that found by sampling and questioning the general population; (2) the use of indices derived from death data and case reports, either as case fatality rates or as the proportion of fatal cases reported before death (*1*, *2*).

The first method was used in 1929 and 1930 in connection with attempts to set up a morbidity reporting area for the United States (*3*). Estimates of the completeness of reporting were also made as by-products of the Hagerstown Morbidity Studies (*4*, *5*) and the National Health Survey (*2*, *6*).

Almost 20 years ago, as part of a proposal for setting up a morbidity reporting area, there was some experimentation (in at least three States) with house-to-house surveys of 1 percent of the population to find cases of diphtheria, poliomyelitis, scarlet fever, smallpox, typhoid fever, and tuberculosis. The cases found in these surveys were checked against health department reports to measure the level of reporting. In one State a study covering a sample of 1.7 percent of a total population of 7,000,000 was completed; in a second, a house-to-house survey representing a 1.3 percent population sample was made by public health nurses.

[1] From the Division of Public Health Methods.

A third State discontinued its survey because it found that for diseases of infrequent occurrence a 1 percent sample gave too few cases for significant results, and the cost of the study was more than the health department was able to carry. The usual problems of getting accurate reports from householders were also encountered. Because obtaining significant information by this method is expensive both in terms of staff and time, its use has been very limited.

The second method—the use of indices based on death data—has limited validity. The case fatality rate is affected by so many fact-tors—therapy, immunizations, susceptibility of the population at risk, change in the virulence of the disease—that its use as an index is limited to comparisons between similar areas for the same period of time. An index based on the proportion of deaths previously reported as cases is rapidly decreasing in usefulness as the death rates from the reportable diseases are dropping. In a city of 100,000 there would be on the basis of the 1945 death rates an average of less than one death each from chickenpox, measles, poliomyelitis, scarlet fever, and typhoid fever; less than two from diphtheria, meningococcal meningitis, rheumatic fever, and whooping cough; and for pneumonia and tuberculosis, less than 50. Even for pneumonia and tuberculosis, then, this method could be used for only a few of the very large local health departments.

In view of the difficulties involved in applying these methods, this office has attempted to develop a simplified method of appraising reporting which would be useful to and could be carried out by local health departments. The material and methods of the 1945 Morbidity Reporting Study have been described in the first paper in this series (*7*). The data collected represent samples of cases which occurred in 1944 and 1945, in five areas—A, a large city; B, a small city; C and D, counties, each with a small city and surrounding rural areas; and E, a predominantly rural county. In this paper an analysis is made of material gathered in the study relative to: (1) sources of morbidity data accessible to health departments and (2) the extent to which data from these sources can be used to determine the general level of reporting.

Sources of Morbidity Data

Physicians' records are usually the original source of information for diagnosed illness. A sampling of these records could be expected to provide valuable morbidity data. In fact, several of the health departments included in the survey had from time to time followed the practice of telephoning each physician each week for his morbidity report, particularly during epidemics. For the purpose of studying the completeness of reporting of communicable diseases, however, there were several objections to using this source. While the law may (and usually does) require reporting by persons and organizations other than the private physician, in general his responsibility is more clear-cut and more generally accepted. A general review of physicians' records would suggest checking on whether they had complied with legal requirements. It might interfere with the working relationship between the health department and the physicians of the community, and would, in addition, be an expensive procedure, For these reasons reviews of physicians' records were not attempted in this study.

In the present study, six sources of morbidity data generally available to health departments were explored:

1. Hospitals and sanatoriums.
2. Visiting nurse associations.
3. Health department clinic, nursing, laboratory and other data.
4. Death data.
5. School absenteeism records.
6. Industrial absenteeism records.

These sources were investigated in each study area, but in only two areas were all six sources available. However, it was possible to use

TABLE 1.—*Hospital records as a source of morbidity data—Five study areas, 1944–45*

Disease	Area A			Area B			Area C		
	Reported cases		Unreported hospitalized cases [1]	Reported cases		Unreported hospitalized cases	Reported cases		Unreported hospitalized cases
	Total	Hospitalized [1]		Total	Hospitalized		Total	Hospitalized	
Diphtheria	433	353	1	28	3	0	2	0	0
Influenza	14	2	18	NR			38	1	2
Meningitis, men	213	205	51	13	8	5	8	5	7
Pneumonia	1,985	1,298	2,067	NR			114	35	76
Poliomyelitis	207	182	28	33	30	8	9	1	0
Rheumatic fever	312	271	242	NR			6	2	9
Tuberculosis	1,141			102			101		
General hospitals		301	133		2	3		4	13
Sanatoriums					80	31		13	17

Disease	Area D			Area E		
	Reported cases		Unreported hospitalized cases	Reported cases		Unreported hospitalized cases
	Total	Hospitalized		Total	Hospitalized	
Diphtheria	2	0	0	8	1	1
Influenza	(2)			2	0	5
Meningitis, men	11	3	1	22	20	11
Pneumonia	(2)			27	13	280
Poliomyelitis	3	0	2	22	20	2
Rheumatic fever	NR			1	0	8
Tuberculosis	59			65		
General hospitals		3	1		5	21
Sanatoriums					16	18

[1] Estimated from sample.
[2] Cases not routinely reported by name to health department.
NR: Not reportable.

hospital records, health department records and death records in all the areas.

Hospitals and sanatoriums.—Studies were made in 20 hospitals and sanatoriums. These included all general hospitals in areas B, C, D, and E, a sample of four general hospitals in area A, and the State tuberculosis sanatoriums in areas B, C, and E. In each area a medical record analyst abstracted records of cases of reportable diseases hospitalized during the study period. These abstracts were matched with health department records of reported cases, and analyses were made of the extent to which reported cases were hospitalized and of the completeness of reporting of hospitalized cases.

Table 1 summarizes the findings of these hospital record investigations. It will be seen that a large proportion of the hospitalized cases were unreported. For some diseases, particularly for influenza, pneumonia, and rheumatic fever, the number of unreported cases was as high or higher than the total reported cases.

Visiting nurse associations.—Studies of visiting nurse association records were made in two of the study areas—C and E. The field worker obtained from the visiting nurse association data on each case of a reportable disease given service, and this information was matched against the health department's reports. Table 2 summarizes the

TABLE 2.—*Visiting nurse association records as a source of morbidity data—Two study areas, 1944–45*

Disease	Area C			Area E		
	Reported cases		Unreported VNA cases	Reported cases		Unreported VNA cases
	Total	With VNA records		Total	With VNA records	
Chickenpox	55	0	3	700	1	22
Pneumonia	114	1	2	27	1	79
Poliomyelitis	9	0	0	22	2	2
Rheumatic fever	6	1	2	1	0	6
Scarlet fever	131	1	2	269	4	3

findings from these records. For only five diseases—chickenpox, pneumonia, poliomyelitis, rheumatic fever, and scarlet fever—were records found of cases of reportable diseases having had visiting nurse service. The total number of cases found in these records was very small. Only for pneumonia and rheumatic fever in area E was the number of cases large in proportion to the reported cases.

In total, the reporting of visiting nurse association cases was very poor. The value of visiting nurse association records in appraising morbidity reporting is obviously largely determined by the amount of visiting nurse association service in the area.

