

Online Supplement

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eTable 1: Characteristics of patients who survive a hospitalization with acute kidney injury after elective and urgent surgery

	Elective surgery N=48,920	Urgent surgery N=11,142
Demographic and social factors		
Age (years), mean (SD)	69.4 (15.1)	69.8 (14.4)
Women, n (%)	19664 (40.2)	4461 (40.0)
Rural residence, n (%)	5301 (10.8)	1225 (11.0)
Place of residence prior to index hospitalization, n (%)		
Community	45838 (93.7)	10391 (93.3)
Rehabilitation facility	374 (0.8)	96 (0.9)
Complex continuing care	189 (0.4)	32 (0.3)
Nursing home	2519 (5.1)	623 (5.6)
Income quintile, n (%)		
1 (lowest income)	11567 (23.6)	2650 (23.8)
2	10505 (21.5)	2390 (21.5)
3	9577 (19.6)	2169 (19.5)
4	9059 (18.5)	2120 (19.0)
5 (highest income)	8212 (16.8)	1813 (16.3)
Comorbidities n, (%)		
Myocardial infarction	3506 (7.2)	949 (8.5)
Coronary artery disease	17772 (36.3)	4529 (40.6)
Congestive heart failure	13027 (26.6)	3606 (32.4)
Hypertension	35178 (71.9)	8211 (73.7)
Diabetes	21093 (43.1)	5279 (47.4)
Cancer	8969 (18.3)	2470 (22.2)
Chronic liver disease	4361 (8.9)	1469 (13.2)
Peripheral vascular disease	1887 (3.9)	540 (4.8)
Cerebrovascular disease	2120 (4.3)	573 (5.1)
Dementia	6055 (12.4)	1406 (12.6)
Chronic kidney disease	10907 (22.3)	2970 (26.7)
Chronic lung disease	16094 (32.9)	4185 (37.6)
Gastrointestinal bleed	2656 (5.4)	847 (7.6)

	Elective surgery N=48,920	Urgent surgery N=11,142
Human immunodeficiency virus	242 (0.5)	54 (0.5)
Healthcare utilization in the year prior to a hospitalization with acute kidney injury, mean (SD)		
Number of outpatient physician visits	25.4 (22.2)	30.1 (24.8)
Number of hospital admissions	0.6 (1.1)	0.9 (1.5)
Characteristics of index hospitalization, n (%)		
Teaching hospital	16979 (34.7)	3976 (35.7)
Rural hospital	3139 (6.4)	713 (6.4)
Cardiac surgery	2406 (4.9)	499 (4.5)
Abdominal aortic aneurysm repair	451 (0.9)	69 (0.6)
Mechanical ventilation	13339 (27.3)	2627 (23.6)
Chemotherapy administration	840 (1.7)	304 (2.7)
Sepsis	10656 (21.8)	2143 (19.2)
Nephrology consultation	18905 (38.6)	4348 (39.0)
Renal replacement therapy	4824 (9.9)	940 (8.4)
Length of stay (days), median (25 th , 75 th percentile)	15 (8-30)	15 (9-28)
Discharged from hospital on renal replacement therapy, n (%)	2508 (5.1)	720 (6.5)
Site of care after hospital discharge, n (%)		
Community	40223 (82.2)	9625 (86.4)
Rehabilitation facility	754 (1.5)	133 (1.2)
Complex continuing care	4155 (8.5)	545 (4.9)
Nursing home	3788 (7.7)	839 (7.5)

eTable 2: Causes of death after hospital discharge stratified by time of death

	Death ≤ 90 days (n=21,647)	Death 91-365 days (n=17,913)	Standardized difference (%)^a
All cardiovascular, n (%)	5924 (27.4)	5169 (28.9)	3
Ischemic heart disease	3350 (56.5)	2955 (57.2)	3
Cerebrovascular	644 (10.8)	579 (11.2)	1
Heart failure	607 (10.2)	492 (9.5)	0
Valvular	279 (4.7)	203 (3.9)	1
Arrhythmia	241 (4.1)	221 (4.3)	1
Other cardiovascular	803 (13.5)	719 (13.9)	2
All cancer, n (%)	6040 (27.9)	4886 (27.3)	1
Lung	760 (12.6)	610 (12.5)	1
Colorectal	639 (10.6)	586 (12.0)	2
Leukemia	643 (10.6)	569 (11.6)	1
Prostate	559 (9.2)	625 (12.8)	5
Bladder	508 (8.4)	456 (9.3)	1
Gynecologic	409 (6.8)	322 (6.6)	1
Lymphoma	365 (6.0)	290 (5.9)	1
Liver/biliary	319 (5.3)	168 (3.4)	5
Breast	278 (4.6)	178 (3.6)	3
Pancreas	263 (4.3)	167 (3.4)	3
Kidney	218 (3.6)	176 (3.6)	0
Stomach	139 (2.3)	94 (1.9)	2
Oral cavity/pharyngeal	78 (1.3)	57 (1.2)	1
Esophagus	74 (1.2)	67 (1.4)	1
Other cancer	193 (3.2)	165 (3.4)	1
Unknown primary	595 (9.8)	356 (7.3)	5
All infectious, n (%)	1768 (8.2)	1429 (8.0)	1
Respiratory	514 (29.1)	436 (30.5)	3
Abdominal	485 (27.4)	308 (21.6)	14

