California finds that when household survey data are adjusted to include information on patients who have died, hospital admissions are increased by 6 percent and hospital days by 10 percent.

Household Surveys for Hospital Planning:
Adjustment for Decedents Missed

BETH M. SIEGEL, B.A., NEDRA B. BELLOC, M.A., and FRANK E. HESSE, M.D., M.P.H.

BECAUSE household surveys can be designed to describe general population groups within a specified range of sampling variation, they are being used increasingly to gather data on illness and medical care, including services provided by hospitals. Household survey data, however, are subject to a number of limitations. Important among these from the standpoint of data for use in planning hospital facilities is the usual exclusion of persons who have died during the period covered by the survey. If this period is the customary 1 year, rates of hospital use may be affected substantially by the omission of data for this group.

Information about persons who have died is seldom obtained in household surveys because it is difficult, if not impossible, to obtain a complete and unduplicated count of decedents. Many persons with terminal illness are elderly and live in one-person households. Such house-

Mrs. Siegel is associate public health analyst, and Dr. Hesse is medical consultant, with the medical facilities planning section, bureau of hospitals, California Department of Public Health. Mrs. Belloc, now with the prevention of blindness project, California Department of Public Health, formerly was associate statistician for the San Jose survey.

Arthur Weissman, who directed the San Jose survey, assisted in preparing material for this paper.

holds are dissolved with the death of their solitary members, leaving no one of whom questions can be asked. Also, a household may be dissolved at the death of a parent or spouse, with several survivors moving to new households and constituting potential respondents.

Two recent surveys conducted by the California State Department of Public Health under research grants from the National Institutes of Health, Public Health Service, permit examination of the question of exclusion of decedents. The first was an exploratory study of methods conducted in San Jose in 1952 (*1*). By means of a check with hospital records, this survey demonstrated the validity of household interview reports of hospitalization (*2*). It also provided data on the actual hospital experience of residents of the city who died during the 1-year period covered by the survey. The second survey, conducted between May 1954 and April 1955, was a statewide effort to measure illness and use of medical services through interviews of about 10,000 households. It covered hospitalization during the previous 1-year period for the population living at the time of the interview.

In this paper, the San Jose data are compared with an estimate of hospital care for decedents used in a nationwide survey of persons aged 65 and over reported by Falk and Brew-

Table 1.   Number of admissions and days in local general hospitals for resident decedents,[1] by place of death, according to age and sex, San Jose, Calif., July 1, 1951–June 30, 1952

Age and sex	Total						Place of death								
							General or special hospital			Other institution [2]			Not in institution		
	Deaths	Admissions	Days	Average days per admission	Admissions per death	Days per death	Deaths	Admissions [3]	Days [3]	Deaths	Admissions [3]	Days [3]	Deaths	Admissions [3]	Days [3]
All ages	[4]984	623	9,833	15.8	0.63	10.0	463	527	8,480	124	31	695	[4]397	65	658
Male	532	313	4,119	13.2	.59	7.7	251	269	3,567	51	11	174	230	33	378
Female	451	310	5,714	18.4	.69	12.7	212	258	4,913	73	20	521	166	32	280
0–14 years	69	24	461	19.2	.35	6.7	53	23	453	3	1	8	13	0	0
Male	40	11	139	12.6	.28	3.5	29	10	131	3	1	8	8	0	0
Female	29	13	322	24.8	.45	11.1	24	13	322	0	0	0	5	0	0
15–64 years	328	241	3,535	14.7	.73	10.8	162	217	3,241	24	1	36	142	23	258
Male	204	127	1,457	11.5	.62	7.1	91	112	1,311	14	0	0	99	15	146
Female	124	114	2,078	18.2	.92	16.8	71	105	1,930	10	1	36	43	8	112
65 years and over	586	358	5,837	16.3	.61	10.0	248	287	4,786	97	29	651	241	42	400
Male	287	175	2,523	14.4	.61	8.8	130	147	2,125	34	10	166	123	18	232
Female	299	183	3,314	18.1	.61	11.1	118	140	2,661	63	19	485	118	24	168

[1] All deaths, including those of the newborn, of persons whose residence was given as San Jose on the death certificate.