Health department data.—Information on the occurrence of reportable diseases may come to the attention of the health department not only through morbidity reports, but also through such activities as school inspections, clinic examinations, nursing visits, tuberculosis or other case follow-up, laboratory examinations and the distribution of biologicals. Information obtained through these sources, in some of the areas studied, was routinely used to supplement the usual morbidity reports. In other places, however, family folders, school health records, tuberculosis case registers, and other health department records showed cases of communicable diseases which had never been included in the morbidity reports to the State. In each study area all available health department records—nursing, clinic, and laboratory—were abstracted and matched with the cases included in the morbidity reports.

Table 3 indicates the diseases for which these records provided morbidity information. It will be seen that the diseases included in health department records varied greatly, in accordance with emphases

TABLE 3.—*Health department (laboratory, nursing, and clinic) records as a source of morbidity data—Five study areas, 1944–45*

Disease	Area A			Area B			Area C		
	Reported cases		Unreported cases with H.D. records	Reported cases		Unreported cases with H.D. records	Reported cases		Unreported cases with H.D. records
	Total	With H.D. records		Total	With H.D. records		Total	With H.D. records	
Chickenpox	798	421	1	NR	--------	--------	55	0	0
Diphtheria	433	156	2	28	28	0	2	1	3
Measles	147	34	0	7	7	0	142	0	0
Pneumonia	1,985	95	1	NR	--------	--------	114	13	6
Poliomyelitis	207	0	0	33	28	1	9	0	0
Rheumatic fever	312	35	0	NR	--------	--------	6	0	2
Scarlet fever	1,400	136	8	84	84	1	131	34	10
Tuberculosis	1,141	374	8	102	25	0	101	10	20
Whooping cough	1,381	510	31	364	363	0	30	0	0

Disease	Area D			Area E		
	Reported cases		Unreported cases with H.D. records	Reported cases		Unreported cases with H.D. records
	Total	With H.D. records		Total	With H.D. records	
Chickenpox	30	0	0	700	0	0
Diphtheria	2	1	0	8	0	0
Measles	122	2	0	256	0	0
Pneumonia	(1)	--------	--------	27	0	0
Poliomyelitis	3	0	0	22	0	0
Rheumatic fever	NR	--------	--------	1	0	0
Scarlet fever	174	1	0	269	0	0
Tuberculosis	59	30	0	65	18	44
Whooping cough	7	0	0	100	0	0

[1] Cases not routinely reported by name to health department.
NR: Not reportable.

in health department programs. In general, the most fruitful data were for tuberculosis, for which health department records in the five areas furnished information on a number of cases ranging from 25 percent to 95 percent of the total reported.

Death data.—In all five areas a review of death certificates was made by the field worker. This was done in the local health department, except in area E in which the local register was not a part of the health department. For this area, the review of death records was made in the State health department.

TABLE 4.—*Death records as a source of morbidity data—Four study areas, 1944–45*

Disease	Area A				Area B			
	Reported cases			Deaths not reported as cases	Reported cases			Deaths not reported as cases
	Total	Deaths			Total	Deaths		
		Reported before death	Reported after death			Reported before death	Reported after death	
Diphtheria	433	6	9	0	28	0	0	0
Meningitis, men	213	0	27	2	13	3	0	2
Pneumonia	1,985	16	672	96	NR	-	-	-
Poliomyelitis	207	0	1	1	33	1	0	1
Rheumatic fever	312	1	1	34	NR	-	-	-
Tuberculosis	1,141	383	71	2	102	21	13	8

Disease	Area C				Area E			
	Reported cases			Deaths not reported as cases	Reported cases			Deaths not reported as cases
	Total	Deaths			Total	Deaths		
		Reported before death	Reported after death			Reported before death	Reported after death	
Diphtheria	2	0	0	0	8	0	1	0
Meningitis, men	8	0	4	0	22	0	7	1
Pneumonia	114	2	53	12	27	0	0	253
Poliomyelitis	9	0	1	0	22	1	2	0
Rheumatic fever	6	0	5	0	1	0	0	25
Tuberculosis	101	8	40	9	65	16	4	109

NR: Not reportable.

Death certificate data and death data from hospital records were matched against data for reported cases. Table 4 summarizes the findings. The greatest number of death records found were for pneumonia and tuberculosis. As indicated earlier in this paper, almost all other communicable diseases have death rates so low that little information is available from this source.

School absenteeism.—The present study included reviews of elementary and high school records in areas C, D, and E. These included all city schools in areas C and D, and a sample of both urban and rural schools in area E. Of the population ages 5 to 19, 34 percent was included in the sample in area C, 40 percent in area D, and 27 percent in area E. In areas A and B, where health department nurses worked closely with the local schools, routinely reporting cases which came to their attention, it was not administratively possible to make studies in the schools.

While school records were often found to be incomplete and while excuses might be vague to the point of irrelevance, the types of errors encountered, in general, were such as to miss cases rather than to find cases where none existed. If a record showed measles it was highly probable that the child did have measles, but if the excuse simply said the child was sick there was no case record for survey purposes. In those places where doctors' excuses giving the cause of illness were required, the school records were, of course, the most complete and accurate.

An analysis of the age distribution of all reported cases in this investigation, as in studies by others, indicates that more than half of all

TABLE 5.—*School records as a source of morbidity data—Three study areas, 1944–45*

Disease	Area C			Area D			Area E		
	Reported cases		Unreported cases with school records[1]	Reported cases		Unreported cases with school records[1]	Reported cases		Unreported cases with school records[1]
	Total	With school records[1]		Total	With school records[1]		Total	With school records[1]	
Chickenpox	55	36	1,001	30	20	542	700	513	1,408
Diphtheria	2	2	7	2	0	2	8	4	1
German measles	2	0	6	(2)			7	5	97
Measles	142	88	766	122	81	648	256	142	372
Mumps	13	3	45	19	15	538	456	390	923
Pneumonia	114	13	72	(2)			27	0	3
Rheumatic fever	6	4	47	NR			1	0	7
Scarlet fever	131	85	57	174	125	16	269	193	103
Whooping cough	30	15	247	7	5	240	100	60	246

[1] Estimated from sample.
[2] Cases not routinely reported by name to health department.
NR: Not reportable.

reported cases of chickenpox, diphtheria, German measles, measles, mumps, poliomyelitis, rheumatic fever, and scarlet fever occurred among persons in the age group 5 to 19 years; while over a third of the cases of whooping cough and meningitis were in those years (*8*, *9*). It would be expected, therefore, that school records would be good sources of data on these diseases. Table 5 indicates that the number of cases of chickenpox, diphtheria, German measles, measles, mumps, rheumatic fever, scarlet fever, and whooping cough in school records was greater than the number reported.

Industrial absenteeism.—Reviews of industrial absenteeism records were made in four of the five study areas, as follows:

Area	Type of industry	Number of employees	Percent of population age 20 and over [1]
A	Airplane manufacture	3, 200	0. 5
C	Airplane manufacture	8, 000	12. 8
D	Manufacturing	4, 200	10. 2
E	Steel mill Quarry	6, 000	7. 6

[1] Population of area included in sample.

Industrial records gave information on more than the reported number of cases of influenza in two areas (table 6). This source was the only one studied which furnished data on more than a few cases of this disease. For other reportable diseases which attack the adult population, the number of cases found was very small.

