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Duration of Hospitalization for Bacteremic Infections at Boston City Hospital during 12 Selected Years between 1935 and 1972

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In survivors of both community-acquired (CA) and hospital-acquired (HA) bacteremic infections at Boston City Hospital during 12 selected years between 1935 and 1972, the mean hospital stay fluctuated widely from one selected year to the next, but it was generally shorter and early discharges were more frequent in the years when effective antibacterial agents were used. The greatest reduction in hospital stay occurred by 1941. The size of the fluctuations and reductions also varied with the causative organism. The average duration of hospitalization of all survivors of HA bacteremic infections after the first positive blood culture was 10.5 days longer than the total hospitalization of survivors of CA infections. The reduced length of hospital stay after 1935 is attributed to the successful use of effective antibacterial drugs, and the greater effect in CA than in HA cases is attributed to more frequent infections in the latter with organisms resistant to those drugs.

In an analysis of the occurrence of and mortality due to bacteremic infections at Boston City Hospital during 12 selected years between 1935 and 1972 [1], it was shown that, in spite of steadily declining numbers of patients admitted to the hospital over this period and the declining case-fatality ratio among those patients, the number of bacteremic infections, the rate of those infections per 1,000 hospital admissions, and the number of deaths per 100 deaths from all causes among all of the hospitalized patients increased steadily over the first 10 selected years of this study (through 1965) and then declined appreciably in the last two years. These paradoxical changes were noted in spite of the successive introduction and intensive use of many highly potent antimicrobial agents. In the present study we present a limited analysis of the length of hos-

pital stay among the bacteremic patients at Boston City Hospital during the same 12 selected years.

Materials and Methods

The patients included in this study are, with some exceptions, the same as those in the previous report [1], and the same criteria were used to distinguish community-acquired (CA) from hospital-acquired (HA) infections. The dates of admission to and discharge from the hospital were obtained from the patients' hospital records. The dates and results of blood cultures were obtained from the original records of the Laboratory of Medical Microbiology of the hospital through A. Kathleen Daly and Alice McDonald. In determining the duration of hospitalization in HA cases, only the day on which the first blood sample was obtained that yielded the significant pathogen(s) was used for each case. In a number of patients, blood cultures obtained later in the same hospital admission yielded other species of bacteria or fungi; these "bacteremic superinfections" are considered elsewhere in this issue [2].

Results

The average number of days of hospital stay in

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Table 1. Duration of hospitalization for patients with community-acquired (CA) and hospital-acquired (HA) bacteremia at Boston City Hospital during 12 selected years between 1935 and 1972.

Year	Patients who survived					Patients who died				
	CA infections		HA infections			CA infections		HA infections		
	No. of patients	No. of days*	No. of patients	No. of days to diagnosis†	No. of days after diagnosis	No. of patients	No. of days	No. of patients	No. of days to diagnosis	No. of days after diagnosis
1935	74	43.7	45	25.0	42.3	120	9.2	70	18.5	6.7
1941	199	28.4	39	14.4	34.6	109	12.4	37	21.4	12.5
1947	230	23.5	63	15.3	40.7	97	9.0	40	20.6	14.0
1951	211	24.7	64	15.7	33.1	119	8.0	37	20.4	10.4
1953	239	25.3	74	22.9	35.0	112	8.1	71	21.7	13.0
1955	258	21.9	90	22.1	41.7	86	14.5	102	23.2	12.5
1957	226	21.3	118	15.5	34.4	87	10.2	130	20.3	13.2
1961	209	20.1	153	13.3	30.9	93	9.8	119	20.5	12.1
1963	266	15.4	168	16.9	32.8	103	6.9	162	17.4	9.6
1965	252	18.8	222	12.2	29.6	111	12.0	168	16.8	11.8
1969	245	18.4	160	11.0	26.6	101	12.6	130	22.0	14.6
1972	271	16.8	152	13.6	26.7	75	15.7	107	21.1	16.5
Total (12 years)	2,680	21.7	1,348	15.3	32.3	1,213	10.5	1,173	20.0	12.3
Subtotal (1935 + 1941)	273	32.2	84	20.1	38.8	229	10.7	107	19.5	8.7
Subtotal (1947-1957)‡	1,164	23.3	409	18.3	36.9	501	9.7	380	21.4	12.8
Subtotal (1961-1972)‡	1,243	17.8	855	13.3	29.4	483	11.2	686	19.2	12.6

*Mean.

†Days from admission to first blood culture that was positive.

‡Five selected years.

each of the 12 selected years for all patients with CA and HA bacteremia who survived and for those who died is shown in table 1 and figure 1. For the CA infections only the total number of days from admission to discharge are considered; for the HA cases, the numbers of days before and after the first positive blood culture are listed separately.

The mean hospital stay for all patients with CA bacteremia who survived dropped sharply (by about 35%) between 1935 and 1941, and the decline continued, but more slowly and irregularly, throughout the later years of the study. A similar but less striking decline in the average number of days in the hospital after the first positive blood culture also occurred in the patients with HA bacteremic infections who survived, but only after 1955; prior to that time the mean number of days in the hospital after diagnosis fluctuated, with values of >40 days in 1935, 1947, and 1955.