[2] Mental hospital, tuberculosis hospital, nursing home, correctional or other institution.

[3] A death may have occurred in a hospital or elsewhere in or outside San Jose, but hospital admissions and days include only those in the 4 general hospitals in or immediately adjacent to the city of San Jose (San Jose Community Hospital, O'Connor Hospital, Doctors Hospital, Santa Clara County Hospital).

[4] Includes 1 death of unknown age.

NOTE: Admissions and days include 1-day stays not overnight and exclude hospitalization of the newborn.

SOURCE: San Jose survey, bureau of chronic diseases, California State Department of Public Health.

ster (*3*). Also, these data are used to adjust the data obtained in the California health survey.

San Jose Survey

In addition to a household survey and an investigation of other sources of information, the San Jose study included examination of (*a*) the hospital medical records of all the city's residents who received care in any of the four local general hospitals between July 1, 1951, and June 30, 1952, and (*b*) the death certificates for all city residents who died in the same period. There were 10,014 hospital records and 984 deaths. The hospital records were abstracted and matched with the death certificates. In this manner the actual hospital experience of decedents was obtained.

Only hospitalization during the year covered in the survey was included in the data for decedents. A person who died in the hospital on July 2, 1951, for example, was counted as having 1 period of hospitalization lasting 1 day.

The San Jose findings are subject to the major limitation of not including any hospital care that may have been received in other communities. This characteristic undoubtedly results in an understatement of hospitalization, particularly for males aged 15–64, who probably used Veterans Administration hospitals and an industrial hospital outside San Jose.

The San Jose data are derived from hospital records and include 1-day stays not overnight. Such stays are specifically excluded from the California health survey. In the San Jose survey, 1-day stays not overnight amounted to 43 percent of all 1-day stays and 7 percent of all admissions. They represented less than 1 per-

cent of the total hospital days. Counts by age, sex, or other characteristics are not available.

Hospitalization data for the 984 persons in San Jose who died during the period covered by the survey are given in table 1. These persons had 623 hospital admissions, one-fourth of which were nonterminal, and they used 9,833 hospital days.

Comparison With Falk-Brewster Method

In their report on hospitalization for persons aged 65 and over, Falk and Brewster drew attention to the problem of omission of decedents. They estimated the amount of care used by this group and found that its addition to household survey findings increased rates of utilization by approximately one-fourth (fig. 1).

Falk and Brewster estimated hospital experience for decedents by applying assumed hospital admission rates to counts of persons dying. For those dying in hospitals, they figured that each death equaled one admission. For those dying in other institutions, they assumed that there were no admissions, reasoning that these persons make negligible use of hospitals. For persons dying outside institutions, they divided the number in half (since persons dying in 1 year have lived on the average for one-half a year) and applied the admission rates of the household survey population. They determined the number of hospital days by multiplying the estimated number of admissions for each group of decedents by the average length of stay for the household survey population.

The one-fourth increase in rates obtained by this method indicates that, at least in the age group 65 and over, omission of decedents creates a large underestimate. A comparison between

Table 2. Comparison of estimated and actual hospital experience for decedents aged 65 years and over, San Jose, Calif., July 1, 1951–June 30, 1952

| Place of death	Number of deaths	Estimated hospital experience (Falk-Brewster method applied to San Jose data)		Actual local general hospital experience (hospital record data)	
		Admissions	Days[1]	Admissions	Days
All places	586	258	4,876	[2] 333	[2] 5,812
General or special hospital	248	248	4,687	[2] 262	[2] 4,761
Other institution	97	0	0	29	651
Not in institution	241	[3] 10	189	42	400

[1] Estimated admissions multiplied by 18.9 days, the average length of stay for persons aged 65 years and over found in household interview part of San Jose survey.

[2] Excludes an estimated 25 admissions and 25 days for 1-day stays not overnight, derived by applying San Jose finding of 7 percent to actual total of 358 admissions.

[3] Based on admission rates for persons aged 65 years and over found in household interview part of San Jose survey: Males, 8.9 percent; females, 7.6 percent.