Table 6.—*Industrial records as a source of morbidity data—Four study areas, 1944–45*

Disease	Area A			Area C			Area D			Area E		
	Reported cases		Unreported cases in industrial survey	Reported cases		Unreported cases in industrial survey	Reported cases		Unreported cases in industrial survey	Reported cases		Unreported cases in industrial survey
	Total	Industrial survey		Total	Industrial survey		Total	Industrial survey		Total	Industrial survey	
Influenza	14	0	110	38	2	258	([1])	-----	-----	2	0	1
Mumps	662	0	1	13	0	7	19	0	5	456	1	3
Pneumonia	1, 985	0	4	114	2	11	([1])	-----	-----	27	1	43
Rheumatic fever	312	0	0	6	0	5	NR	-----	-----	1	0	0
Scarlet fever	1, 400	0	0	131	2	1	174	1	1	269	1	2
Streptococcal sore throat	126	0	5	15	1	50	87	0	5	NR	-----	-----
Tuberculosis	1, 141	1	0	101	0	1	59	1	0	65	0	3

[1] Cases not routinely reported by name to health department.
NR: Not reportable.

Discussion

The first question raised in this study concerns the sources accessible to local health departments which might furnish information on a sufficient number of cases to serve as a basis for estimating the completeness of morbidity reporting. The foregoing tables and observations have indicated the extent to which each source investigated was found to furnish data on reportable diseases.

Schools provided information on the greatest number of cases of chickenpox, diphtheria, German measles, measles, mumps, scarlet fever, and whooping cough—the common communicable diseases of childhood—in the three areas in which school data were available. For all of these the number of cases found in school records exceeded the total number of cases reported.

Hospital records gave information on the greatest number of cases of meningococcal meningitis, pneumonia, and poliomyelitis, diseases which are in general hospitalized. For meningitis and pneumonia more cases were hospitalized than reported; for poliomyelitis the numbers were approximately equal.

Industrial records gave information on the greatest number of cases of influenza. In samples representing less than 10 percent of the adult population more influenza cases were found than in any other source studied—more than 7 times the total of reported cases.

No one source gave information on a large sample of rheumatic fever or tuberculosis cases. Hospitals, schools, and death records together provided information on more than the reported number of rheumatic fever cases; and hospitals, sanatoriums, health department records and death certificates together gave information on more than the reported number of tuberculosis cases in the three areas in which data from all of these sources were available. The incidence of other diseases was too low, or records on them were too scattered, to furnish satisfactory sources of data.

Completeness of Reporting

To what extent can data from sources such as these be used to derive indices of the completeness of reporting? If together all sources provided information on all cases which occurred, the ratio of reported to total cases would of course be the measure of the completeness of reporting. Complete information as to the incidence of disease, however, cannot be obtained by this method of surveying records. Neither by this method can the representativeness of the sample be measured.

Survey data, however, can give one straightforward index. If 100 cases of pneumonia have been reported for a community, and there are found to be unreported 40 hospitalized cases and another 5 cases for which death certificates have been filed, the true reporting level is:

$$\frac{100}{100+40+5+x}$$

with x representing all of the unreported cases not found in the surveys. It is apparent that the value of the fraction decreases as x increases, and that $\frac{100}{100+40+5}$ is therefore the theoretical upper limit to the reporting level and represents the highest possible proportion of reported cases. In this hypothetical case, then, not more than 69 percent of the pneumonia cases can have been reported. This composite upper limit can give the health officer one definite and valuable piece of information about his morbidity reporting. In this case, at least 31 percent of the cases of pneumonia were unreported.

TABLE 7.—*Composite index—upper limits of the level of reporting—Five study areas, 1944–45*

Disease and area [2]	Total cases reported and in survey	Reported cases	Unreported cases found in survey [1]				Composite index
			Total	Hospital [3]	School [4]	Other	Completeness of reporting not greater than (percent)
Chickenpox:							
C	1,074	55	1,019	0	1,001	18	5
D	573	30	543	0	542	1	5
E	2,134	700	1,434	2	1,408	24	33
Diphtheria:							
E	10	8	2	1	1	0	80
German measles:							
E	104	7	97	0	97	0	7
Influenza:							
A	142	14	128	18	----------	110	10
C	514	38	476	2	212	262	7
E	11	2	9	5	0	4	18
Measles:							
C	935	142	793	0	766	27	15
D	772	122	650	0	648	2	16
E	634	256	378	3	372	3	40
Meningitis, men:							
A	268	213	55	51	----------	4	79
B	19	13	6	5	----------	1	68
C	15	8	7	7	0	0	53
D	12	11	1	1	0	0	92
E	37	22	15	11	2	2	59
Mumps:							
C	68	13	55	1	45	9	19
D	562	19	543	0	538	5	3
E	1,392	456	936	2	923	11	33
Pneumonia:							
A	4,097	1,985	2,112	2,067	----------	45	48
C	287	114	173	76	72	25	40
E	651	27	624	280	3	341	4
Poliomyelitis:							
A	236	207	29	28	----------	1	88
B	42	33	9	8	----------	1	79
E	26	22	4	2	0	2	85
Rheumatic fever:							
A	571	312	259	242	----------	17	55
C	70	6	64	9	47	8	9
E	47	1	46	8	7	31	2
Scarlet fever:							
C	202	131	71	1	57	13	65
D	192	174	18	1	16	1	91
E	381	269	112	2	103	7	71
Tuberculosis:							
A	1,283	1,141	142	133	----------	9	89
B	133	102	31	3	----------	28	77
C	153	101	52	12	3	37	66
E	244	65	179	24	0	155	27
Whooping cough:							
C	283	30	253	2	247	4	11
D	270	7	263	1	240	22	3
E	350	100	250	0	246	4	29

[1] Cases found in more than one source have been allocated in this table according to the following order of priority: hospital, school, other.
[2] Diseases shown only where the number of cases found was representative of the population at risk or where the "necessary" sources for the composite index were available.
[3] Estimated from sample in area A.
[4] Estimated from sample.

Composite upper limits based on the present study, for 13 diseases and for each study area for which data were obtained, are shown in table 7.

At best an index computed as an upper limit furnishes a somewhat inflated picture of the level of reporting. To be meaningful it would have to include at least these sources of data:

Diseases	*Necessary sources*
Chickenpox	School
Diphtheria	School
German measles	School
Influenza	Industrial
Measles	School
Meningococcal meningitis	Hospital
Mumps	School
Pneumonia	Hospital
Poliomyelitis	Hospital
Rheumatic fever	Hospital, school, death
Scarlet fever	School
Tuberculosis	Hospital, sanatorium, health department
Whooping cough	School

For example, for measles in area C, the composite upper limit is (from table 7):

$$\frac{142}{142+793}=15.2 \text{ percent}$$

While if school data alone are used the limit is computed as:

$$\frac{142}{142+766}=15.6 \text{ percent}$$

And if all the sources used in this study except school records were used the limit would be:

$$\frac{142}{142+27}=84.0 \text{ percent}$$

When a large proportion of all cases of a disease is found in a certain age or population group a simpler index and one which may more closely approximate the true proportion of all cases reported can be derived directly from the data available from one type of source.

For the seven common communicable diseases of childhood, school children provide a sample of between one-third and two-thirds of all cases which occur (*8*, *11*). The proportion of reported cases among all school cases should give a more direct index for these diseases than the composite upper limit, unless the reporting of pre-school cases is at a substantially higher level than that for school-age cases. (This could be suspected if the health department finds a higher than expected proportion of reported cases in ages 1 to 5.)