In 1935 the mean total hospital stay of survivors of CA bacteremia was the same as that of

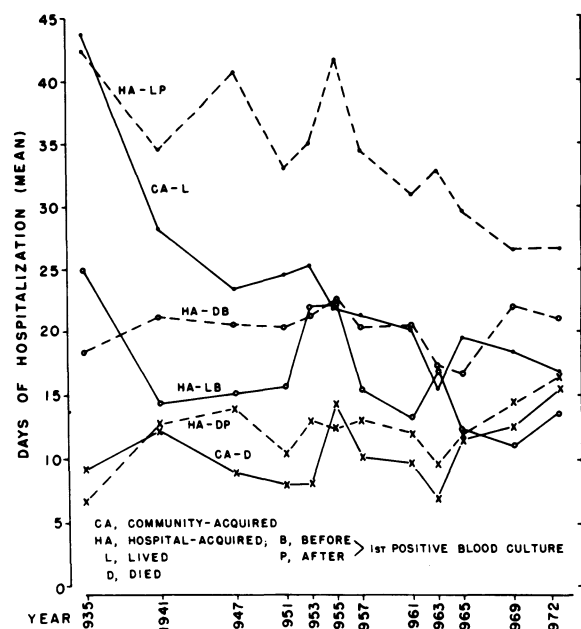


Figure 1. Mean duration of hospitalization of patients with bacteremic infections at Boston City Hospital, Boston, Mass., during each of 12 selected years between 1935 and 1972.

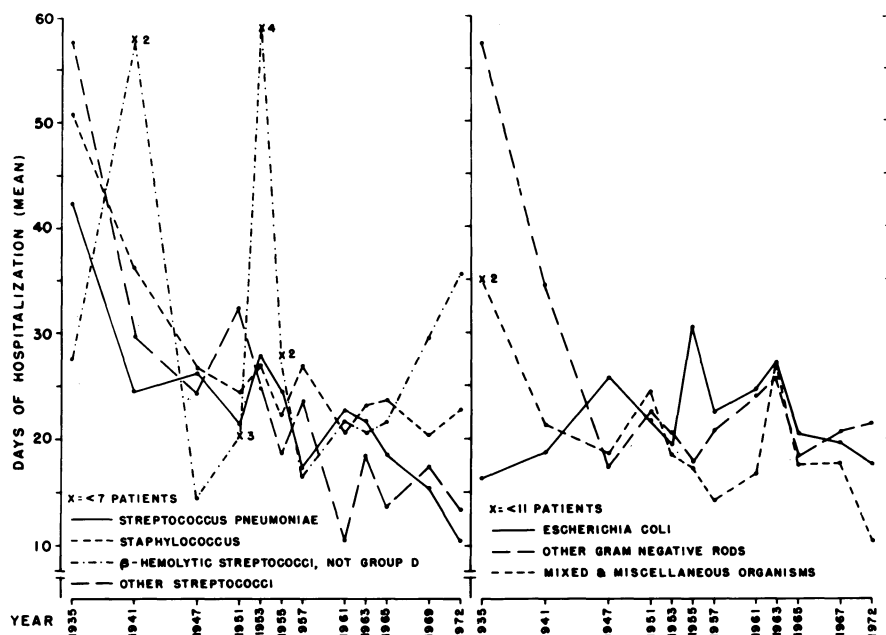


Figure 2. Mean duration of hospitalization in each of 12 selected years between 1935 and 1972 for survivors of community-acquired bacteremic infections of different etiologies at Boston City Hospital, Boston, Mass.

the surviving patients with HA bacteremia after the first positive blood culture was obtained. In all 12 selected years, the mean hospital stay of all of the CA cases (21.7 days) was considerably shorter than that of the HA cases by about 10.5 days. On the other hand, the mean survival

time after the fatal HA bacteremia was established in HA cases was longer in most years than the mean duration of survival in the hospital for the CA fatal cases; however, the difference between the mean values for the 12 years was less than two days. In the HA cases, the average in-

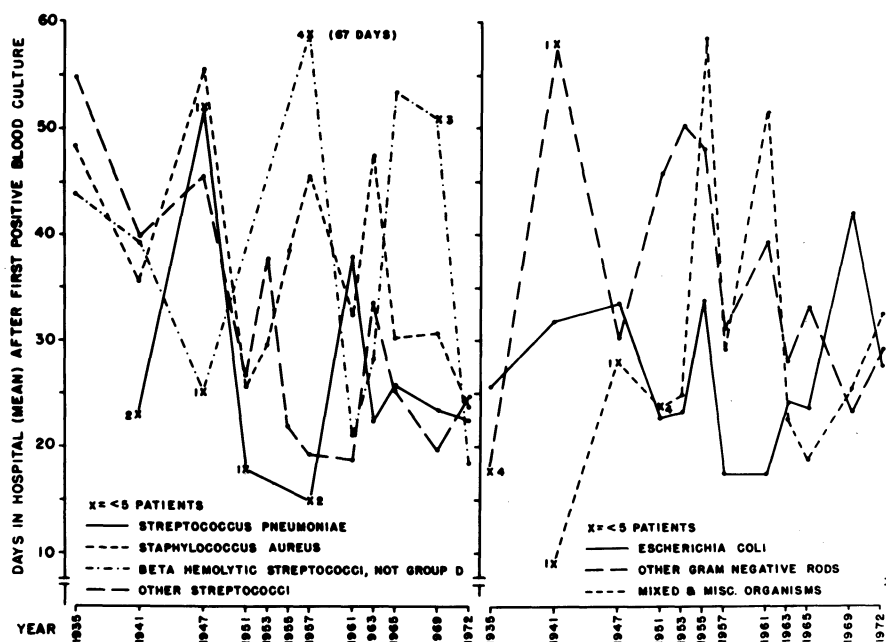


Figure 3. Mean duration of hospitalization in each of 12 selected years between 1935 and 1972 for survivors of hospital-acquired bacteremic infections of different etiologies at Boston City Hospital, Boston, Mass.

terval from admission to the day of the first positive blood culture varied somewhat from year to year, but it was shorter for all 12 years in the survivors (15.3 days) than in those who died (20.0 days), with a difference of 4.7 days.

The mean duration of hospital stay varied considerably from one selected year to another depending on the etiologic agent in both CA and HA cases (figures 2 and 3). The fluctuations were more frequent and more marked in the HA cases, particularly but not exclusively in years when the number of patients was small. The mean survival time of patients who died also varied from one selected year to the next, but the fluctuations were much less striking, although there were considerable differences in length of survival of individual patients.