SOURCE: San Jose survey, bureau of chronic diseases, California State Department of Public Health.

Figure 1. Falk-Brewster adjustment of annual hospital utilization rates, 1952: admissions and days per 1,000 persons, aged 65 years and over.
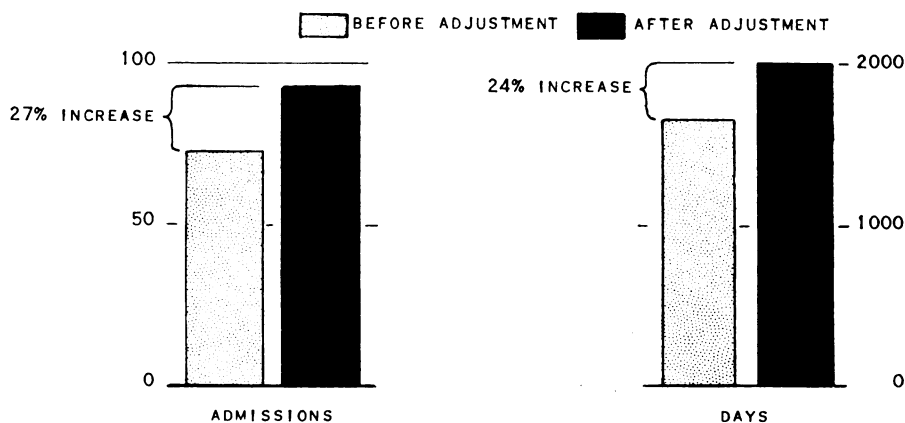
the actual hospital experience for 586 San Jose decedents aged 65 and over and an estimated experience calculated according to the method of Falk and Brewster indicates that the discrepancy caused by the omission of decedents is even larger (table 2). The Falk-Brewster method gave an estimate of 258 admissions and 4,876 days, whereas there were actually (subtracting an estimated twenty-five 1-day stays not overnight) 333 admissions and 5,812 days. The difference results partly from the failure to allow for multiple admissions of persons who died in general hospitals, partly from the fact that no allowance was made for prior admissions to general hospitals for persons who died in other institutions, and partly from the underestimation of admissions for those who died outside institutions.

Adjustment of Statewide Data

To estimate the total annual use of general hospitals in California, the San Jose data were used to adjust the findings of the California health survey. Although a respondent in the California health survey might have died on the day following the interview, only his experience as a survivor of the past 12 months was included in the household survey rates. During any one year hospitals also provided care to persons who failed to survive the 12 months. These persons had lived, on the average, for 6 months. Their hospital experience during the part of the year they lived was missed in the California health survey.

The age-sex-specific ratios (admissions and days per death) found for the San Jose decedents were applied to the deaths in each age-sex group reported for the State in 1954 to obtain estimated rates of admissions and days (table 3). These rates were then applied to the data obtained in the California health survey to obtain adjusted rates of admissions and days (table 4).

For all ages, the adjustment of the California health survey data increased the estimate of hospital admissions by 6 percent and hospital

Table 3. Estimated number of admissions and days in non-Federal general hospitals for decedents in California, according to age and sex, 1954

Age and sex	California deaths, 1954 [1]	Ratios found in San Jose		Estimated number		Estimated rate per 1,000 persons [2]	
		Admissions per death	Days per death	Admissions	Days	Admissions	Days
All ages	[3] 109, 402			68, 800	1, 072, 100	6	88
Male	[3] 63, 662			37, 300	486, 900	6	82
Female	[3] 45, 740			31, 500	585, 200	5	93
0-14 years	9, 307			3, 300	62, 400	1	18
Male	5, 386	0. 28	3. 5	1, 500	18, 900	1	10
Female	3, 921	. 45	11. 1	1, 800	43, 500	1	25
15-44 years	10, 054			7, 300	106, 500	1	21
Male	6, 437	. 62	7. 1	4, 000	45, 700	2	19
Female	3, 617	. 92	16. 8	3, 300	60, 800	1	22
45-64 years	29, 688			21, 400	307, 700	8	121
Male	19, 695	. 62	7. 1	12, 200	139, 800	10	112
Female	9, 993	. 92	16. 8	9, 200	167, 900	7	129
65 years and over	60, 306			36, 800	595, 500	37	593
Male	32, 105	. 61	8. 8	19, 600	282, 500	41	591
Female	28, 201	. 61	11. 1	17, 200	313, 000	33	594

[1] By place of residence.
[2] Adjustment factor; based on population estimates of the California health survey.
[3] Includes 39 male and 8 female deaths of unknown age.