For the example given above, measles cases in area C, a direct index based on school data gives (from table 5):

$$\frac{\text{Reported school cases}}{\text{All school cases}}=\frac{88}{88+766}=10.3 \text{ percent}$$

The composite upper limit indicates, as shown above, that the completeness of measles reporting in total was not more than 15.2 percent. By this second method, which assumes that school children are representative of the population at risk, it is estimated that some 10.3 percent of the cases were reported.

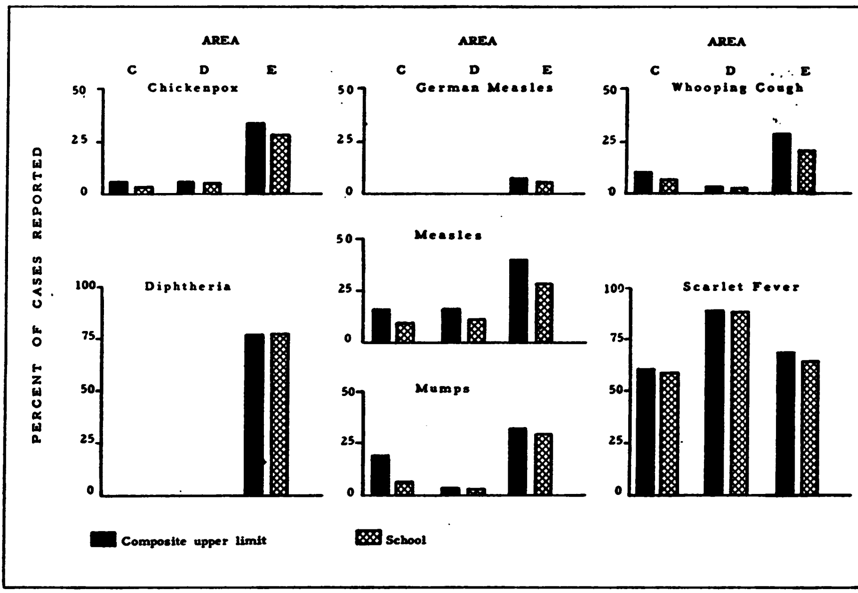

Chart 1. Completeness of reporting of childhood diseases. Composite upper limit and school index. Three study areas, 1944–45.

The composite upper limit, then, provides a check as to the validity of a direct index based on data from individual sources.

Chart 1 shows the composite and school indices for the seven childhood diseases. It indicates that school data provide indices close to, but lower than, the theoretical upper limit for each of these diseases. If it were assumed that the reporting of pre-school cases was at the same level as school-age cases, and the upper limit reduced accordingly, the school index and the upper limit would be very close.

Similarly, it was found that the hospitalized cases were such a high proportion of all cases of meningococcal meningitis, pneumonia, and poliomyelitis, that the completeness of reporting of hospitalized cases

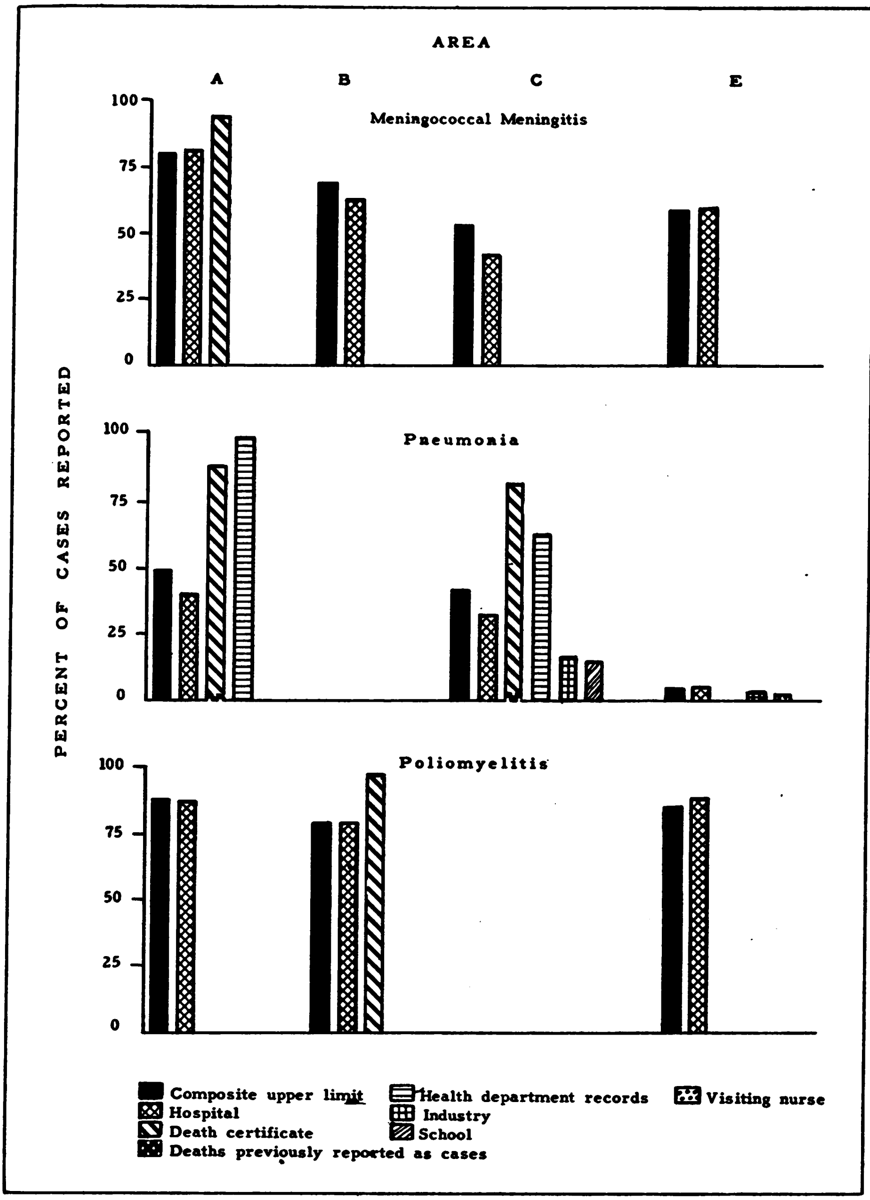

Chart 2. Completeness of reporting of meningococcal meningitis, pneumonia, and poliomyelitis. Composite upper limit and indices based on data from selected sources. Four study areas, 1944–45.

gives an index very near to, or slightly lower than, the composite upper limit. This is shown in chart 2.