Statistical analysis of differences in duration of hospitalization among categories of cases is hampered by the often irregular distribution of the length of hospital stay within the groups, with varying proportions of patients being discharged (or dying) at intervals ranging from less than

one day to more than six months. However, by constructing curves of the cumulative percentage of patients who were discharged or who died at successive intervals, it was possible to make visual comparisons of the hospitalizations for different categories of infections. Such comparisons for all patients with CA and HA infections due to various organisms in the 12 selected years are shown in figures 4 and 5.

Figure 6 shows similar comparisons for all patients in different years. As shown in the left panel of figure 6, greater proportions of patients with CA bacteremia who survived had a shorter hospital stay in 1941 than in 1935. This trend continued, but to a lesser degree, in the interval from 1947 to 1957 (five selected years) and from 1961 to 1972 (five selected years) as evidenced by the shorter distance between the curves for those two periods and the smaller differences in the corresponding mean number of days in the hospital. The differences in the mean durations

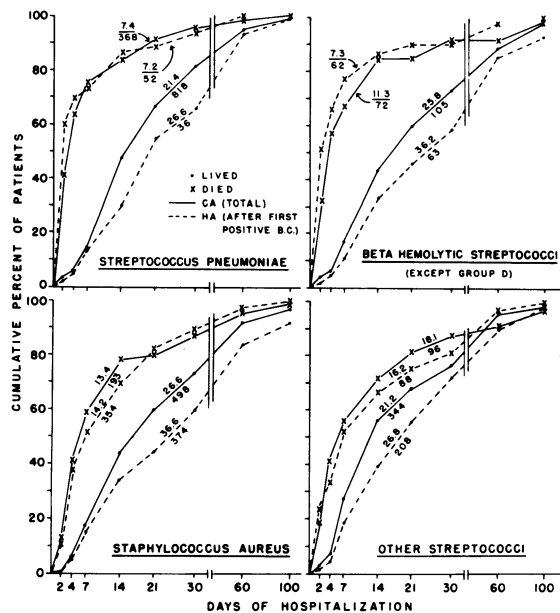


Figure 4. Comparison of durations of hospitalization of patients surviving after community-acquired (CA) and hospital-acquired (HA) bacteremic infections due to various cocci and comparison of survival times for those who died of such infections. BC = blood culture. Numbers on curves signify mean number of hospitalization days/number of patients.

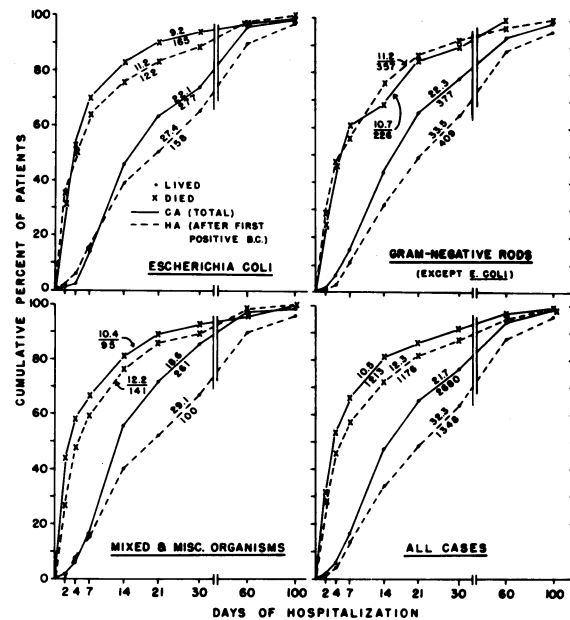
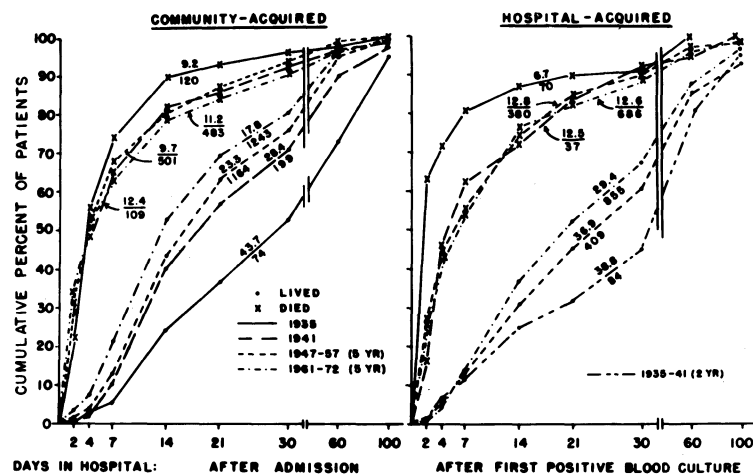


Figure 5. Comparison of durations of hospitalization of patients surviving after community-acquired (CA) and hospital-acquired (HA) bacteremic infections due to *Escherichia coli*, other gram-negative rods, mixed and miscellaneous organisms, and all organisms and comparison of survival times for patients who died of such infections at Boston City Hospital, Boston, Mass. BC = blood culture. Numbers on curves signify mean number of hospitalization days/number of patients.

Figure 6. Mean duration of hospitalization for all patients with bacteremic infections at Boston City Hospital, Boston, Mass., during selected periods between 1935 and 1972. Numbers on the curves signify mean number of hospitalization days/number of patients.



of survival for the patients with CA bacteremia who died are also shown in the left panel of figure 6: until day 4 the proportion of patients who died was nearly the same during each of the four periods shown; after day 4 the survival time was shorter in a greater proportion of patients who died in 1935 than in the other three periods shown.

Similar comparisons of the average length of hospital stay or survival after the first positive blood culture was obtained in the patients with HA bacteremia are shown in the right panel of figure 6. The same trends are seen as among the CA cases. In this instance the survivors for 1935 and 1941 are combined for clarity, because the curves for the individual years were irregular although the average hospitalization was longer (42.3 days) in 1935 than in 1941 (34.6 days).

