

Mortality From Infections

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CONTRARY to a common assumption, infectious diseases or processes are still important causes of death. In the United States, more than 100,000 deaths are reported each year for which infections are stated to be the underlying cause. This number is exceeded only by the numbers of deaths from three major chronic diseases: heart disease, cancer, and cerebral hemorrhage.

The purpose of this brief preliminary report is to call attention to a rising trend in mortality from a number of infections. Most of these are due to bacterial agents, although they are seldom included in studies of infectious diseases and, except for two categories of sepsis that may be regarded as systemic infections, they include infections that affect specific organs of the body. It is estimated that only a small proportion of the deaths from infections were caused by viral agents, in spite of the fact that incidence of viral infections is relatively high.

All data presented are from final annual vital statistics reports for the United States for the years 1949-58, except for some provisional data for 1959. This analysis has been limited to the period subsequent to 1948 because of changes made in the International Classification of Diseases at that time. These changes affected the comparability of figures for some categories of infections.

Septicemia and Pyemia

Septicemia and pyemia are included in one rubric in the International Classification of Diseases and, for the sake of brevity, will be

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referred to as septicemia in the remainder of the text and in tables and charts.

An epidemiological note in *Public Health Reports* for April 1959 (1) called attention to an increase in number of deaths from septicemia from 1949 to 1957. Table 1 and figure 1 show that total deaths from septicemia increased threefold over the 11-year period 1949-59. During the same period the number of deaths from staphylococcal septicemia increased sevenfold, and deaths from other specified types and from unspecified types, about threefold. The "other specified" category includes deaths caused by such bacterial agents as *Escherichia coli*, *Pseudomonas*, *Klebsiella*, and certain other organisms. The unspecified group includes those deaths from septicemia for which physicians did not specify an etiological agent when certifying the cause of death.

In contrast to these increases, deaths from streptococcal and pneumococcal septicemia declined during the 11-year period.

Infections of the Newborn

Mortality from infections of the newborn includes deaths from infections in infants under 1 month of age. As shown in table 2 and figure 2, the mortality rates for the entire category remained relatively stationary from 1950 to 1955, after which time there was an increase of about 30 percent. Since deaths from pneumonia of the newborn constitute a large proportion of the total neonatal deaths, the trend for pneumonia sets the pattern for the whole group.

The number of deaths from sepsis of the newborn increased steadily over the entire period, about 240 percent from 1949 to 1958. The

trend closely followed the trend of septicemia shown in table 1. Sepsis of the newborn includes sepsis of the umbilical cord and "other sepsis," mainly the latter. Many of these deaths probably are caused by the same etiological agents that cause septicemia in infants

1 month of age or over. On the other hand, one of the infections of the newborn common in past years, namely, diarrhea, is causing an increasingly smaller number of deaths.