SOURCES: San Jose survey, bureau of chronic diseases, and death records, California State Department of Public Health.

Table 4. Number of admissions and days per 1,000 persons per year and average length of stay in general hospitals, according to age and sex: California health survey data unadjusted and adjusted to include experience of decedents [1]

Age and sex	Admissions			Days			Days per admission			For 95 percent confidence level plus or minus the following percent of the unadjusted rate [2]	
	Rate per 1,000 persons		Percent increase	Rate per 1,000 persons		Percent increase					
	Unad-justed	Ad-justed		Unad-justed	Ad-justed		Unad-justed	Ad-justed	Percent change	Admis-sions	Days
All ages_____	93	99	6	881	969	10	9. 5	9. 8	+3	5	12
Male_____	70	76	9	968	1, 050	8	13. 8	13. 8	0	8	18
Female_____	114	119	4	798	892	12	7. 0	7. 5	+7	8	18
0–14 years_____	41	42	2	229	247	8	5. 6	5. 9	+5	17	27
Male_____	46	47	2	286	296	3	6. 2	6. 3	+2	21	39
Female_____	35	36	3	169	194	15	4. 8	5. 4	+12	21	35
15–44 years_____	123	124	1	1, 000	1, 021	2	8. 1	8. 2	+1	8	25
Male_____	63	65	3	1, 027	1, 046	2	16. 3	16. 1	−1	15	34
Female_____	176	177	1	976	997	2	5. 5	5. 6	+2	10	22
45–64 years_____	98	106	8	1, 151	1, 272	10	11. 7	12. 0	+3	8	16
Male_____	101	111	10	1, 451	1, 563	8	14. 4	14. 1	−2	16	28
Female_____	94	101	7	862	991	15	9. 2	9. 8	+7	16	23
65 years and over___	109	146	34	1, 900	2, 493	31	17. 4	17. 1	−2	15	33
Male_____	121	162	34	2, 018	2, 609	29	16. 7	16. 1	−4	24	48
Female_____	98	131	34	1, 792	2, 386	33	18. 3	18. 2	−1	24	47

[1] California health survey covered hospitalization in both Federal and non-Federal hospitals for the non-institutional population living off military posts. The interview period was May 1954–April 1955 covering hospitalization in prior 12-month periods. Hospitalization of newborn is excluded. The adjusted rates underestimate male utilization more than female utilization because this was true of the San Jose ratios used in the adjustment.

[2] Twice the estimated coefficient of variation. The chances are 95 out of 100 that the percentage difference between the sample survey findings and the results of a complete census of the population would be within twice the coefficient of variation.

days by 10 percent. For persons aged 65 and over, who are the majority of the decedents, the adjustment increased the rates of both admissions and days by about one-third (fig. 2).

Unlike rates of admissions and days, average length of stay is not necessarily increased by adjustment for persons who have died. This adjustment of the California health survey data decreases average stay for the age group 65 and over and increases average stay for all other age groups. The changes are all relatively small. Whether the data reflect real changes cannot be determined because the differences are smaller than sampling fluctuations at the 95-percent confidence level.

In connection with planning medical facilities under the Hospital Survey and Construc-tion Act (Hill-Burton program), there is considerable interest in bed-population ratios for non-Federal hospitals. These ratios as derived from the California health survey, both unadjusted and adjusted to include experience of decedents, are shown in table 5. The adjustment increases the bed-population ratio from 2.8 to 3.1 beds per 1,000 population of all ages and from 6.9 to 9.2 for the age group 65 and over. From reports submitted to the California State Department of Public Health by hospitals and on information from its field staff, an average of approximately 3 general hospital beds for acutely ill patients per 1,000 population is known to be in actual use in California. In 1956 the State adopted this ratio as the minimum for planning under the Hospital Survey and Construction Act (4).