Specific bacteremic infections. The corresponding data for bacteremic infections caused by common bacterial species are shown in table 2 and figures 7-13.

Survivors with CA infections. For the two years 1935 and 1941, there were considerable differences in the average length of hospital stay of surviving patients with CA infections of different etiologies: the longest were for infections due to single gram-negative rods other than *Escherichia coli* (GNR) and infections due to *Staphylococcus aureus* (44.2 and 40 days, respectively), and the shortest were for infections due to *E. coli* (17.7 days). Except for the *E. coli* infections, the mean hospital stay decreased considerably over the next five selected years (1947-

1957), the greatest reduction being for the GNR bacteremias. In survivors with CA cases due to *Streptococcus pneumoniae*, other streptococci including the viridans group and enterococci, *S. aureus*, and GNR, the greatest reductions were from 1935 to 1941 (figures 2 and 3 and 7, 9, 10, and 12, respectively). Further reductions in the mean hospital stay occurred during the last five selected years (1961-1972) in patients with infections due to *S. pneumoniae*, other streptococci, *S. aureus*, and mixed and miscellaneous organisms including *Neisseria meningitidis* and *Haemophilus influenzae* (figures 7, 9, 10, and 13, respectively). For *E. coli* infections (figure 11), hospitalization was longer in the five years between 1947 and 1957 than in the years 1935 and 1941. For the entire 12 selected years, however, the mean duration of hospitalization varied over a rather narrow range, between 21.2 and 26.6 days, for cases of diverse etiology except for the mixed and miscellaneous infections (18.8 days).

Survivors with HA infections. For some of the etiologic categories for these cases, there were too few cases in the early years for comparison. The trends generally differed in surviving HA cases from those in the surviving CA cases of the corresponding etiology. However, except in *E. coli* and *S. pneumoniae* infections, the mean hospital stay after the first positive culture was shorter in the last five selected years than in the years of the preceding period; the greatest reduction (from 40 to 13.5 days) was for *S. aureus* infections. In most instances the mean period of

Table 2. Duration of hospitalization for bacteremic infections at Boston City Hospital during 12 selected years between 1935 and 1972.

Organism, years*	Community-acquired infections				Hospital-acquired infections						
	Lived		Died		Lived			Died			
	No. of patients	No. of days†	No. of patients	No. of days	No. of days		No. of days		No. of patients	No. of days	
					Admission to first positive blood culture	First positive blood culture to discharge	Admission to first positive blood culture	First positive blood culture to discharge			
<i>Streptococcus pneumoniae</i>											
1935-1941	109	27.9	114	6.3	2	9.5	23.0	25	18.1	3.6	
1947-1957	321	23.7	132	7.6	4	24.0	25.0	12	20.1	15.7	
1961-1972	388	17.6	122	8.1	30	20.7	27.0	15	33.5	5.7	
1935-1972	818	21.4	368	7.4	36	20.4	26.6	52	22.8	7.2	
β -Hemolytic streptococci (other than group D)											
1935-1941	9	34.3	27	18.4	21	22.9	42.8	29	20.9	6.6	
1947-1957	27	22.9	16	7.0	5	53.2	58.6	3	23.0	13.7	
1961-1972	69	25.6	29	7.0	37	14.1	29.5	30	12.8	8.5	
1935-1972	105	25.8	72	11.3	63	19.3	36.2	62	15.9	7.3	
Other streptococci‡											
1935-1941	30	36.9	17	36.7	12	25.0	47.3	14	20.7	14.4	
1947-1957	158	24.9	35	10.0	62	17.3	28.2	24	9.1	21.5	
1961-1972	156	14.7	44	17.0	134	11.2	24.3	50	15.7	13.5	
1935-1972	344	21.2	96	18.1	208	13.9	26.8	88	15.6	16.2	
<i>Staphylococcus aureus</i>											
1935-1941	72	40.0	38	8.6	27	25.3	42.1	17	19.7	19.1	
1947-1957	282	25.1	95	13.2	143	15.9	40.0	138	22.0	13.8	
1961-1972	144	22.9	60	16.7	204	13.5	13.5	199	22.8	14.1	
1935-1972	498	26.6	193	13.4	374	15.5	36.6	354	12.4	14.2	
<i>Escherichia coli</i>											
1935-1941	19	17.7	20	9.2	16	13.7	29.9	10	27.8	3.8	
1947-1957	99	24.3	72	7.3	40	20.4	25.4	35	16.1	10.5	
1961-1972	159	21.2	73	11.5	102	15.0	27.8	77	16.6	12.5	
1935-1972	277	22.1	165	9.2	158	16.2	27.4	122	17.6	11.2	
Other single gram-negative rods											
1935-1941	21	44.2	10	8.2	5	13.0	25.8	9	12.2	5.8	
1947-1957	177	19.9	119	11.1	128	19.9	41.0	130	27.0	11.0	
1961-1972	179	22.1	95	10.6	276	14.6	30.4	218	17.7	11.6	
1935-1972	377	22.3	224	10.7	409	16.4	33.5	357	21.0	11.2	
Mixed and miscellaneous§											
1935-1941	13	23.4	3	7.7	1	10.0	9.0	6	18.9	3.8	
1947-1957	100	19.4	32	9.0	27	14.4	36.0	38	11.6	11.3	
1961-1972	148	17.6	60	11.2	72	11.5	26.9	97	22.3	22.3	
1935-1972	261	18.6	95	10.4	100	12.3	29.1	141	19.3	12.2	
Total											
1935-1941	273	32.2	229	10.7	84	20.1	38.8	107	19.7	8.5	
1947-1957	1,164	23.3	501	9.7	408	18.3	36.9	380	21.4	12.8	
1961-1972	1,243	17.8	483	11.2	855	13.3	29.4	686	19.2	12.6	
1935-1972	2,680	21.7	1,213	10.5	1,348	15.3	32.3	1,176	20.0	12.3	

*1935-1941 (two years); 1947-1957 (five selected years); 1961-1972 (five selected years).