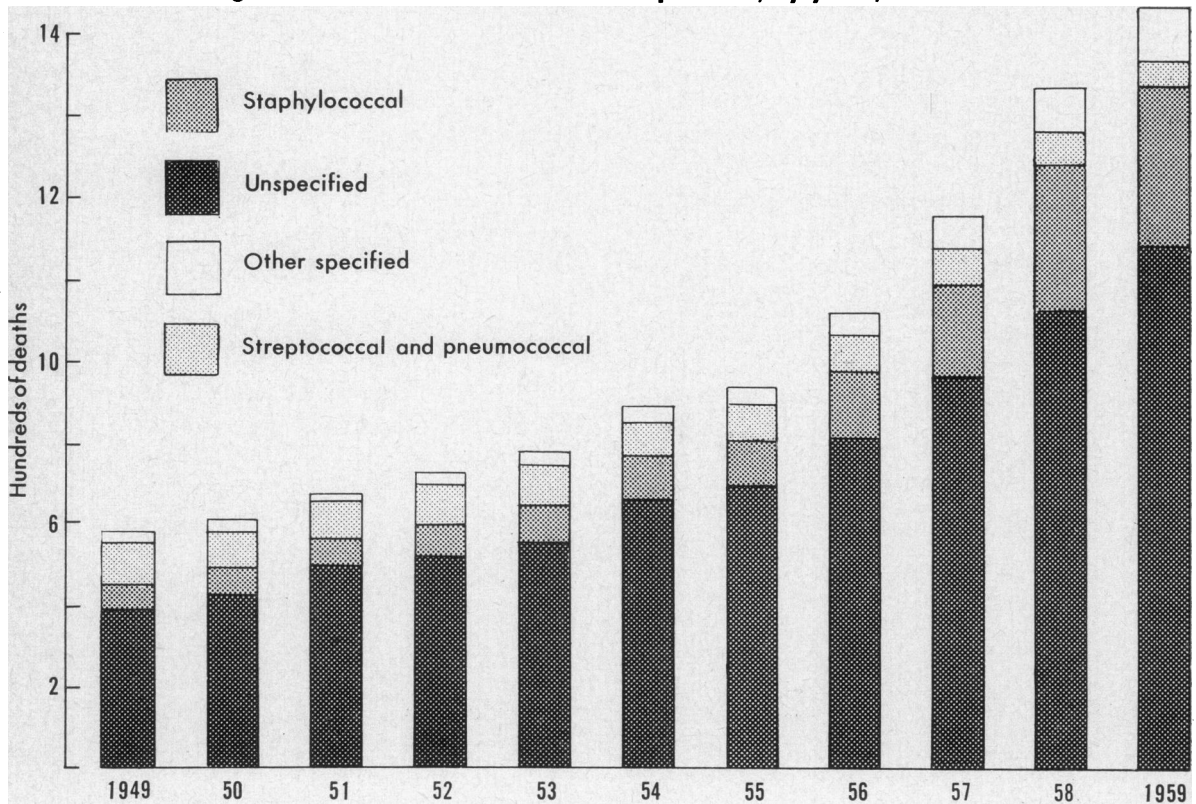
The category "other infections of the newborn" is made up almost entirely of pemphigus

Table 1. Deaths from septicemia and pyemia, 1949-59

Year	Staphylococcal	Streptococcal and pneumococcal	Other specified	Unspecified	Total	Rate per million
1959 ¹	390	60	130	1,280	1,860	10.5
1958	353	94	90	1,126	1,663	9.6
1957	217	90	76	968	1,351	7.9
1956	160	87	54	817	1,118	6.7
1955	111	89	43	695	938	5.7
1954	109	81	44	663	897	5.6
1953	94	97	38	554	783	4.9
1952	79	96	31	520	726	4.7
1951	64	89	24	500	677	4.4
1950	62	96	29	429	616	4.1
1949	54	108	27	398	587	3.8

¹ Provisional.

Figure 1. Number of deaths from septicemia, by years, 1949-59



neonatorum. No increase in number of deaths from this cause has been apparent in recent years.

A more detailed discussion of infections in infants has been published in *Public Health Reports* (2).

Other Specified Infections

Certain categories of infections have been selected for presentation in this report because

