Finally, it is likely that improvements in treatment procedures over time have resulted in reduced average in-hospital and post-hospital mortality for people with a hip fracture. For this reason, studies conducted 10 to 15 years ago may show higher in-hospital mortality than studies conducted in the past few years.

Many of these factors—patient age, gender, race, general physical condition and coexisting illnesses, residence at the time of the fracture, type of treatment, and average hospital length of stay—are interrelated. Together with improvements in treatment procedures over time, they help to explain observed differences in in-hospital mortality in different studies.

OTA's Estimate of Average In-Hospital Mortality

Since the National Hospital Discharge Survey sample represents almost all hip fracture patients in the United States and provides the most recent available data on in-hospital mortality, OTA used the survey data to develop an estimate of in-hospital mortality for patients age 50 and over. Combining the figures from the 1988 and 1991 surveys, OTA estimates that average in-hospital mortality for hip fracture patients age 50 and over is 4 percent and varies by patient gender and age as noted in table 10.[17]

TABLE 10: OTA's Estimate of the Proportion of Hip Fracture Patients Age 50 and Over Who Die in the Hospital, by Age and Gender

Age	All hip fracture patients	Male hip fracture patients	Female hip fracture patients
50-59	**1%**	**O%**	1%
60-69	3	6	1
70-79	3	7	2
80-89	3	7	3
90+	7	19	4
Totals	4	8	3

SOURCE Office of Technology Assessment, 1993

LONG-TERM MORTALITY

A considerable proportion of hip fracture patients die in the year following their fracture. This section presents the information OTA used to estimate long-term mortality for people age 50 and over with a hip fracture. OTA's principal findings based on this information were summarized at the beginning of this document.

Table 11 shows one-year mortality from a study of more than 22,000 Medicare beneficiaries in six New England states who had a hip fracture between 1984 and 1986 (27). As shown in the top section of the table, 24 percent died in the first year post-fracture. Average mortality increased with age and was much higher for males than females in each age group. *These data and all other mortality data discussed in this section reflect all-cause mortality for hip fracture patients, not just mortality attributable to the fracture.*

OTA is aware of two studies that provide information on longer term mortality for female hip fracture patients. Table 12 shows cumulative mortality over a five-year period from a study of more than 2,000 females age 50 and over who were enrolled in the Kaiser Permanence Health Plan in California and were treated for a hip fracture between 1980 and 1984 (96). Information on subject deaths was collected through 1985. The study data show successively higher mortality at each of nine time points and higher mortality at each time point for successive y older age groups. Because of the timing of their fracture in relation to the period of the study, many of the subjects could not be followed for the full duration of the study: for example, a subject who had a hip fracture in January 1980 could have been followed for six years, through December 1985, but a subject who had a hip fracture in December 1984, could

17 Since the total number of people age 100 and over in the National Hospital Discharge Survey samples is relatively small and in-hospital mortality varied so greatly in this age group for the two years, OTA combined the age group 100+ with the group age 90 to 99 for this estimate.

TABLE 11: One-Year Mortality for Hip Fracture Patients Age 65 and Over in New England, by Age, Gender, and Residence at the Time of the Fracture, 1984–86

Age	Number	All patients	Male patients	Female patients
		All hip fracture patients		
65-74	4,216	14Y0	22%	12%
75-84	9,082	21	34	17
85+	8,741	31	48	28
Totals	22,039	24	36	21
		Patients who were living in the community at the time of the fracture		
65-74	3,840	13?40	21%	1 1%
75-84	7,489	18	31	15
85+	6,122	28	44	25
Totals	17,451	21	32	18
		Patients who were living in a nursing **home at the time of the fracture**		
65-74	376	26%	33%	23%.
75-84	1,593	31	48	26
85+	2,619	39	60	36
Totals	4,566	35	52	32

SOURCE Calculated by the Office of Technology Assessment based on data from ES. Fisher, J.A Baron, D J. Malenka et al., "Hip Fracture Incidence and Mortality in New England, " *Epidemiology,* 1991,

only have been followed for one year (97). Thus, the data on five-year mortality are contributed by a subset (about 40 percent) of the sample, and the entire sample contributes only to the one-year mortality figures.