†Mean number of days in hospital.

‡Includes viridans streptococci (α - and γ -), anaerobic and microaerophilic streptococci, and enterococci.§Includes *Neisseria meningitidis* and *Haemophilus influenzae*.

Figure 7. Mean duration of hospitalization for patients with bacteremic infections due to *Streptococcus pneumoniae* at Boston City Hospital, Boston, Mass. In the community-acquired cases (left), the greatest increase in the proportion of surviving patients discharged in the first two weeks was between 1935 and 1941; another increase occurred after 1957. The greatest decreases in the proportion of patients who died within four days after admission occurred between 1935 and 1941. In the hospital-acquired cases (right), there were too few survivors through 1957 to define any trends that would permit comparisons. A much larger proportion of the patients who died survived for longer periods during the five selected years between 1947 and 1957 than in the earlier or later years. Numbers on the curves signify mean number of hospitalization days/number of patients.

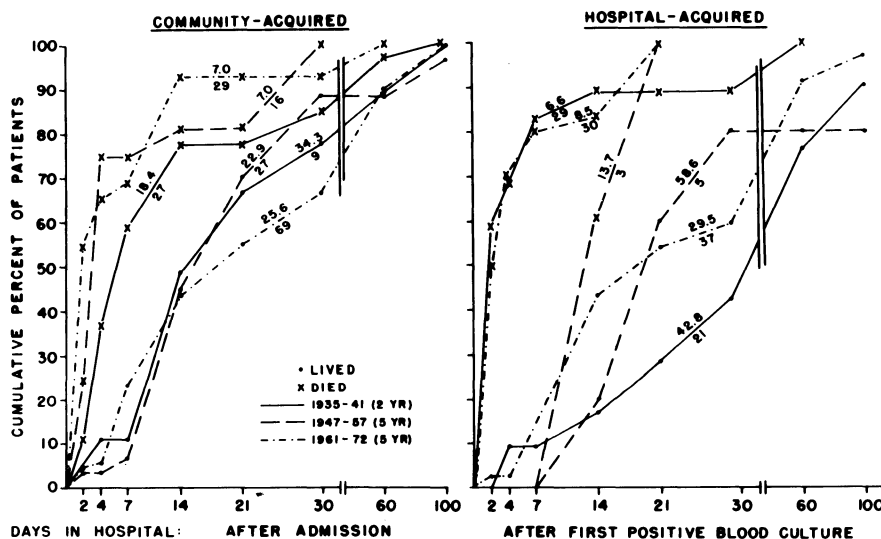
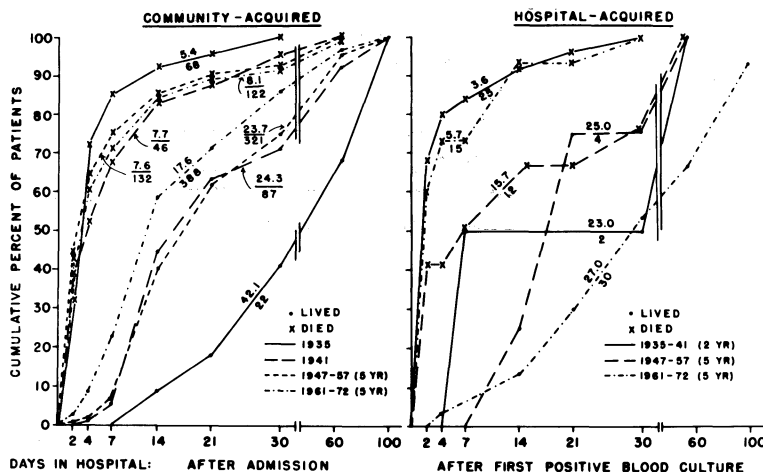


Figure 8. Mean duration of hospitalization for patients with bacteremic infections due to β -hemolytic streptococci other than those of group D at Boston City Hospital, Boston, Mass. In the community-acquired cases (left), a similar proportion of survivors were discharged by day 14 in all three periods, but different proportions remained in the hospital much longer, particularly between 1961 and 1972. The proportion of patients who died within the first four days was greater in the five years between 1947 and 1957 than in either of the other two periods. There were too few hospital-acquired cases to define a trend during the five selected years between 1947 and 1957. In the five selected years between 1961 and 1972, a much larger proportion of the survivors were discharged within the first two weeks than in 1935 and 1941. None of the fatal cases in 1935 and 1941 survived more than 21 days, whereas in the five selected years between 1961 and 1972, several of the patients died more than 30 days after the first positive culture was obtained. Numbers on the curves signify mean number of hospitalization days/number of patients.