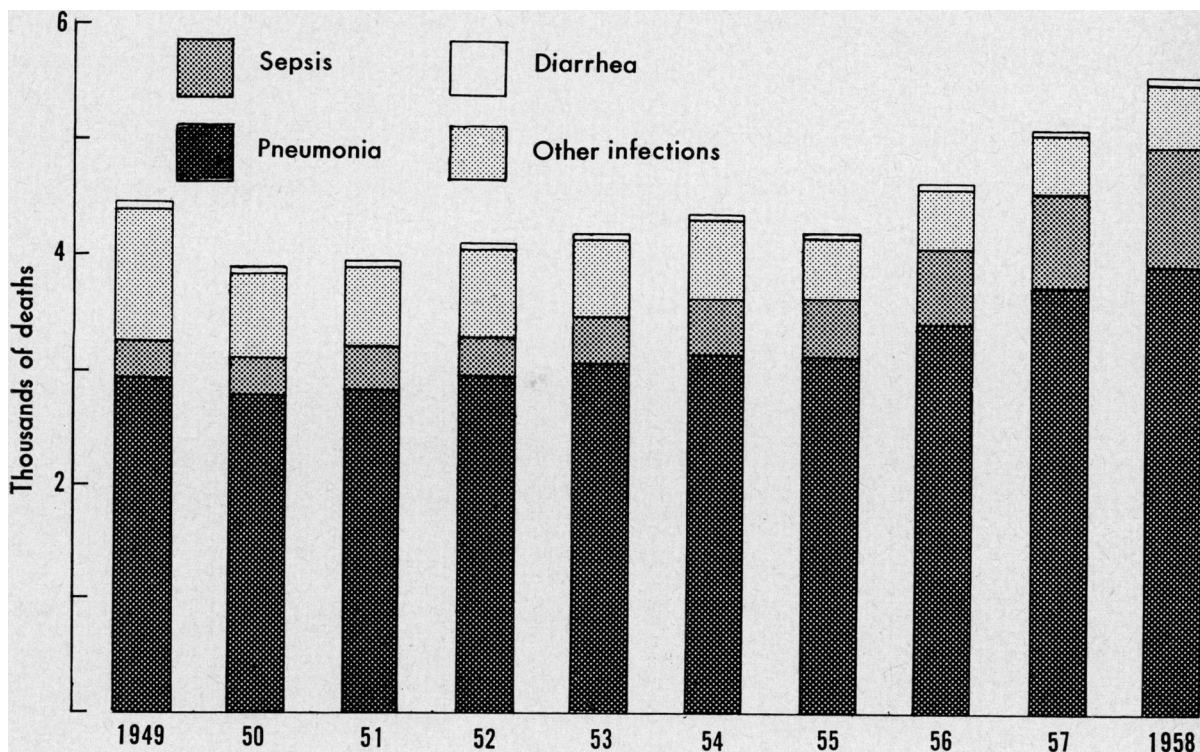
of increasing mortality from these causes in recent years (table 3).

Although mortality from influenza and pneumonia, nearly all of which is credited to pneumonia, has fluctuated because of influenza epidemics, influenza and pneumonia mortality has continued high for the past 3 years. It is questionable, however, whether all of this increase can be attributed to the effect of the 1957-58 influenza epidemic. Although relatively little influenza was reported in 1959, the

Table 2. Deaths from infections of the newborn, 1949-58

Year	Pneumonia	Diarrhea	Sepsis	Other	Total	Rate per 10,000 live births
1958	3,918	531	1,055	27	5,531	13.1
1957	3,715	516	832	24	5,087	12.0
1956	3,400	527	662	24	4,613	11.1
1955	3,108	547	518	28	4,201	10.3
1954	3,140	700	485	36	4,361	10.8
1953	3,074	697	388	28	4,187	10.7
1952	2,943	773	356	22	4,094	10.6
1951	2,825	687	387	28	3,927	10.5
1950	2,771	730	320	25	3,846	10.8
1949	2,966	1,142	307	56	4,471	12.5

Figure 2. Number of deaths from infections of the newborn, 1949-58



influenza and pneumonia mortality rate remained at a relatively high level.

Mortality from empyema and abscess of the lung declined for several years at the beginning of the period covered in this report, but the trend has been reversed since 1955. Two out of three deaths in this category were due to abscess of the lung.

The trend of mortality from infections of the skin and cellular tissue, principally boils, carbuncles, and cellulitis, was progressively downward for several years subsequent to 1949. However, a reversal of this trend is evident for the past few years.

Infections of the kidney, mainly pyelonephritis, have been certified as the underlying cause of an increasingly larger number of deaths since 1951. At present, there are only two other categories of infections, tuberculosis and pneumonia, for which more deaths are reported annually. This high frequency of deaths from infections of the kidney is consistent with clinical impressions that these infections are relatively common causes of illness.

Between 1957 and 1958 mortality from meningitis rose 10 percent, and the provisional figures for 1959 suggest that the higher level of mortality is being maintained. In tables and charts and in subsequent discussions, this category will be referred to as meningitis, which excludes tuberculous and meningococcal forms. The meningitis mortality category

consists of four groups, deaths due to *Haemophilus influenzae*, to pneumococci, to other specified organisms, and to unspecified types of organisms. There has been some decrease in meningitis due to *H. influenzae* and a corresponding increase in deaths due to other specified organisms. The numbers and proportions of the total meningitis deaths due to pneumococci and to unspecified types of organisms have remained constant in the decade under study.

Mortality rates for osteomyelitis and for otitis media and mastoiditis declined for several years following 1949 but have remained constant in the past few years.