Note on Institutional Population

Both the study reported by Falk and Brewster and the California health survey were concerned primarily with the noninstitutional population. However, the institutional population uses general hospital care (table 2) and cannot be ignored in estimating total annual admissions and days.

Since the San Jose ratios include use of general hospitals by the institutional population that dies, the adjustment of the California health survey makes allowance for this group. The adjustment, however, does not make allowance for the institutional population that survives. The California health survey included a small sample of the surviving institutional population, but at the time this paper was written this sample had not been tabulated and analyzed.

Validity of the Adjustment

It is recognized that the San Jose ratios represent the experience of only one community. Their application to the United States is questionable. For persons aged 65 and over, Falk and Brewster reported that 31 percent die in general and special hospitals in the United States, whereas the figure for San Jose residents in this age group is 42 percent. The San

Jose ratios, however, are considered applicable to the California health survey data for the following reasons:

1. The San Jose information is the only information known to us on the actual hospital experience of decedents which includes nonterminal care and is also related to a general population.

2. Although no one city can be considered typical of the State, San Jose corresponds to the State in a number of respects. The age and sex composition is similar (table 6). The 1950 census showed no important differences between the population of San Jose and the total population of the State except that the city had a higher proportion of persons with Spanish surnames and a smaller proportion of Negroes.

3. San Jose in 1951–52 and California in 1955 had similar proportions of deaths occurring in hospitals and institutions. For all ages and for persons aged 65 and over, the figure was approximately 60 percent. (California data by age are not available for earlier years, nor do California data separate deaths in general hospitals from deaths in other institutions.)

4. Knowledge of local hospital practices and the little existing comparable data indicate that the type of hospital care available in San Jose in 1951–52 was similar to what might be ex-

Figure 2. Adjustment of annual hospital utilization rates obtained from the California health survey, 1953–55: admissions and days per 1,000 persons, all ages and 65 years and over.
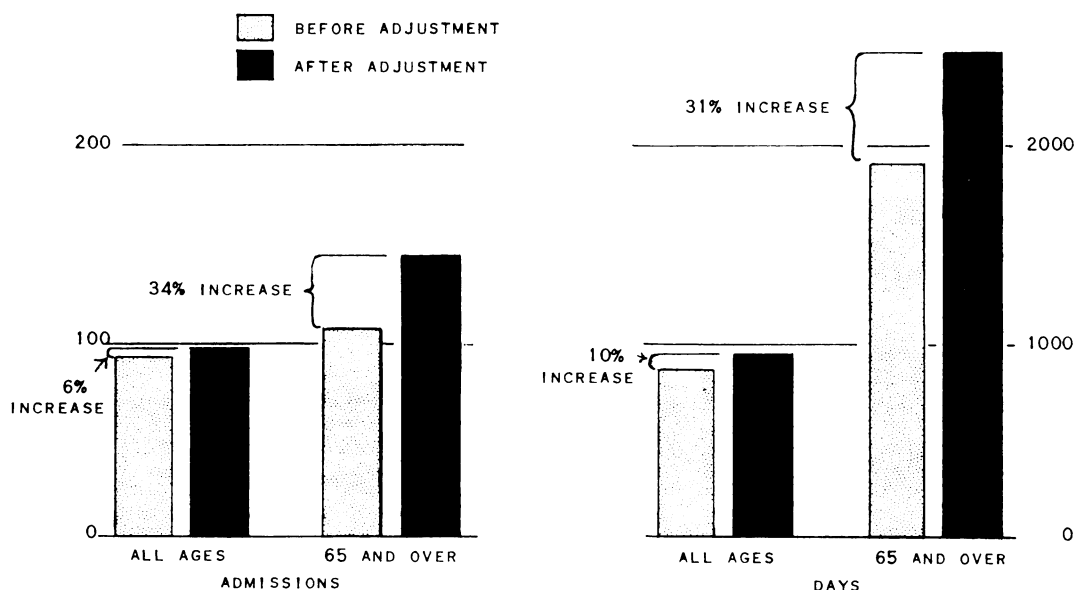
Table 5. Non-Federal general hospital beds used per 1,000 population per year, according to age and sex: California health survey data unadjusted and adjusted to include experience of decedents [1]