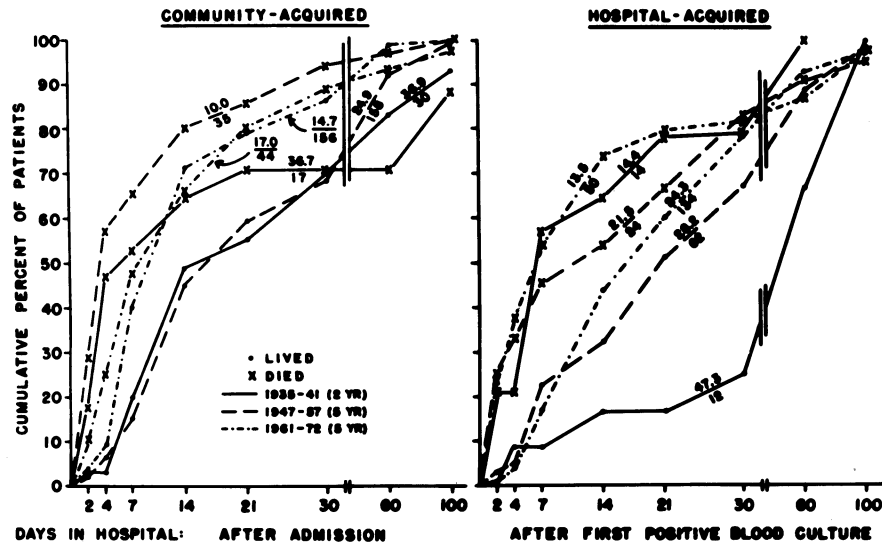


Figure 9. Mean duration of hospitalization for patients with bacteremic infections due to other streptococci (see table 2 for organisms included) at Boston City Hospital, Boston, Mass. About one-third of the infections were due to enterococci. In the community-acquired cases (CA) (*left*), in 1935 and 1941 and in the five selected years between 1947 and 1957, surviving patients were discharged at about the same rate over the first 30 days; after that time a greater proportion were discharged sooner during the latter years. The unusually long average survival time (36.7 days) for the 30 patients with CA infections who died in 1935 is accounted for by the patients with subacute bacterial endocarditis who lived for more than two months. In the selected years from 1961 to 1972, a much greater proportion of survivors were hospitalized for ≤ 14 days. Deaths during the first four days were more frequent in the years from 1947 to 1957 and less frequent in the last five selected years as compared with 1935 and 1941. In the hospital-acquired cases (*right*), hospitalization for ≤ 14 days of patients who recovered was progressively more frequent in successive intervals, and a decreasing proportion of the patients in the successive intervals remained hospitalized for >30 days. Survival of fatal cases for >14 days was most frequent in the years between 1947 and 1957. Numbers on the curves signify mean number of hospitalization days/number of patients.

hospitalization for fatal HA bacteremias was longer than for fatal CA cases of the corresponding etiology and interval.

Discussion

For this study 12 years between 1935 and 1972 were selected for a rough estimate of the impact of the successive introduction and widespread use in the hospital of many effective antibacterial agents on the course and outcome of bacteremic infections. The years selected are the same as those utilized in previous reports on the changing ecology of serious bacterial infections [1, 3-5] and in reports on the duration of hospitalization for acute bacterial meningitis [6] and acute pleural empyema [7]. Some of this impact, at least with respect to incidence of infections and mortality, has been blunted or at least complicated by the changing incidence of different age groups among the patients with serious in-

fections, the accompanying increases in the incidence and severity of underlying diseases, the longer survival of patients with previously fatal disease, and the use of immunosuppressive agents, new mechanical devices, and other potent therapeutic agents that affect the course and length of hospital stay of the patients. These factors in turn may also have altered the rapidity of the clinical response of patients to antimicrobial drugs and have been associated with increased occurrence of nosocomial infections and of epidemics of HA infections. These factors are also probably involved in determining the duration of hospitalization. In recent years, increasing concern about the utilization and costs of hospitalization have led to the use of professional review and audits for reduction of costs and the length of hospital stay.

Important as these factors undoubtedly are, it has not been possible to obtain reliable quantitative data on their effects even from careful

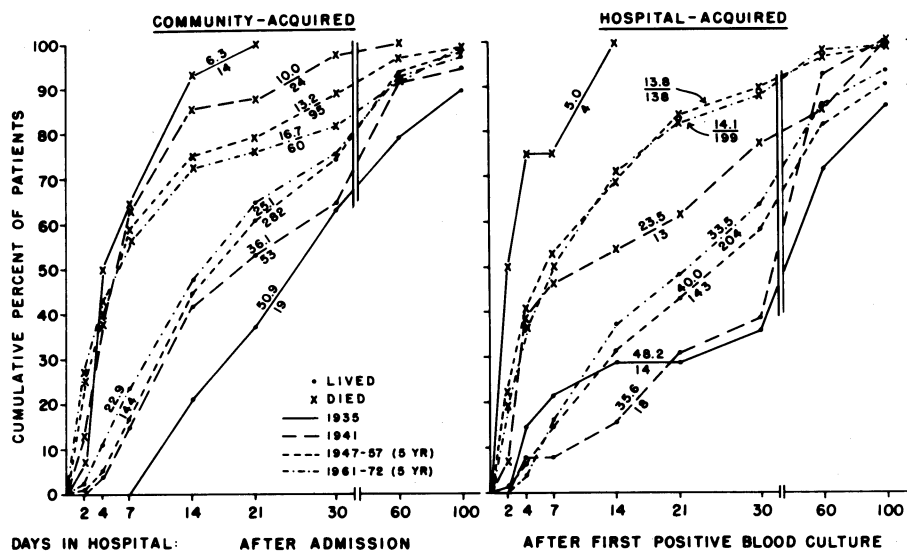


Figure 10. Mean duration of hospitalization for patients with bacteremic infections due to *Staphylococcus aureus* at Boston City Hospital, Boston, Mass. In community-acquired cases (left), a much greater proportion of survivors had a much shorter hospital stay in 1941 than in 1935; the trend continued, but to a lesser extent, in the two subsequent periods shown. A greater proportion of the fatal cases survived for more than 14 days in 1941 than in 1935, and that proportion increased in the next two periods. In the hospital-acquired cases (right), hospitalization for more than one month was most frequent in survivors during 1935 and in a progressively smaller proportion in subsequent years. In 1941, one-half of the patients who died survived for more than 14 days, and 40% for more than three weeks. In the two subsequent periods, about one-third survived for more than two weeks, and 20% for more than three weeks. Numbers on the curves indicate mean hospitalization days/number of patients.