Mortality rates for other categories of infections were also examined to see whether there had been any increase in recent years. The trend for bronchitis has been similar to that of influenza and pneumonia, while mortality from bronchiectasis has remained at about the same level since 1949.

Deaths from one category of infections, namely, sepsis associated with abortions and the puerperium, have shown a rather consistent decline during the 10-year period. During the period 1949-56 the mortality from peritonitis remained relatively constant, but in 1957 and 1958 there was a moderate increase compared with previous years. It remains to be seen whether this is the beginning of a rising trend that is evident for some other infections.

Table 3. Numbers of deaths and death rates per million population for specified types of infections, 1949-59

Year	Influenza and pneumonia		Empyema and lung abscess		Infections of skin and cellular tissue		Infections of kidney		Meningitis		Otitis media and mastoiditis	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
1959 ¹ -----	57,300	32.5	-----	-----	-----	-----	6,447	36.5	2,230	12.6	-----	-----
1958-----	57,439	33.1	895	5.2	488	2.8	6,889	39.7	2,247	12.9	433	2.5
1957-----	61,001	35.8	862	5.1	483	2.8	6,346	37.2	2,025	11.9	398	2.3
1956-----	47,103	28.2	835	5.0	413	2.5	5,767	33.8	1,933	11.5	383	2.3
1955-----	44,510	27.1	738	4.5	326	1.9	4,911	29.9	1,873	11.4	468	2.8
1954-----	40,991	25.5	743	4.6	335	2.1	4,300	26.7	1,829	11.3	455	2.8
1953-----	52,238	33.0	749	4.7	322	2.0	4,052	25.6	2,059	13.0	467	2.9
1952-----	46,265	29.7	715	4.5	314	2.0	3,691	23.7	1,918	12.3	463	2.9
1951-----	48,169	31.4	740	4.8	373	2.4	3,261	21.2	1,881	12.2	492	3.2
1950-----	47,120	31.3	838	5.5	354	2.3	3,129	20.7	1,839	12.1	538	3.5
1949-----	44,640	30.0	920	6.1	413	2.7	3,128	20.8	2,147	14.3	920	6.3

¹ Provisional.

Infections of the gastrointestinal tract have not been included in this report because their etiology is quite different from that of the infections mentioned. However, it may be said here that a gradual decrease in mortality from gastrointestinal infections has been evident in the period under study.

Mortality from some categories of infection has been increasing since the beginning of the period of this study. Mortality for some causes declined early in the period but increased in more recent years. A few categories showed a decrease in mortality initially but have remained stationary in the last few years of the decade.

In order to determine the significance of the increase in mortality, data for certain of the categories have been tabulated by age, race, and geographic division (tables 4-6).

Age

Mortality for most infections included in this report has a similar age curve or pattern, relatively high in infants and older persons and low in the intervening ages. Comparison of the mean annual mortality rates for specified age groups in two 3-year periods, 1953-55 and 1956-58 (table 4) indicated the following:

- Mortality from influenza and pneumonia did not increase in the groups under 15 years of age. In the groups 15 years old and over, the amount of increase varied from about 15 to 25 percent.

- For empyema and lung abscess the increase in mortality was confined to children under 5 years old and persons 45 years of age and over.

- An increase in mortality from septicemia occurred in all but one age group, namely, 5-14 years.

- Mortality from infections of the skin and cellular tissue increased in all age groups except children 5-14 years old.

- The increase in mortality from infections of the kidney occurred in persons 25 years of age and over.

- It appears that the slight recent increase in mortality from meningitis was confined to infants under 1 year of age.

Race

The data in table 5 show that mortality was consistently higher in the nonwhite than in the white population. However, the percentage increase in mortality from 1953-55 to 1956-58 was remarkably similar for both racial groups for each cause except that there was a 12.2 percent increase in mortality from empyema and lung abscess in the white population and a slight decrease for nonwhites. An increased number of deaths from most of these categories of infections was apparent for Indians and other racial groups.

