

Based on the CIMDRG investigation and published data from other investigations,¹⁵⁻¹⁸ we calculated mortality rates for unpreventable and preventable deaths by number of obstetricians per facility type and mortality rates for the subset of preventable maternal deaths due to hemorrhage that occurred during the critical period of death preventability (onset of serious symptoms to the time of inevitable death, ie, apnea or cardiac arrest, or actual death). Finally, we examined the distribution of maternal deaths by characteristics of the facility rendering treatment during the critical period of death preventability (ie, the number of obstetricians and anesthesiologists and availability of laboratory services). Because the current analysis accounted for the entire population of cases, we did not perform inferential statistical calculations.

RESULTS

Based on the ICD-9 classification system,¹⁴ there were 230 maternal deaths between January 1, 1991, and December 31, 1992, with 115 deaths in each year. Ninety percent of the deceased were married, and 96% were Japanese nationals. The deaths were distributed throughout Japan. Mortality increased exponentially for women aged 35 years and older (TABLE 1). For 197 deaths (85.7%), at least 1 medical facility where the patient received care participated in the investigation. Twenty-two of the deceased (9.6%) never sought medical care for their pregnancy and died outside a medical facility. We could not investigate 11 deaths (4.8%) because 3 facilities refused participation; 5 had no patient records; and 3 were closed.

Of 327 medical facilities contacted, 312 (95%; 81 clinics with beds, 57 university hospitals, 67 public hospitals, 106 private hospitals, and 1 midwife's maternity home) where the 197 women received care participated. Of the 15 nonparticipating facilities that transferred patients, 7 refused participation, and 8 had closed. Participating facility categories included 82 nontransferring facilities (26%); 115 trans-

ferring medical facilities (37%); and 115 receiving medical facilities (37%) (TABLE 2). Maternal death distribution by timing relative to delivery was 84 predelivery deaths (43%), 61 post-delivery deaths (31%), and 52 deaths without delivery (26%). Of these maternal deaths, 104 (53%) occurred in receiving facilities after the woman was transferred once from a transferring facility and 12 (6%) occurred in receiving facilities after the woman was transferred 2 or more times.

Transferring facilities were the smallest (mean [SD] number of general beds, 105.8 [214.8]), nontransferring facilities (mean [SD] number of general beds, 316.4 [266.3]) were intermediate in size, and receiving facilities were the largest (mean [SD] number of general beds, 576.9 [295.0]). Both the total [SD] number of deliveries (transferring, 358.8 [357.5]; nontransferring, 502.1 [433.4]; and receiving facilities, 529.2 [311.7]) and cesarean delivery rate (transferring, 38.1 [51.8], nontransferring, 60.5 [59.4]; and receiving facilities, 80.4 [57.2]) increased in a similar pattern. Few transferring facilities had intensive

care services, and physicians' estimations of the length of time from decision to perform cesarean delivery until incision of the abdomen for all patients treated in their facilities was 9 to 16 minutes longer in transferring than receiving facilities other than university hospitals. There was a very large SD in length of time until cesarean delivery, particularly on weekends and holidays.

There was a precipitous decrease in on-duty (staff available in the hospital) obstetricians, anesthesiologists, operating room nurses, and neonatologists in all facilities during weekends and evenings (TABLE 3). There were differences in on-duty staff within each facility group when university and non-university hospitals were compared. For example, in receiving facilities, the mean (SD) number of obstetricians was 16.6 (6.8) and 4.4 (3.5) for university and nonuniversity hospitals, respectively. The trend for fewer staff in non-university hospitals was seen for anesthesiologists, operating room nurses, and neonatologists. At night and on weekends or holidays, the mean (SD) number of on-duty obstetricians was 1.9

Table 1. Maternal Mortality Rate per 100 000 Live Births by Maternal Age, Japan, 1991-1992

Age, y	Maternal Deaths, No.	Total No. of Live Births	Maternal Deaths per 100 000 Live Births	Relative Risk of Maternal Mortality*
≤19	2	36 835	5.4	0.57
20-24	19	405 742	4.7	0.45
25-29	64	1 065 305	6.0	0.49
30-34	68	714 823	9.5	1.01
35-39	45	183 821	24.5	2.98
40-44	29	25 100	115.5	13.85
≥45	3	553	542.5	58.43
Total	230	2 432 179	9.5	NA

*Risk is for respective age group vs all others. NA indicates not applicable.

Table 2. Types of Medical Facilities by Number of Maternal Deaths, Japan, 1991-1992*

Type of Medical Facility	Nontransferring (n = 82)	Transferring (n = 115)	Receiving (n = 115)	Total, No. (%) (N = 312)†
Clinic with beds	13	65	3	81 (26)
University hospital	11	5	41	57 (18)
Other hospital	58	44	71	173 (55)
Midwives' maternity home	0	1	0	1 (<1)

*Nontransferring indicates medical facilities where patients were never transferred; transferring, medical facilities that transferred patients to receiving facilities; and receiving, medical facilities where the patients ultimately died after transfer from a transferring facility.

†Percentages do not sum to 100% because of rounding.