	Death ≤ 90 days (n=21,647)	Death 91-365 days (n=17,913)	Standardized difference (%)^a
Sepsis	308 (17.4)	306 (21.4)	10
Kidney/genitourinary	235 (13.3)	184 (12.9)	1
Cardiac	113 (6.4)	76 (5.3)	5
Neurologic	14 (0.8)	7 (0.5)	4
Other infectious	99 (5.6)	112 (7.8)	9
Other, n (%)	7738 (35.7)	6258 (34.9)	2
Neurologic/dementia	1568 (20.3)	913 (14.6)	9
Digestive diseases	1253 (16.2)	929 (14.8)	3
Diabetic complications	1085 (14.0)	1078 (17.2)	4
Chronic lung disease	966 (12.5)	976 (15.6)	5
Suicide/accident	466 (6.0)	428 (6.8)	2
Other	2400 (31.0)	1934 (30.9)	1
Missing, n (%)	177 (0.8)	171 (1.0)	1

^aAn absolute standardized difference >10% represents meaningful imbalance

eTable 3: Distribution of causes of death and standardized mortality ratios (SMRs) after a hospitalization with acute kidney injury requiring dialysis and acute kidney injury not requiring dialysis

Cause of death	Dialysis-Requiring AKI		AKI not Requiring Dialysis	
	No. of death (%) (n=1654)	Standardized mortality ratio (95% CI)	No. of deaths (%) (n=37,906)	Standardized mortality ratio (95% CI)
All cardiovascular	348 (21.0)	6.85 (6.15-7.59)	10745 (28.3)	5.78 (5.67-5.89)
Valvular	18 (5.2)	13.37 (7.92-20.22)	464 (4.3)	8.69 (7.92-9.50)
Heart failure	24 (6.9)	9.16 (5.87-13.18)	1075 (10.0)	9.39 (8.83-9.95)
Ischemic heart disease	216 (62.1)	7.51 (6.54-8.55)	6089 (56.6)	6.12 (5.97-6.28)
Other cardiovascular	54 (15.5)	7.25 (5.45-9.31)	1468 (13.7)	5.32 (5.06-5.60)
Arrhythmia	11 (3.2)	4.97 (2.48-8.31)	451 (4.2)	4.82 (4.38-5.27)
Cerebrovascular	25 (7.2)	2.97 (1.92-4.24)	1198 (11.1)	3.67 (3.46-3.88)
Cancer	509 (30.8)	10.15 (9.28-11.05)	10417 (27.5)	7.79 (7.64-7.94)
Leukemia	115 (22.6)	39.84 (32.89-47.44)	1097 (10.5)	14.07 (13.25-14.92)
Bladder	54 (10.6)	31.66 (23.78-40.64)	910 (8.7)	17.79 (16.65-18.97)
Gynecologic	31 (6.1)	21.92 (14.89-30.29)	700 (6.7)	16.66 (15.45-17.91)
Kidney	24 (4.7)	19.87 (12.73-28.57)	370 (3.6)	11.73 (10.56-12.95)
Lymphoma	39 (7.7)	19.42 (13.81-25.97)	616 (5.9)	11.60 (10.70-12.53)
Prostate	59 (11.6)	13.65 (10.39-17.35)	1125 (10.8)	8.75 (8.25-9.27)
Liver/biliary	19 (3.7)	10.21 (6.15-15.29)	468 (4.5)	10.25 (9.34-11.19)
Colorectal	43 (8.4)	7.68 (5.55-10.14)	1182 (11.3)	7.42 (7.00-7.85)
Pancreas	18 (3.5)	6.81 (4.03-10.30)	412 (3.9)	5.91 (5.36-6.50)
Unknown primary	32 (6.3)	6.78 (4.64-9.33)	919 (8.8)	6.64 (6.22-7.08)
Breast	14 (2.8)	6.50 (3.55-10.33)	442 (4.2)	6.37 (5.79-6.97)
Stomach	7 (1.4)	4.93 (1.98-9.20)	226 (2.2)	6.01 (5.25-6.82)
Other cancer	11 (2.2)	3.78 (1.89-6.33)	347 (3.3)	4.72 (4.24-5.23)
Esophagus	Suppressed ^a	3.64 (1.17-7.46)	136 (1.3)	4.19 (3.52-4.920)
Lung	37 (7.3)	2.89 (2.04-3.90)	1333 (12.8)	4.43 (4.20-4.67)
Oral cavity/pharyngeal	Suppressed ^a	0.87 (0.01-3.18)	134 (1.3)	5.01 (4.20-5.89)
All infectious	146 (8.8)	15.02 (12.69-17.56)	3051 (8.0)	8.05 (7.76-8.34)