Table 13 shows cumulative mortality over a five-year period from a study of 612 female hip fracture patients of all ages treated in hospitals in Rochester, Minnesota, between 1980 and 1989 (85). Like the data from the Kaiser Permanence Health Plan Study, the Rochester data show successively higher mortality at each of nine time points and higher mortality at each time point for successively older age groups. The two studies' findings are not precisely comparable because of differences in the age categories used to group the data, but the findings are quite similar. The findings on one-year mortality from both studies are also similar to the one-year mortality data for female patients in the New England study (see table 1 1).

Table B-1 in appendix B presents the findings on long-term mortality from numerous other studies of hip fracture patients. As with in-hospital mortality, differences among the studies in the characteristics of their subjects probably account for most of the differences in the studies' findings on long-term mortality.

Factors That Affect Long-Term Mortality

Many factors affect long-term mortality following a hip fracture. One factor is patient age. Each of the three studies described above and virtually all the studies cited in table B-1 in appendix B show that long-term mortality is higher for older than for younger patients. A study of814 hip fracture patients treated in seven Maryland hospitals from 1984 to 1986 found that the relative risk of dying by one year post-fracture was 1.8 for patients age 85 and over compared with those age 65 to 74 (79).

TABLE 12: Cumulative Mortality for Female Hip Fracture Patients Age 50 and Over in the Kaiser Permanente Health Plan Study, 1980–85

Age	Number	3 mos	6 mos	9 mos	1 yr	18 mos	2 yrs	3 yrs	4 yrs	5 yrs
50-64	**390**	**3%**	**4%**	**5%**	7%	9%	1070	12'XO	13Y0	15'%0
65-74	565	5	8	9	10	13	15	18	20	23
75-84	693	8	12	14	17	20	25	29	32	34
85-89	252	15	21	23	26	32	34	41	44	48
90+	101	20	28	31	34	45	46	49	53	53
Total	**2,001**	**8**	**11**	**13**	**15**	**19**	**21**	**25**	**28**	**30**

SOURCE D Petitti, University of California, San Francisco, letter to the Office of Technology Assessment, July 23, 1991

TABLE 13: Cumulative Mortality for Female Hip Fracture Patients in Rochester, Minnesota, 1980–89

Age	Number	3 mos	6 mos	9 mos	1 yr	18 mos	2 yrs	3 yrs	4 yrs	5 yrs
Under 64	**62**	**2%**	**5%**	**5%**	**81%**	**8%**	**8%**	12%	12Y0	17Y0
65-84	334	8	11	13	14	18	22	28	35	41
85+	225	15	20	22	26	31	38	50	58	65

SOURCE L J Melton, III, Mayo Clinic, Rochester, MN, letter to the Off Ice of Technology Assessment, May 3, 1993

A second factor that affects long-term mortality is patient gender. Data from the New England study indicate that one-year mortality was 71 percent higher for male patients than for female patients (36 versus 21 percent, respectively (see table 11)). The Maryland study cited above found that the relative risk of dying by one year post-fracture was 1.9 for male versus female hip fracture patients (79).

The relationship between race and long-term mortality following a hip fracture is unclear. Some studies show higher long-term mortality for black hip fracture patients. According to the Maryland study, for example, the relative risk of dying by one year post-fracture was 1.8 for black versus white patients (79). In contrast, the New England study shows a lower relative risk of dying by one year post-fracture for black versus white patients (0.82) (27). A study of more than 700,000 Medicare beneficiaries with a hip fracture from 1984 to 1987 found that average mortality at one year post-fracture was nearly identical for black and white males but higher for black females than white females (45).

Data from the 1990 HCFA *Special Report* described earlier suggest that mortality for black versus white hip fracture patients differs not only by patient gender but also by patient age, type of fracture, and type of treatment.[18] at one year post-fracture, mortality was higher for black males than white males among those who had a trochanteric hip fracture and received reduction and internal fixation; lower for black males than white males

[18] As noted earlier, the 1990 HCFA Special Report provides national data for 1986 on hip fracture patients for whom Medicare reimbursement was provided for one of two types of surgical treatment: I) partial replacement of (he hip joint, and 2) reduction and internal fixation. Patients who received reduction and internal fixation were further divided into two subgroups according to the exact location of their fracture, trochanteric or cervical.

among those who had a cervical hip fracture and received reduction and internal fixation, except subjects age 65 to 74; higher for black males than white males among those who received a partial hip replacement, except subjects age 75 to 84; and higher for black females than for white females with both types of fractures, both types of treatment, and in each age category (122).