Age and sex	Beds per 1,000 persons at 70 percent occupancy [2]		
	Unadjusted	Adjusted	Percent increase[3]
All ages	2. 8	3. 1	12
Male	2. 7	3. 0	12
Female	2. 9	3. 3	12
0–14 years	. 9	. 9	7
Male	1. 1	1. 2	4
Female	. 6	. 7	16
15–44 years	2. 8	2. 9	3
Male	2. 1	2. 2	3
Female	3. 4	3. 5	3
45–64 years	3. 8	4. 3	13
Male	4. 4	4. 9	10
Female	3. 2	3. 7	16
65 years and over	6. 9	9. 2	34
Male	6. 8	9. 1	34
Female	6. 9	9. 3	34

[1] The interview period was May 1954–April 1955 covering hospitalization in prior 12-month periods. Hospitalization of newborn is excluded. The adjusted rates underestimate male utilization more than female utilization because this was true of the San Jose ratios used in the adjustment.

[2] Days of care in non-Federal general hospitals per 1,000 persons divided by 256 (70 percent of 365). Average occupancy in California non-Federal general hospitals is 70 percent.

[3] Calculated from bed occupancy rates with two decimal places.

SOURCE: California health survey, bureau of chronic diseases, California State Department of Public Health.

pected statewide during the period covered by the California health survey.

5. The estimate derived from San Jose experience is conservative since it excludes hospitalization of residents outside the local community.

6. The adjustment using San Jose ratios brings the estimate of total hospitalization based on the California health survey data into closer agreement with data from other sources, as shown in table 7.

Other Approaches to the Problem

The San Jose data measure the general magnitude of the effect on hospitalization rates of the omission of decedents in household surveys, and we believe they give an adequate, conservative adjustment of the California health survey data. However, there is need to develop better methods for overcoming limitations due to the omission of persons who have died. Ratios existing in one community during one year cannot be applied with confidence to future years or to the Nation as a whole. Another consideration is that omission of decedents affects findings on illness, disability, and other items as well as findings on hospital use.

One approach to the problem is to supplement the household survey with a study of a sample of deaths. Death certificates provide what can be considered a complete universe and are easily sampled. A more difficult problem is how to obtain the additional information on hospital care and perhaps on other subjects.

By mail or by interview, information might be obtained from the physician certifying the death, from the informant named on the death certificate, or from the hospital or institution where the death occurred. Further information might be obtained by followup of these sources. All these methods should be tried and evaluated.

Table 6. Percentage of population according to age and sex, San Jose, October 1952, and California, May 1954–April 1955

Age and sex	San Jose	California
All ages	100	100
Male	47	49
Female	53	51
0–14 years	24	29
Male	12	15
Female	12	14
15–44 years	44	42
Male	20	20
Female	24	22
45–64 years	22	21
Male	11	10
Female	11	11
65 years and over	10	8
Male	4	4
Female	6	4

SOURCES: U. S. Bureau of the Census, Current Population Reports, series P–28, No. 464, October 24, 1952; California health survey, bureau of chronic diseases, California State Department of Public Health.

For data on hospital use, we have decided that the following method probably will be the most accurate and also the most feasible, at least for a special study in California:

1. Enlist the cooperation of a sample of local registrars of death (health officers), who in turn will obtain the cooperation of funeral directors.

For most California deaths the funeral director obtains information for the death certificate from the family and, for hospital deaths, communicates with the attending physician and with the hospital.