Geographic Divisions

Mortality rates for several infections are shown for each geographic division of the

Table 4. Mean annual mortality rates for specified causes, by age, 1953-55 and 1956-58

Age (years)	Influenza and pneumonia ¹		Empyema and lung abscess ²		Septicemia ²		Infections of skin and cellular tissue ²		Infections of kidney ²		Meningitis ²	
	1953-55	1956-58	1953-55	1956-58	1953-55	1956-58	1953-55	1956-58	1953-55	1956-58	1953-55	1956-58
Under 1----	242.1	246.9	8.7	12.9	78.9	104.7	9.9	14.4	12.1	13.1	189.2	209.9
1-4-----	16.7	16.6	.4	.8	7.0	8.5	.7	.8	1.5	1.2	26.6	25.5
5-14-----	2.9	2.8	.3	.2	1.6	1.4	.2	.2	.9	1.0	4.7	4.4
15-24-----	2.8	3.6	1.0	.8	1.2	1.6	.3	.6	3.1	3.8	2.6	2.7
25-44-----	5.4	6.3	2.5	2.2	1.6	2.3	.6	1.0	9.9	11.9	3.8	3.1
45-64-----	22.7	26.1	8.6	9.2	4.8	7.3	2.6	3.2	39.2	51.6	8.7	8.9
65-84-----	135.6	155.9	20.1	23.6	12.7	22.4	9.3	13.8	163.0	234.3	15.1	14.9
85 and over.	801.2	939.2	24.2	32.4	28.2	51.7	37.6	49.3	525.5	764.4	17.5	16.8

¹ Rate per 100,000 population.

² Rate per million population.

Table 5. Mortality rates per million population for specified causes, by race, 1953-55 and 1956-58

Cause of death	White		Nonwhite	
	1953-55	1956-58	1953-55	1956-58
Septicemia and pyemia.....	4.9	7.3	9.6	14.3
Infections of newborn.....	8.2	9.2	24.9	28.4
Influenza and pneumonia.....	255.0	294.0	531.0	561.0
Empyema and lung abscess.....	4.1	4.6	9.0	8.9
Infections of skin.....	1.8	2.6	3.4	4.5
Infections of kidney.....	25.4	34.2	44.2	61.7
Meningitis.....	9.6	9.7	31.0	31.8

United States in table 6. Rates for each cause are fairly uniform in the various areas, and increases from 1953-55 to 1956-58 occurred almost without exception for each cause in all divisions.

Mortality rates for certain infections for the United States and for England and Wales are shown in table 7. These data show certain differences and some similarities.

Mortality from septicemia has been higher in the United States than in England and Wales and has shown a fairly substantial rise. In England and Wales the trend has been downward. Mortality from meningitis has been about 20 to 30 percent higher in the United States, but trends have been similar in the two countries. Mortality from empyema and lung abscess has been about the same in both coun-

tries. Mortality from infections of the kidney has been about equal, and an upward trend in rate is evident in both countries. A higher rate of mortality from infections of the skin has occurred in England and Wales than in the United States, but the direction of their trends has been different. For most years, mortality from infections of the newborn has been higher in England and Wales, and again the trends have been in opposite directions.

It is possible that some of these differences are due to variations in certification of deaths, and some may also be due to differences in environmental factors.

Comment

Data on mortality from various categories of infection indicate that there has been a definite increase in numbers as well as rates in recent years in the United States. Total numbers for some categories have been small, but the increases seem to be real because data by age, race, and geographic location are consistently in the same direction.

Provisional data for 1959, based on a 10 percent sample of all deaths registered, showed a continuing increase in deaths from septicemia. Influenza and pneumonia deaths and meningitis deaths remained at about the same level. Mortality from infections of the newborn and infections of the kidney showed some decrease. However, although the sampling error of the estimated numbers of deaths for 1959 is small for each of these categories, figures for an additional number of years are needed before

Table 6. Mean annual mortality rates per million population for specified infections, by geographic division, United States, 1953-55 and 1956-58