Long-term mortality is higher for hip fracture patients who have coexisting medical illnesses than for those who do not have such illnesses. The New England study found that mortality for patients with one or more coexisting illnesses was substantially higher than for those without coexisting illnesses for all subjects, for subjects in each age group, and for male and female subjects (27). Several other studies listed in table B-1 had similar findings (17,62,79). A study of 211 females treated for a hip fracture in 17 hospitals in Philadelphia found that the presence and number of coexisting illnesses was not associated with mortality (87), but the study sample included only relatively healthy hip fracture patients.

The Maryland study found that mortality was higher for hip fracture patients who had delirium at the time of hospital admission but no history of Alzheimer's disease or any other disease that causes dementia (79). The relative risk of dying by one year post-fracture was 3.1 to 3.5 for hip fracture patients with delirium but not dementia versus those with both delirium and dementia, neither delirium nor dementia, or dementia but not delirium.

Long-term mortality is higher for individuals living in a nursing home than for individuals living in the community at the time of their fracture. As shown in table 11, the New England study found that one-year mortality was at least 10 percent higher in each age interval for individuals who were living in a nursing home at the time of their fracture (27). It is interesting to note that most of the studies listed in table B-1 that report relatively low long-term mortality excluded nursing home residents (see, for example, Fitzgerald et al. (28), Fitzgerald et al. (29), Kenzora et al. (62), Mossey et al. (87), Palmer et al. (95), Weiss et al. (140)).

The exact location of an individual's hip fracture may affect long-term mortality. Data from the 1990 HCFA *Special Report* show that one-year mortality was higher for females with a trochanteric versus a cervical hip fracture in each age group (122) (see table 14). For males, mortality was lower for those with a trochanteric fracture except in the 65 to 74 age group. Two other studies cited in table B-1 found higher mortality for individuals with a trochanteric fracture (17,68); one study found lower mortality for individuals with a trochanteric fracture (83); and two studies found no significant difference in mortality by the exact location of the fracture (62,87).

The type of treatment provided for a patient probably affects long-term mortality, although, as noted earlier, it is difficult to separate the effects of the type of treatment from the effects of patient characteristics that lead to a decision to use that type of treatment. Data from the 1990 HCFA *Special Report* show that one-year mortality for female patients who received a partial hip replacement (replacement of the head of the femur) was intermediate between mortality for female patients who received reduction and internal fixation for a trochanteric fracture and female patients who received reduction and internal fixation for a cervical fracture (see table 14). For male patients, one-year mortality was somewhat higher for those who received a partial hip replacement compared with those who received reduction and internal fixation for either type of fracture (122).

Average age-specific mortality was slightly lower in the 1990 HCFA *Special Report* than in many of the other studies cited in table B-1. Hip fracture patients who received nonsurgical treatment and hip fracture patients who received a total hip replacement were not included in the samples for the HCFA *Special Report.* It is not clear whether the exclusion of patients who received these two types of treatment accounts for the lower age-

TABLE 14: One–Year Mortality for Hip Fracture Patients, by Type of Fracture, Type of Treatment, Age, and Gender, 1986

Age	Patients with a trochanteric hip fracture who had reduction and internal fixation	Patients with a cervical hip fracture who had reduction and internal fixation	Patients who had a partial hip replacement
65-74	**13%**	**1070**	**12'%0**
75-85	**20**	**18**	**19**
85+	**29**	**29**	**29**
Males			
65-74	**19**	**16**	**21**
75-85	**30**	**31**	**33**
85+	**43**	**44**	**46**
Females			
65-74	**10**	**8**	**10**
75-85	**17**	**14**	**16**
85+	**27**	**26**	**26**

SOURCE U S Department of Health and Human Services, Health Care Financing Administration, *Special Report,* Vol 3, June 1990

specific mortality in the study. [19] Research currently being conducted at the University of Maryland School of Medicine and the Dartmouth Medical School will eventually provide better information than is currently available about the relationship between type of treatment and mortality for hip fracture patients.

The timing of surgery may affect long-term mortality. One study of 406 hip fracture patients treated in a Boston hospital between 1971 and 1977 found that 23 percent of the 96 subjects who received surgery on their first hospital day died by six months post-fracture, and 34 percent died by one year post-fracture (62). In contrast, only 4 to 5 percent of the 268 patients who received surgery on their second, third, or fourth hospital day died by six months post-fracture, and only 5 to 6 percent died by one year post-fracture. Surgical delay past the fourth hospital day was associated with increased mortality in this study. Another study of 323 hip fracture patients found that delaying surgery past the second hospital day was associated with increased mortality at one year post-fracture (1 12).