2. At the time the death certificate is prepared, have the funeral director obtain the

Table 7. Number of admissions and days per year in non-Federal general hospitals in California: comparison of findings from three sources

Source	Admissions		Days		Definitions
	Number	Rate per 1,000 population [1]	Number	Rate per 1,000 population [1]	
California health survey (interview period May 1954–April 1955 covering hospitalization for May 1953–April 1955):					Care reported in (a) community [4] hospitals classified as general or maternity in the list of hospitals licensed by the California Department of Public Health and (b) county and city hospitals. Excludes care of persons with no usual place of residence outside an institution. This probably excludes all of the domiciliary care and a large but unknown proportion of the long-term chronic and nursing care given by county hospitals.
Unadjusted	1, 048, 000	[2] 86	8, 737, 000	[3] 713	
Adjusted to include estimated care to decedents.	1, 117, 000	92	9, 809, 000	801	
Adjusted to include estimated care to decedents and estimated 1-day stays not overnight.[5]	1, 201, 000	98	9, 893, 000	808	
Bureau of hospitals, California State Department of Public Health (1954 for community [4] hospitals; 1954–55 for county and city hospitals).	1, 425, 089	116	9, 629, 301	786	Includes all non-Federal general and special [6] hospitals in California. Within these hospitals excludes services in beds assigned for tuberculosis, psychiatric, chronic, nursing, and domiciliary care.
American Hospital Association (year ending September 30, 1954).	1, 258, 790	103	10, 573, 320	863	Includes non-Federal short-term general and special [6] hospitals listed by the American Hospital Association in the Administrators Guide Issue, August 1955. Within these hospitals includes services in beds assigned for tuberculosis, psychiatric, chronic, nursing, and domiciliary care.

[1] Rates based on population estimate of California health survey (12,250,000 resident noninstitutional population exclusive of persons living on military posts).

[2] Plus or minus 5 percent, twice the estimated coefficient of variation.

[3] Plus or minus 12 percent, twice the estimated coefficient of variation.

[4] Proprietary, nonprofit, and district hospitals plus University of California Hospital (State).

[5] One-day stays not overnight are estimated to be 84,000 admissions and days, based on San Jose finding that 93 percent of admissions were overnight or longer.

[6] Excludes tuberculosis and mental hospitals.

names and addresses of any hospitals in which the decedent spent one or more days during the year of death.

3. Check with the hospitals named to verify the information and to obtain additional data on such items as number of days and treatment received.

Another approach to the problem is prospective study of the surveyed population to determine which persons die in the 12 months following interview and the amount of hospitalization used by these persons during that period. This is not an efficient method if its only purpose is to adjust data on hospital use. However, in California the method is under consideration for other purposes and may incorporate a test of the San Jose ratios. The major disadvantages of the method are (a) a small sample of deaths, (b) a relatively costly followup to locate informants and obtain the desired data, and (c) a later time period from the period covered in the household survey.

Summary and Conclusions

From hospital records, the actual hospital experience (in the four local general hospitals) of the 984 residents of San Jose, Calif., who died in the fiscal year 1952 was determined. This information was used to adjust the findings of the 1954–55 California health survey, a statewide household survey covering the living population.

For all ages the adjustment increased the estimate of hospital admissions by 6 percent and the estimate of hospital days by 10 percent. For persons aged 65 years and over, the adjustment increased both the rate of admissions and the rate of days in the hospital by approximately one-third.

From this study, it is evident that persons who die during a 1-year period use hospital care during that period in amounts too great to be ignored in planning medical facilities. If household survey findings are to be used to describe the total amount of services provided by hospitals, it is necessary to add the experience of persons who have died.

Adjustment of the California health survey data on the basis of the San Jose data appears to give a reasonable estimate of total annual use of general hospitals in California for the period studied. However, further study is needed to test the accuracy of this adjustment and also to develop methods of adjustment that would be applicable whenever household surveys are done.

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Footnote on Asian Influenza

A report of Asian influenza affecting 2,770 recruits and more than 70 percent of the crew of a naval vessel at San Diego appeared in the September 1957 issue of *Public Health Reports*, page 769.

The vessel had not been to the Far East or to any other foreign area. It is reported that the infection was present in San Diego before the ship left the port on June 6, 1957.