This chart also shows indices of the completeness of reporting of these diseases based on data from death certificates and health department records. These indices furnish a measure of the reporting level

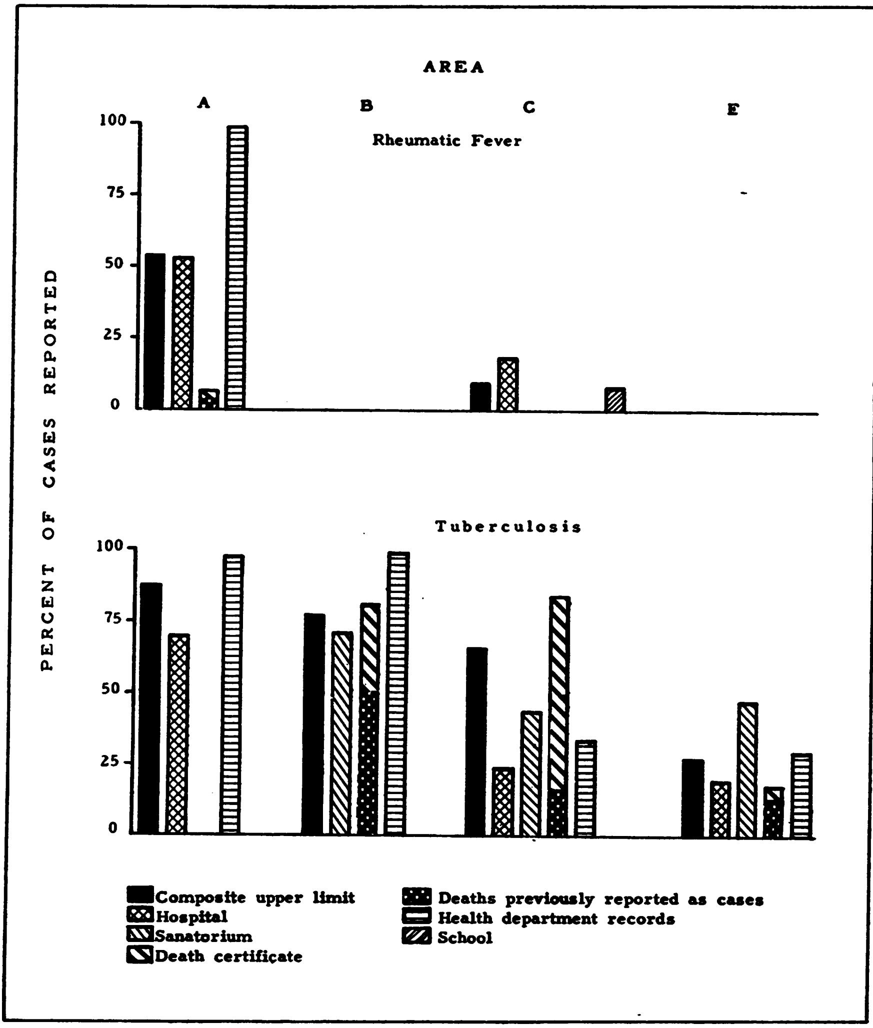

Chart 3. Completeness of reporting of rheumatic fever and tuberculosis. Composite upper limit and indices based on data from selected sources. Four study areas, 1944–45.

which is much higher than the composite upper limit. Indices for pneumonia based on industrial, school, and visiting nurse data fell below their respective theoretical limits, but the samples were so small that the findings could not be considered too meaningful. Industrial records alone could be used as an index for influenza and possibly for streptococcal sore throat.

For rheumatic fever (chart 3) the indices from individual sources were erratic. Hospital records gave an index below the composite upper index in area A and double this index in C. In area A most cases were found in hospital records, in C most were in school records, and in E most were in death records. In view of these erratic findings, the composite upper limit was found to be the most satisfactory index which could be computed from these data.

Tuberculosis indices were also very uneven (chart 3). Data from general hospitals consistently gave an index lower than the theoretical upper limit, but this source provided a relatively small sample. Death certificate data and health department data generally gave indices that were impossibly high. Sanatorium data likewise gave uncertain figures. Each of these sources, however, represents a numerically important group of cases. The composite upper limit based on these four sources of data, therefore, might be considered to be the best index of the completeness of tuberculosis reporting in these areas. These findings indicate again that when the number of cases found from any one source is small, the composite upper limit furnishes the best index.

Summary

In the present study of five health jurisdictions a number of sources of morbidity data—hospitals, sanatoriums, visiting nurse associations, death certificates, schools, industrial plants, and health department records—were investigated to determine to what extent it would be possible to obtain from them indices of the level of morbidity reporting.

In these areas it was found that for the childhood diseases—chickenpox, diphtheria, German measles, measles, mumps, scarlet fever, and whooping cough—the level of reporting of cases included in the school records furnishes useful information as to the completeness of reporting.

For meningococcal meningitis, pneumonia, and poliomyelitis the completeness of reporting of cases in general hospitals provides a very useful index.

For diseases for which there is available no one source representative of the population at risk an index representing an upper limit to the completeness of reporting can be obtained by combining the available data in the form:

$$\frac{\text{All reported cases}}{\text{All reported cases} + \text{unreported cases from each source}}$$

For rheumatic fever, for instance, no single source was found to be satisfactory. Here an upper limit based on data from hospital, school, and death records provides an index. For tuberculosis an upper limit based on the reporting of cases found in hospital, sanatorium, death certificate, and health department data provides the most useful index.

For other reportable diseases one or more of these sources can be expected to give useful information. However, in the areas studied

so few cases of other reportable diseases were found that it was not possible to find significant aggregates of data.

Probably no final index of the completeness of reporting can be set up, since such shifting factors as the presence of an epidemic will temporarily change the level of reporting of a particular disease. The need of the health officer, however, is not for refined figures which could be developed from protracted study, but for approximate figures which will assist him in interpreting and evaluating the morbidity program of his own department and in planning the better utilization of reporting sources. The indices suggested here can be expected to provide such information.

The design of a simplified morbidity reporting study for a local area will be discussed in a further paper, as will the relationship of the reporting level and the reporting pattern and its meaning in terms of desirable reporting methods.

ACKNOWLEDGMENTS

The State and local health departments participating in this study were very generous in giving time and assistance in planning and carrying out the study. Especial thanks are given to the many hospitals, schools, visiting nurse associations and industrial plants whose records form the basis of this work.

Field workers from the Division of Public Health Methods included Erna Landsiedel, Cecelia Dalton, Marion Lee, Sarah Welsh and Loma Jane Cole.

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A Reduced Tellurite Medium for Isolating and Typing *C. Diphtheriae*[1]

By Ted W. Galbraith, E. H. Bramhall and Russell S. Fraser

Tellurium salts were first used by Conradi and Touch in 1912 as a selective agent in the isolation of *Corynebacterium diphtheriae* (*1*). Since then many media containing tellurite in different forms have been described. Most of these media were investigated and compared with Loeffler's medium by three independent observers in 1930 (*1*). They agreed that Clauberg's medium containing potassium tellurite was most worthy of being substituted for Loeffler's. This comparison was made for growth and isolation; the difference in the colony forms of *C. diphtheriae* was not mentioned. In 1931, Anderson et al., reported an excellent medium for typing gravis, intermedius, and mitis forms of diphtheria bacilli. The minimus type was described later (*3*, *4*, *5*).

The preparation of media containing tellurite usually involves one or more filtrations or other difficult procedures. These procedures are often so complicated that a good differential medium is generally not found in diagnostic laboratories where *C. diphtheriae* is usually isolated. A good medium that is easy to prepare is needed in the study of the diphtheria bacillus.

Methods and Materials

The medium used by us is prepared by weighing out 75 gms. of meat infusion agar No. 14, 0.4 gm. potassium tellurite, and 10 gms. of bacto hemoglobin. Place the weighed portions in a mortar and mix well. Suspend this mixture in 1,000 ml. of cold distilled water. Boil for a few minutes to dissolve the medium. Adjust the pH to 7.2–7.3. Autoclave for 20 minutes at 121° C. Allow medium to cool to 45–50° C. before pouring 12–15 ml. of the dark medium into sterile plates. The plates are ready for use on solidification.

The tellurite is reduced by autoclaving. This produces a dark color. The base is a meat infusion agar No. 14 prepared by Difco for contaminated wound studies. Its composition per liter is: Infusion from 454 gms. of beef heart, 20 gms. proteose peptone, 5 gms. sodium chloride and 20 gms. bacto agar.