It has been suggested that mortality following a hip fracture might be reduced if procedures were implemented to identify delirium or acute confusional state in elderly hip fracture patients and treat its causes (38,79,83). One attempt to implement such procedures in Sweden resulted in reduced incidence of acute confusional state, but no change in mortality (37).

With the implementation of PPS in late 1983, concerns were expressed about the impact of shorter hospital lengths of stay on outcomes for elderly patients, including hip fracture patients. Several of the studies listed in table B-1 were designed to compare mortality and other outcomes for hip fracture patients before and after the implementation of PPS. The largest of these studies,

[19] HCFA data for Medicare beneficiaries who received a total hip replacement show much lower one-year mortality than for those who received a partial hip replacement or reduction and internal fixation. The data for beneficiaries who received a total hip replacement are not broken out by patient diagnosis, however, so it is not possible to compare mortality for hip fracture patients who received a total hip replacement versus either of the other two types of treatment.

TABLE 15: OTA's Estimate of the Proportion of Hip Fracture Patients Age 50 and Over Who Die of Any Cause by One-Year Post-Fracture

Age	All hip fracture patients	Male hip fracture patients	Female hip fracture patients
50-64	*	•	7%
65-74	14Y0	22%	10
75-84	21	34	17
85+	31	48	28
Totals	24	36	21

● Data not available to determine these proportions.

SOURCE. Off Ice of Technology Assessment, 1993.

which compared outcomes for 4,368 Michigan residents with a Medicare-covered hip fracture before and after the implementation of PPS found no significant difference in mortality at 30 days, three months, or one year post-fracture (103).

Another study, which compared outcomes for 2,762 hip fracture patients treated in 297 hospitals in five states between 1981 and 1986, found no significant difference in mortality at 30-days post-fracture and a decrease in mortality at six months post-fracture from 17.9 percent in the pre-PPS period to 14.8 percent in the post-PPS period (51). Likewise, a study of hip fracture patients in one hospital found a 2 percent decrease in mortality at six months from the pre-PPS period to the post-PPS period (95).

In contrast, three studies, each conducted in a single hospital, found an increase in mortality in the post-PPS period: one study found a 3 percent increase in mortality at six months (28); the second study found a 5 percent increase in mortality atone year (29); and the third study found an 8 percent increase in mortality at one year, but this difference was not statistically significant (32).

| OTA's Estimate of Average Long-Term Mortality

Table 15 shows OTA's estimate of all-cause mortality for hip fracture patients atone year post-fracture by patient age and gender. The figures are based primarily on the results of the New England study (see table 11). For female hip fracture patients age 50 to 64 and 65 to 74, OTA used the figure from the Kaiser Permanente Health Plan Study (see table 12). OTA is not aware of data on mortality at one year post-fracture for all hip fracture patients age 50 to 64 or for male hip fracture patients age 50 to 64.

The figures in table 15 represent all-cause mortality for hip fracture patients, not just mortality specifically attributable to the fracture. To understand the true impact of hip fracture on long-term mortality, it is important to determine the proportion of observed mortality that is in excess of expected mortality given the age, sex, race, general physical condition, and coexisting illnesses of the patients.

Table 16 shows age- and gender-specific mortality for 1988 for persons over age 45. A comparison of the 1988 mortality figures for males in table 16 and the mortality figures for male hip fracture patients at one year post-fracture in table 15 indicates that mortality is 18 percent higher for male hip fracture patients age 65 to 74,26 percent higher for male hip fracture patients age 75 to 84, and 30 percent higher for male hip fracture patients age 85 and over. A similar comparison of the 1988 mortality figures for females in table 16 and the mortality figures for female hip fracture patients at one year post-fracture in table 15 indicates that mortality is 6 percent higher for female hip fracture patients age 50 to 64, 8 percent higher for female hip fracture patients age 65 to 74,

TABLE 16: Age-Specific Mortality from All Causes, 1988

Age	All persons	All males	All females
45-54	1%	1%	>1%
55-64	1	2	1
65-74	3	4	2
75-84	6	8	5
85+	16	18	14

SOURCE U S Department of Health and Human Services, *Health United States 1991,* May 1992