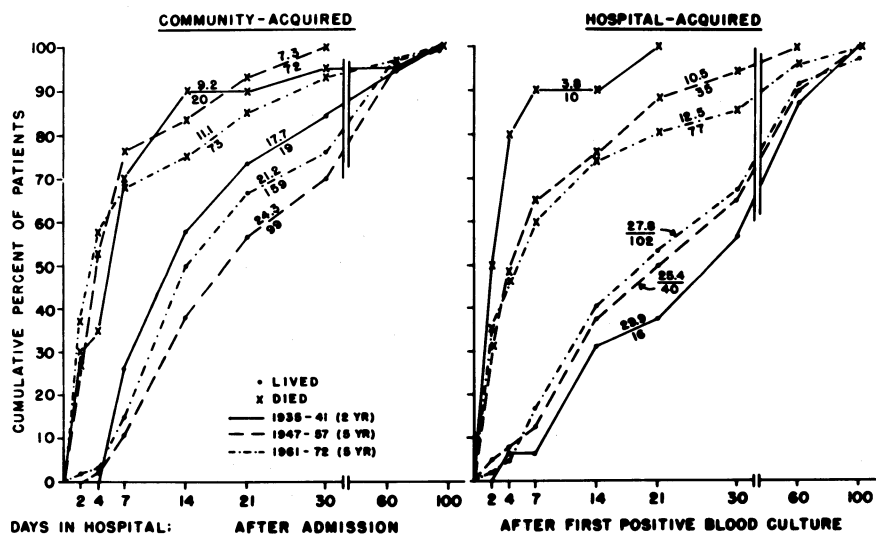


Figure 11. Mean duration of hospitalization for patients with bacteremic infections due to *Escherichia coli* at Boston City Hospital, Boston, Mass. In the community-acquired cases (left), during 1935 and 1941 the proportion of patients discharged during the first three weeks was greater than during the two later periods. Among the fatal cases a greater proportion died within four days during the last five selected years than in the earlier periods. In the hospital-acquired cases (right), increasing proportions of survivors were discharged earlier in the years between 1947 and 1957 and between 1961 and 1972 than in 1935 and 1941. Of the fatal cases in 1935 and 1941, 70% died within four days, and none survived for more than three weeks, whereas survival was much longer in the two later periods. Numbers on the curves signify mean number of hospitalization days/number of patients.

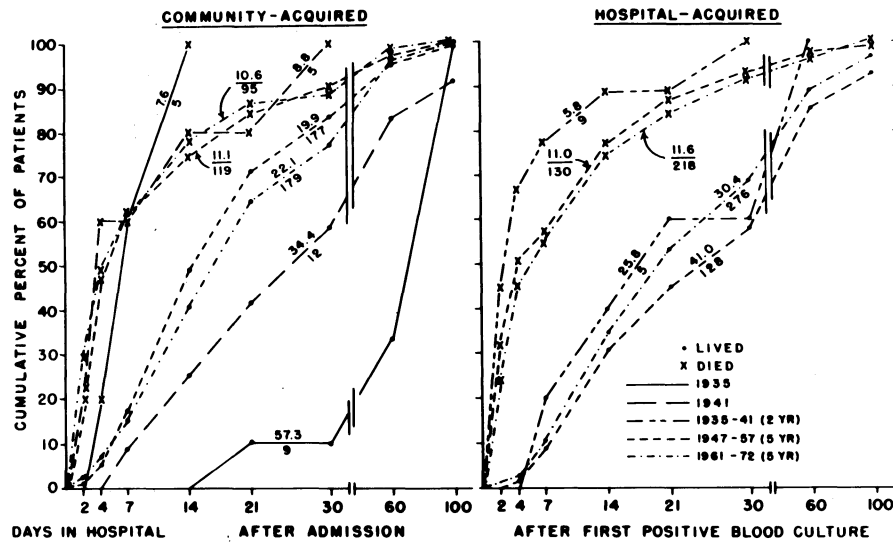


Figure 12. Mean duration of hospitalization for bacteremic infections due to single gram-negative rods other than *Escherichia coli* at Boston City Hospital, Boston, Mass. In the community-acquired cases (*left*), in 1935 none of the nine survivors were discharged within the first two weeks, and six of them stayed for more than two months. In 1941 one-fourth of the survivors left the hospital within the first two weeks and $>40\%$ were hospitalized for three weeks or less. In the two later periods, the length of hospital stay was much shorter. About 60% of the patients who died in each of the four periods survived for a week or less. In 1935 the remaining patients died during the second week; in 1941 they all died within four weeks, and $\geq 10\%$ survived for more than two months during the later years. In the hospital-acquired cases (*right*), survivors were discharged earlier during the five selected years between 1947 and 1957 than in the later years. In the fatal cases there was a progressive increase in the length of survival in the successive periods. Numbers on the curves signify mean number of hospitalization days/number of patients.

and detailed review of records, and no attempts to do so have been made in this study. Indeed, the only data utilized were those from the bacteriologic and hospital records, and only to ascertain the dates of admission and discharge or death and to verify the probable clinical significance of the bacteriologic findings.

Denominators for the rates of bacteremic infection were previously presented [1]. No attempt was made to obtain data on the duration of hospitalization in all hospitalized patients, in other categories of patients, or for patients with other kinds of infection, except for those with acute bacterial meningitis [6] and acute pleural empyema [7]. The patients in the last two categories included many who were bacteremic and thus were also included in the present study; however, they accounted for only a relatively small proportion of the total of patients with bacteremic infections, but a larger proportion of those with prolonged hospitalization.