Results

This medium is not selective for diphtheria bacilli. Nearly all organisms common to the nose and throat will grow on it. The

[1] From Division of Laboratories, Utah State Department of Health, Salt Lake City, Utah.

colonial characteristics of *C. diphtheriae* are such that with a little experience the desired colonies may be picked. It is necessary to use some form of magnification, at least 9–12 powers, to bring out the colonial characteristics. In our laboratory we use a stereoscopic microscope employing reflected light. Minimus colonies cannot be seen with transmitted light or differentiated with the unaided eye.

Descriptions of the colonial characteristics of the organisms commonly found in the nose and throat together with those of some of the Corynebacteria are given below:

Streptococci

S type: convex, 0.2–0.5 mm. in diameter, dark brownish grey to black, glistening, smooth, entire edges; soft even spread when probed with a needle.
R type: dark grey, flat, irregular and rough.

Staphylococci

Convex, 0.5–2.0 mm. in diameter, light grey, glistening, smooth, entire edges; soft, moist, even spread when probed with a needle.

Yeast

Convex, 0.5–1.0 mm. in diameter, light grey, dull, granular, entire edges; soft granular dry spread when probed with a needle.

Proteus like organisms

Flat to convex, 1.0–5.0 mm., green or red metallic sheen, rough and dull; granular moist spread when probed with a needle.

Gravis type

Conical, 0.5–2.0 mm., dull, dark brownish grey with centers darker than periphery, marked radial striations, finely granular, slight to markedly indented periphery; fractures when probed with a needle. "Daisy head" colonies are often seen.

Mitis type

Conical, 0.5–1.5 mm. in diameter, dull light grey to brownish grey, may have dark center-slight radial striations usually confined to periphery, slight marginal indentations at striations; fractures when probed with a needle.

Minimus type

Generally effuse, some strains umbonate, 0.1–0.2 mm. in diameter, dull, light to dark grey, coarsely granular with erose to lobate edges; fractures when probed with a needle.

Diphtheroids

Conical to convex, 0.5–3.0 mm. in diameter, glistening to dull, light grey to brownish grey, smooth to finely granular, entire to erose edges; soft moist waxy spread when probed with a needle.

Discussion

The number of tellurite media for the isolation of the diphtheria bacillus is considerable and still increasing. This can only mean that the ideal medium for isolating *C. diphtheriae* has not yet been found. Johnstone and Zinnemann (1943) claim such a medium should have the following properties:

1. It should support the growth of every strain and type of *C. diphtheriae*.

2. Type differentiation should be easy, or selectivity should be complete.
3. Diphtheriae colonies should be recognizable in at least 18 hours.
4. The medium should be simple and easy to prepare.

The reduced tellurite medium described above seems to meet these qualifications better than any medium we have tested so far. It will support the growth of all strains and types of *C. diphtheriae*. Most strains and types are so typical that recognition is usually simple. Eighty-five percent of all positive cultures may be read in 18 hours or less. With meat infusion agar No. 14 (Difco) the preparation is very easy.

We find, as did Cooper et al. (1940) that more positive results are obtained when a blood tellurite agar medium is used rather than Loeffler's medium alone. This fact is further emphasized because the morphology of the minimus type is not distinctive enough to be identified in all cases on a smear from Loeffler's.

We do not claim our medium will type the diphtheria bacilli. We do feel the colonial characteristics on this medium are distinctive enough to assist materially in carrying out McLeod's (1943) postulates.

Summary

1. The reduced tellurite medium described in this paper is simple to prepare and will support growth of all strains and types of *C. diphtheriae* tested.

2. Colonial characteristics for streptococci, staphylococci, proteus. yeast and gravis, mitis and minimus types of *C. diphtheriae* on this medium are described.

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INCIDENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

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UNITED STATES

REPORTS FROM STATES FOR WEEK ENDED AUGUST 21, 1948

Summary

For the first time since May, the reported weekly incidence of poliomyelitis declined. A total of 1,307 cases was reported for the week ended August 21, as compared with 1,409 for the preceding week, 1,816 for the corresponding week in 1946, and a 5-year (1943–47) median of 747. Of 26 States reporting 10 or more cases, 14 showed an increase of 95 (375 to 470), 8 showed a decline of 137 (706 to 569), and 4 States reported the same numbers for each week (New Jersey 40, Ohio 82, Nebraska 34, Arkansas 10). Only New York, with an increase of 40 cases, showed an increase of more than 10 cases; only 4 other States reported increases of more than 5 cases, and 2 States, Rhode Island and Nevada, reported no cases in either week. Reporting currently more than 17 cases each and showing changes are 15 States, as follows (last week's figures in parentheses): *Increases*—New York 99 (59), Illinois 66 (60), Michigan 42 (41), Wisconsin 36 (26), Minnesota 67 (57), Iowa 37 (36), Tennessee 28 (27); *decreases*—Massachusetts 19 (20), Pennsylvania 43 (52), Virginia 38 (52), North Carolina 159 (192), South Carolina 25 (31), Oklahoma 25 (28), Texas 54 (90), California 206 (241). Since March 20, approximate average date of seasonal low incidence, 9,393 cases have been reported, as compared with 2,051 for the same period last year, 8,374 in 1946, and a 5-year median for the period of 3,911.

Of 25 cases of Rocky Mountain spotted fever (last week 29, 5-year median 19), 15 occurred in the South Atlantic area, 9 in the South Central, and 1 in Illinois. One case of anthrax was reported in Pennsylvania, and 1 case of smallpox in Kentucky. Of 31 cases of tularemia (last week 22, 5-year median 11), Missouri reported 11, Arkansas 6, and Oklahoma and Utah 4 each.

Deaths recorded in 93 large cities in the United States totaled 8,085, as compared with 7,904 last week, 8,348 and 8,091, respectively, for the corresponding weeks of 1947 and 1946, and a 3-year (1945–47) median of 8,348. For the year to date the total is 317,064, as compared with 318,515 for the corresponding period last year. Infant deaths during the week totaled 618, last week 617, 3-year median 684. The cumulative figure is 22,731, as compared with 25,489 for the same period in 1947.

Telegraphic case reports from State health officers for week ended August 21, 1948

(Leaders indicate that no cases were reported)