Geographic division	Influenza and pneumonia		Empyema and lung abscess		Septicemia		Infections of skin		Infections of kidneys	
	1953-55	1956-58	1953-55	1956-58	1953-55	1956-58	1953-55	1956-58	1953-55	1956-58
New England.....	252	340	4.7	6.0	6.4	12.6	3.1	3.9	34.8	47.8
Middle Atlantic.....	263	325	4.7	5.3	4.7	6.9	1.8	3.4	25.4	37.3
East North Central.....	269	312	4.6	4.4	4.2	6.0	1.8	2.4	26.9	35.1
West North Central.....	300	323	4.1	4.7	5.5	8.3	2.3	2.4	26.4	32.4
South Atlantic.....	298	327	4.8	5.8	6.6	9.9	2.3	3.4	30.1	42.9
East South Central.....	350	360	3.6	4.4	5.3	8.0	2.0	1.9	28.9	41.5
West South Central.....	304	325	4.8	5.1	7.9	12.3	2.0	2.2	27.4	36.2
Mountain.....	329	366	4.4	4.7	7.0	8.0	2.2	2.7	19.6	25.5
Pacific.....	247	292	5.0	5.7	4.2	6.9	1.6	3.2	26.8	37.6

Table 7. Crude mortality rates for specified infections, United States compared with England and Wales, 1949-58

Year	Septicemia ¹		Meningitis ¹		Empyema and lung abscess ¹		Infections of kidney ¹		Infections of skin ¹		Infections of newborn ²	
	United States	England and Wales	United States	England and Wales	United States	England and Wales	United States	England and Wales	United States	England and Wales	United States	England and Wales
1958.....	9.6	(3)	12.9	(3)	5.2	(3)	4.0	(3)	2.8	(3)	13.1	(3)
1957.....	7.9	2.2	11.9	9.3	5.1	4.4	3.7	3.8	2.5	3.2	12.0	11.0
1956.....	6.7	2.4	11.5	8.6	5.0	4.0	3.4	3.5	2.0	3.6	11.1	12.6
1955.....	5.7	1.8	11.4	8.3	4.5	4.9	3.0	3.3	1.7	4.2	10.3	14.6
1954.....	5.6	2.8	11.3	8.0	4.6	5.2	2.7	3.0	1.7	4.4	10.8	12.3
1953.....	4.9	2.7	13.0	9.2	4.7	5.5	2.6	2.7	1.6	4.8	10.7	14.2
1952.....	4.7	2.5	12.3	7.8	4.5	4.8	2.4	2.5	1.6	4.7	10.6	14.9
1951.....	4.4	2.5	12.2	9.0	4.8	5.1	2.1	2.5	1.8	5.6	10.5	14.3
1950.....	4.1	3.8	12.1	9.3	5.5	4.9	2.1	2.4	2.0	5.1	10.8	15.8
1949.....	3.8	3.3	14.3	9.7	6.1	5.4	2.1	2.2	2.1	5.1	12.5	9.2

¹ Rate per million population.

² Rate per 10,000 live births.

³ Data not available.

it can be assumed that the trends have continued upward, remained stationary, or reversed. The frequencies for other categories of infection are too small to warrant using the 1959 provisional figures.

It would be desirable to identify etiological agents involved in the various categories of infection, but such information is available only in tabulations of a certain proportion of the deaths from septicemia and meningitis. It is possible that the etiological agent was known for many of the deaths listed as unspecified type of septicemia but was not mentioned by the certifying physician. With respect to deaths from empyema and lung abscess, infections of the skin, sepsis of the newborn, and certain other infections, the etiological agent may be included on the death certificate but no provision has been made for coding and tabulating causes so as to identify deaths associated with staphylococci, streptococci, or other specific bacterial agents.

It would also be desirable to identify sources of infection, such as a hospital or some other identifiable source. Although most deaths from infections occur in hospitals, it is not possible to determine from death certificates what proportion of the fatal infections were hospital acquired.

If a large number of death certificates are examined, it becomes apparent that there are

many deaths for which one or the other of the categories included in this report is mentioned as a contributing cause. It is estimated that the number of deaths in which infections are a contributing cause is several times larger than the number of those in which infections are certified as the underlying cause. Thus, it is apparent that the role of infections associated with deaths is far greater than is indicated by the numbers shown in the tables. It is conceivable that there is a still larger volume of unreported nonfatal infections occurring in hospitals and elsewhere.

In order to produce more meaningful data physicians should always include the type of etiological agent, if known, when certifying the cause of death. The second step in making mortality data more valuable would be to code and tabulate certain causes of death by etiological agent. Finally, if it were possible to enumerate all other deaths in which specific types of infection were associated as contributing causes, a still better appreciation of the total volume of severe infections could be obtained.

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