There are other reasons for either shortening or prolonging the stay of a patient in the hospital. The desires or needs of the patient or

the family may work either way. Indeed, most patients who recovered and left the hospital within the first four days did so either against the advice of the physicians or because they appeared to be well enough to be discharged on their own request and with the implied consent of their physicians. In 16 of the patients included among the cases of pneumococcal bacteremia in 1972, the positive blood culture was obtained at the time the patients were first seen for a febrile illness in a "walk-in" clinic, but they did not appear to be seriously ill and were sent home [8]. All of these 16 patients were seen again within 24–36 hr and were given therapy if none had previously been prescribed, but they were not admitted because they appeared to be improved. They were counted as having one day of hospitalization. In other patients, social conditions were involved in prolonging the hospital stay until suitable arrangements were made. In Boston City Hospital most of these factors were probably operative throughout the years of this study, although early discharges may have been permitted or even encouraged more often

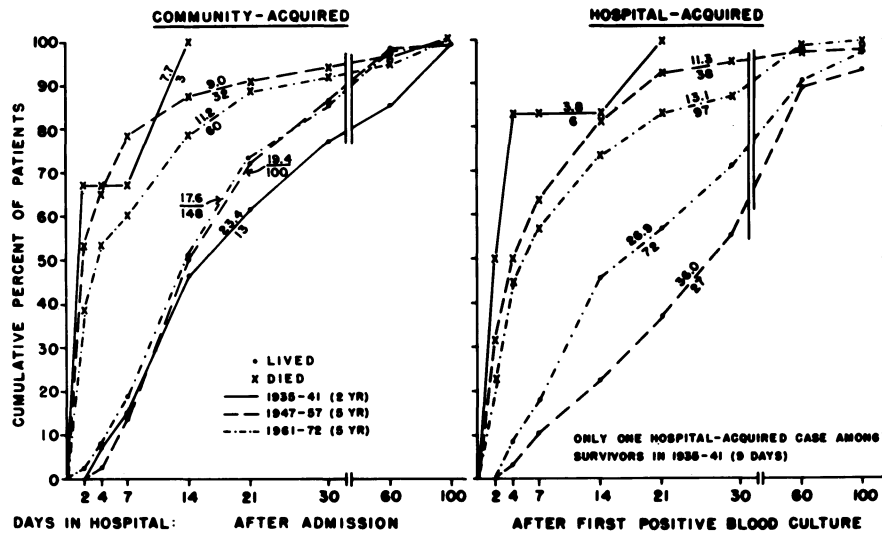


Figure 13. Mean duration of hospitalization for patients with bacteremic infections due to mixed or miscellaneous organisms at Boston City Hospital, Boston, Mass.; 35% of these infections were due to *Neisseria meningitidis* or *Haemophilus influenzae*. In the community-acquired (CA) cases (left), about one-half of the survivors during each of the three periods were discharged within the first two weeks. The remaining patients were hospitalized longer during 1935 and 1941 than in the later periods. Survival of fatal cases was longer in the years between 1961 and 1972 than in those between 1947 and 1957. In the hospital-acquired (HA) cases (right), survivors during the five years between 1961 and 1972 were discharged much sooner than those in the years between 1947 and 1957. The length of survival of fatal cases increased progressively in the successive periods. The patients who recovered from HA infections were in the hospital much longer after they became bacteremic than those with CA cases in the same periods. Numbers on the curves signify mean number of hospitalization days/number of patients.

during the last years of this study, and there may have been more dependence on continuing therapy outside of the hospital in some cases or in extended-care facilities in others.

On the whole, however, it is reasonable to assume that the changes in the duration of hospitalization of patients with bacteremic infections over the years were related to the availability and efficacy of specific antibacterial drugs, and the total impact of the other factors was relatively small and practically negligible, although some of them may have had some role in increasing the time of survival of some patients who died.

As was to be expected, there was a substantial decline in the average hospital stay of patients with CA bacteremic infections who recovered in the years after the antibacterial drugs came into wide use. Of interest is the fact that the greatest decline occurred from 1935 to 1941, when the sulfonamides were the only effective antibacterial agents available. A great part of this decline may have been due to the simplicity and the great extent to which the sulfonamides were prescribed by physicians both outside and within

the hospital. A fairly steady but slower drop in the average duration of hospitalization occurred over the subsequent years. However, the extent of the reduction between 1935 and 1941 as well as in the subsequent years varied depending on the organisms involved.

It is of interest that only the surviving patients with *E. coli* bacteremia did not show this reduction in hospital stay; in fact, their hospitalizations increased in duration. This finding seems surprising since the great majority of *E. coli* bacteremias were associated with urinary tract infections which, when uncomplicated, generally responded rapidly to sulfonamides and many of the antibiotics that became available later. However, bacteremia in urinary tract infections is usually associated with invasion of tissue (pyelonephritis), and sulfonamide action may be inactivated by inhibitors within the local infected areas but not in the urine where the sulfonamide drugs and most antibiotics are excreted in high concentrations, in contrast to relatively low concentrations attained in infected renal tissue.

For the patients with HA bacteremic infections, the duration of hospital stay fluctuated widely over the years between 1935 and 1953. This variation may be related to the resistance of the organisms in the invasive infections acquired in the hospital to the available antibacterial drugs that had been extensively used within the hospital and in most of the patients who became infected there. After 1955 increasing numbers of antibiotics became available that were effective against organisms resistant to the earlier antibacterial drugs. This aspect was not specifically documented for the patients in the present study.

In addition, the duration of hospitalization of patients with HA bacteremic infections after the first positive blood culture was generally longer than the total hospital stay for corresponding CA infections. The difference may be related to factors within the patients, including the conditions for which they were originally hospitalized, but the HA infections were most often with organisms that were less susceptible to most of the effective antibiotics than were organisms causing CA bacteremia [9].

In the fatal cases, although there appeared to be some prolongation of survival in patients with some of the specific bacteremias in the years after the sulfonamides and antibiotics were used, the mean survival time of all patients, both those with CA and those with HA infections, fluctuated irregularly and within a much smaller range over the years, without any clear trend, as shown in figure 1.

Rose et al. [10] recently presented data on the morbidity, mortality, and added duration and cost of HA bacteremic infections in comparison with similar infections, some of them in matched controls, in which bacteremia was not demonstrated. The death rates were 38% and 10%, respectively; total hospitalization was 33 days at a cost of \$6,692 for the bacteremic patients as compared with 14 days and \$2,322 for

the nonbacteremic infections. Comparisons with CA bacteremic infections were not included in this report [10].

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