Division and State	Diphtheria	Encephalitis, infectious	Measles	Meningitis meningococcus	Poliomyelitis	Rocky Mt. spotted fever	Scarlet fever	Tularemia	Typhoid; paratyphoid fever [c]	Whooping cough
NEW ENGLAND										
Maine	1		46		4		4			3
New Hampshire			1		1					
Vermont			19		3		1			
Massachusetts	2		94	1	19		17		11	62
Rhode Island							[b] 6			2
Connecticut			17	1	6		2		1	10
MIDDLE ATLANTIC										
New York	5		125	1	99		[b] 30		1	128
New Jersey	1		98	1	40		7		1	46
Pennsylvania	2		54	4	43		20		5	38
EAST NORTH CENTRAL										
Ohio	2		13	4	82		26		1	34
Indiana	1		5	1	17		10		1	12
Illinois	4	3	22	4	66	1	17		5	60
Michigan [a]	1		84	1	42		21		3	27
Wisconsin			157		36		16			59
WEST NORTH CENTRAL										
Minnesota	3		6		67		9		2	8
Iowa			3	1	37		7		1	5
Missouri	1		2	2	17		6	11	3	3
North Dakota	1	4	5		4		3			3
South Dakota	1	2			6		2			
Nebraska	1		6		39		1			3
Kansas	3		3		10		5	1		10
SOUTH ATLANTIC										
Delaware				1	8					
Maryland [a]	1	3	40		7	7	3		1	21
Dist. of Col.				1	6	1	1		1	3
Virginia	1		19	1	38	2	2	1	1	26
West Virginia	2		2		7		[b] 7			2
North Carolina	11		5	[1] 1	[1] 159	4	7	1	1	18
South Carloina	11		3		25	1	3		3	42
Georgia			3	1	8		7		5	11
Florida	3		4		14		2		1	14
EAST SOUTH CENTRAL										
Kentucky	7		11	2	16	3	10		1	8
Tennessee	3		6	3	28	2	20		7	6
Alabama	12		5	1	6	1	5		1	9
Mississippi [a]	7			1	7		2		1	2
WEST SOUTH CENTRAL										
Arkansas	4		3	1	10		3	6	3	5
Louisiana			1	1	5	1	1			
Oklahoma	1		5	4	25	2	5	4	3	9
Texas	14		109		54		7	2	15	96
MOUNTAIN										
Montana			5				2			4
Idaho	1		8		4		[b] 2		2	
Wyoming	1		2		10		2			
Colorado	3		19	1	7		4	1	1	6
New Mexico			4		4		2			
Arizona	3		1		11					13
Utah [a]	3		141				3	4		17
Nevada			1							2
PACIFIC										
Washington	1		50		3		8		1	10
Oregon	1		55		6		3			10
California	2	7	136	3	206		30		13	55
Total	121	19	1,398	43	1,312	25	351	31	96	902
Median, 1943–47	206	19	814	79	747	19	650	11	140	2,129
Year to date, 33 weeks	5,308	328	549,351	[1] 2,265	[1] 9,748	410	55,967	672	2,162	57,453
Median, 1943–47	7,265	372	537,131	6,176	4,308	365	97,729	590	2,734	84,194
Seasonal low week ends	July 10		Sept. 4	Sept. 18	Mar. 20		Aug. 14		Mar. 20	Oct. 2
Since seasonal low week	698		584,297	[1] 3,047	[1] 9,398		351		1,689	88,719
Median, 1943–47	1,067		575,144	8,628	3,911		650		2,110	106,241

[a] Period ended earlier than Saturday. [b] Including cases reported as streptococcal infections and septic sore throat.

[c] Including paratyphoid fever and salmonella infections currently reported separately as follows: Massachusetts (salmonella infection) 9; New Jersey 1; Illinois 1; Iowa 1; Maryland 1; North Carolina 1; Florida 1; Alabama 1; Oklahoma 1; Texas 1; California 10.

[1] Correction: North Carolina, meningitis, week ended June 19, 1 case (instead of 2); poliomyelitis, week ended July 31, 211 cases (instead of 212).

Anthrax: Pennsylvania 1 case.

Alaska: Diarrhea 5; Pneumonia 2; Chickenpox 1. Territory of Hawaii: Measles 9; Whooping cough 5.

Poliomyelitis Cases Show Slight Decline

The number of poliomyelitis cases reported for the United States continues high, but it would appear that the total number has about leveled off. The figures for the week ending August 21 were lower (1,307) than the previous week (1,411). The dotted line on the accompanying poliomyelitis graph shows this drop in the total number of cases.

Although California, North Carolina, and Texas still account for one-third of the cases reported, the peak of the epidemic has apparently passed in those three States.

Increases have occurred in a number of northern States. The New England, Middle Atlantic, and North Central State groups have each experienced the usual seasonal increase. New York, Ohio, Minnesota, and Illinois together account for a quarter of all cases reported, but much higher levels were reached in New York, Illinois, and Minnesota either in 1944 or in 1946. Some further increase can be expected in these northern groups of States, as their peaks usually come in the middle of September.

In total, the peak seems to have passed in the southern States, and while the number of cases is still increasing in certain of the northern States, the rate of increase is slackening and the peak will be reached very soon.

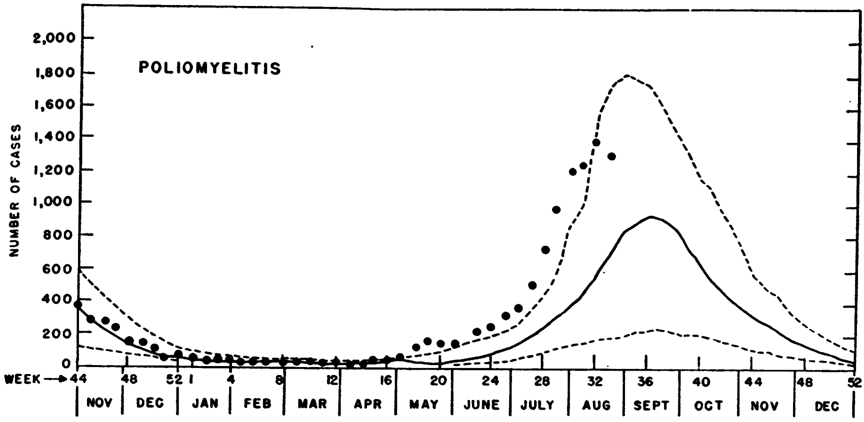
Diphtheria and Typhoid at Record Low

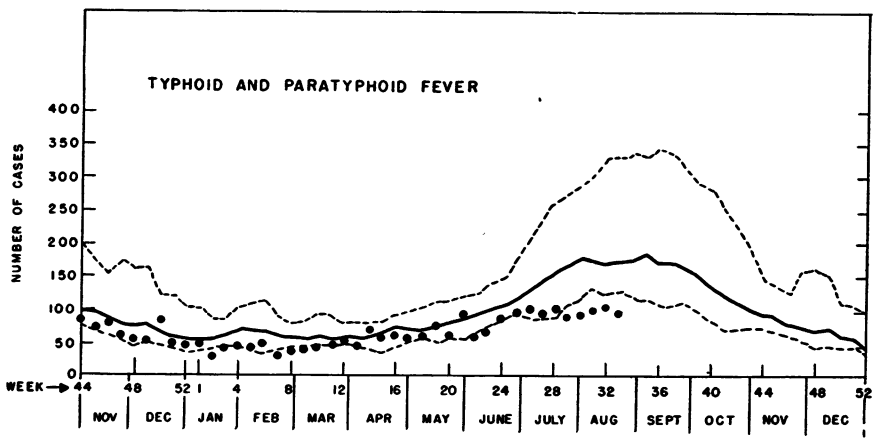
The number of diphtheria cases reported has continued very low. Almost every week this year the number has been less than the previously reported low. During the past 2 months, cases reported have averaged less than 125 a week. Some seasonal rise is to be expected during the coming months, but present indications are for a record low year.

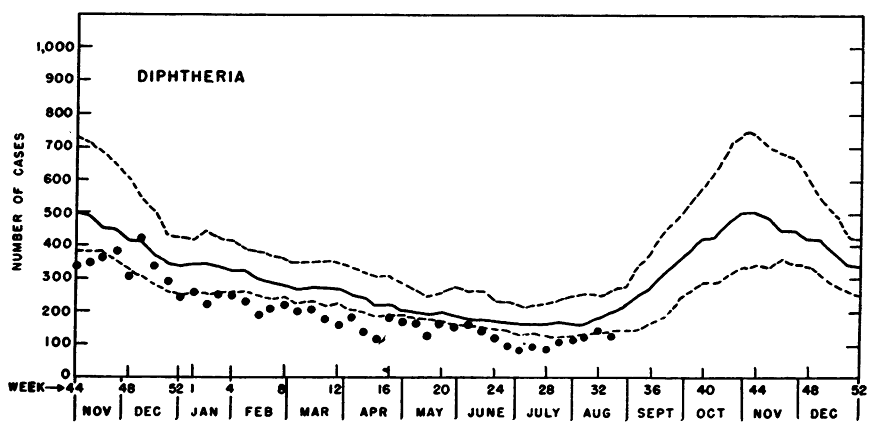
The incidence of typhoid and paratyphoid has been very low all during 1948, and has reached a new low for this season of the year. For the 4 weeks ended August 14 the United States total was 401 cases, compared with 510 cases for the same period in 1947. For the 17 years this disease has been reported by all States, each year but one has been appreciably lower than the year before. Although the seasonal rise has usually been fairly rapid during July and August, this year no increase has taken place since the end of June.

Communicable Disease Charts

All reporting States, November 1947 through August 21, 1948







The upper and lower broken lines represent the highest and lowest figures recorded for the corresponding weeks in the 7 preceding years. The solid line is the median figure for the 7 preceding years. All three lines have been smoothed by a 3-week moving average. The dots represent numbers of cases reported for the weeks of 1948.

PLAGUE INFECTION IN GAINES COUNTY, TEXAS

Under date of August 23, 1948, plague infection was reported proved in tissue of a prairie dog found dead near its burrow in Gaines County, Tex. Plague bacillus (*Pasteurella pestis*) was demonstrated by the Texas State Health Department Laboratories.

In this same area plague infection was reported proved earlier in pools of fleas collected from pack rats (*Neotoma* sp.), but infection has not been reported in other animal species in this area. The infection was reported in pools of field rodents in Cochran and Dawson Counties, respectively, in 1946 and 1947.

DEATHS DURING WEEK ENDED AUG. 14, 1948

[From the Weekly Mortality Index, issued by the National Office of Vital Statistics]

	Week ended Aug. 14, 1948	Corresponding week, 1947
Data for 92 large cities of the United States:		
Total deaths	7,873	8,811
Median for 3 prior years	7,649	
Total deaths, first 33 weeks of year	307,781	309,111
Deaths under 1 year of age	612	674
Median for 3 prior years	674	
Deaths under 1 year of age, first 33 weeks of year	21,974	24,679
Data from industrial insurance companies:		
Policies in force	70,956,591	67,213,944
Number of death claims	11,885	10,299
Death claims per 1,000 policies in force, annual rate	8.8	8.0
Death claims per 1,000 policies, first 33 weeks of year, annual rate	9.6	9.5

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended July 31, 1948.—During the week ended July 31, 1948, cases of certain communicable diseases were reported by the Dominion Bureau of Statistics of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Chickenpox		43		48	111	23	18	32	40	315
Diphtheria				2				1	2	5
Dysentery, bacillary				1						1
Encephalitis, infectious					1					1
German measles				3	2	1			8	14
Influenza		23			1	1				25
Measles		2		116	198	11	5	37	32	401
Meningitis, meningococcus					2				1	3
Mumps		8		27	46	17	19	11	10	138
Poliomyelitis		1		3	17	1	1	14	4	41
Scarlet fever		4	1	38	10	1		3	6	63
Tuberculosis (all forms)		2	15	103	35	61	8		12	236
Typhoid and paratyphoid fever			1	8	1		1	1	4	16
Undulant fever				1	2					3
Venereal diseases:										
Gonorrhea	7	10	8	141	53	32	13	28	82	374
Syphilis	2	7	5	46	45	6	5	2	13	131
Other forms									4	4
Whooping cough		36		67	8	1		2	1	115

JAMAICA

Notifiable diseases—5 weeks ended July 31, 1948.—During the 5 weeks ended July 31, 1948, cases of certain notifiable diseases were reported in Kingston, Jamaica, and in the island outside of Kingston, as follows:

Disease	Kingston	Other localities
Chickenpox	2	117
Diphtheria	2	
Dysentery, unspecified		3
Erysipelas		2
Leprosy		1
Scarlet fever	3	3
Tuberculosis (pulmonary)	78	56
Typhoid fever	10	116
Typhus fever (murine)	3	

CUBA

Habana—Communicable diseases—5 weeks ended July 31, 1948.—During the 5 weeks ended July 31, 1948, certain communicable diseases were reported in Habana, Cuba, as follows:

Disease	Cases	Deaths
Diphtheria	17	
Malaria	1	
Measles	2	
Tuberculosis	3	5
Typhoid fever	13	
Typhus fever (murine)	3	

Provinces—Notifiable diseases—5 weeks ended July 31, 1948.—During the 5 weeks ended July 31, 1948, cases of certain notifiable diseases were reported in the Provinces of Cuba as follows:

Disease	Pinar del Rio	Habana [1]	Matanzas	Santa Clara	Camaguey	Oriente	Total
Cancer	4	10	17	20	2	11	64
Chickenpox		1				2	3
Diphtheria		17	2		1		20
Hookworm disease		32					32
Leprosy		7				2	9
Malaria	3	6		1	3	11	24
Measles		6	15	1			22
Poliomyelitis				1			1
Rabies, human						1	1
Tuberculosis	9	33	7	17	26	15	107
Typhoid fever	2	33	7	37	12	32	123
Typhus fever (murine)		5					5
Whooping cough			58				58

[1] Includes the city of Habana.

REPORTS OF CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER RECEIVED DURING THE CURRENT WEEK

NOTE.—Except in cases of unusual incidence, only those places are included which had not previously reported any of the above-named diseases, except yellow fever, during recent months. All reports of yellow fever are published currently.

A table showing the accumulated figures for these diseases for the year to date is published in the PUBLIC HEALTH REPORTS for the last Friday of each month.

Cholera

India—Nagpur.—For the week ended July 31, 1948, 30 cases of cholera with 7 deaths were reported in Nagpur, India.

Plague

Portugal—Azores.—Plague has been reported in Rabo de Peixe, about 6 miles from the port of Ponta Delgada in the Azores, as follows: Week ended May 29, 1948, 1 case; week ended July 17, 1 case.

Siam.—Information dated August 2, 1948, states that a light epidemic of plague was reported in Siam in recent weeks. New cases were reported as follows: Week ended July 17, 5 cases; week ended July 24, 5 cases with 1 death.

Smallpox

Indochina—Cambodia.—During the week ended August 7, 1948, 400 cases of smallpox with 70 deaths were reported in the state of Cambodia, French Indochina.

Rhodesia (Northern).—For the week ended July 24, 1948, 100 cases of smallpox with 23 deaths were reported in the Zambesi Valley in Northern Rhodesia. The following week (week ended July 31), 29 cases with 1 death were reported in the same area.

Siam.—During the months of May and June 1948, a light outbreak of smallpox was reported in Siam. For the week ended June 26, 30 cases with 12 deaths were reported, but succeeding reports showed the epidemic ended thereafter.

Yellow Fever

Gold Coast—Accra.—During the week ended August 7, 1948, 1 suspected fatal case of yellow fever was reported at Accra in the Gold Coast, stated to have been infected in Achimota.