Cardiac	12 (8.2)	31.31 (16.16-51.36)	177 (5.8)	13.59 (11.66-15.67)
Other infectious	13 (8.9)	24.45 (13.00-39.42)	198 (6.5)	12.10 (10.47-13.84)
Abdominal	33 (22.6)	20.65 (14.21-28.26)	760 (24.9)	13.20 (12.28-14.16)
Sepsis	29 (19.9)	15.47 (10.36-21.59)	585 (19.2)	8.74 (8.05-9.46)
Kidney/genitourinary	12 (8.2)	11.44 (5.90-18.76)	407 (13.3)	8.95 (8.10-9.84)
Neurologic	Suppressed ^a	11.00 (0.14-40.35)	20 (0.7)	9.49 (5.79-14.08)
Respiratory	46 (31.5)	10.98 (8.04-14.37)	904 (29.6)	5.09 (4.76-5.43)
Other	639 (38.6)	11.24 (10.39-12.13)	13357 (35.2)	6.39 (6.28-6.50)
Other	306 (47.9)	25.12 (22.39-28.02)	4028 (30.1)	9.36 (9.08-9.66)
Diabetic complications	140 (21.9)	23.19 (19.51-27.19)	2023 (15.1)	10.77 (10.31-11.24)
Digestive diseases	99 (15.5)	15.77 (12.81-19.02)	2083 (15.6)	10.34 (9.90-10.78)
Suicide/accident	48 (7.5)	7.03 (5.18-9.15)	846 (6.3)	3.64 (3.39-3.88)
Chronic lung disease	38 (5.9)	3.62 (2.56-4.86)	1904 (14.2)	5.50 (5.25-5.75)
Neurologic/dementia	8 (1.3)	0.53 (0.23-0.96)	2473 (18.5)	3.57 (3.43-3.71)

^aEvents with small numbers are suppressed to comply with the privacy policy of the Institute for Clinical Evaluative Sciences

eTable 4: Distribution of causes of death and standardized mortality ratios (SMRs) after a hospitalization with acute kidney injury

Cause of death	No. of deaths (%) (n=39,560)	Standardized mortality ratio (95% CI)
All cardiovascular	11,093 (28.0)	5.81 (5.70-5.92)
Heart failure	1099 (9.9)	9.38 (8.83-9.94)
Valvular	482 (4.3)	8.81 (8.04-9.61)
Ischemic heart disease	6305 (56.8)	6.16 (6.01-6.32)
Other cardiovascular	1522 (13.7)	5.37 (5.11-5.65)
Arrhythmia	462 (4.2)	4.82 (4.39-5.27)
Cerebrovascular	1223 (11.0)	3.65 (3.45-3.86)
Cancer	10,926 (27.6)	7.87 (7.72-8.02)
Bladder	964 (8.8)	18.24 (17.10-19.41)
Gynecologic	731 (6.7)	16.83 (15.63-18.07)
Leukemia	1212 (11.1)	14.99 (14.16-15.85)
Kidney	394 (3.6)	12.03 (10.87-13.24)
Lymphoma	655 (6.0)	11.88 (10.99-12.81)
Liver/biliary	487 (4.4)	10.24 (9.35-11.17)
Prostate	1184 (10.8)	8.91 (8.41-9.43)
Colorectal	1225 (11.2)	7.43 (7.02-7.85)
Unknown primary	951 (8.7)	6.65 (6.23-7.08)
Breast	456 (4.2)	6.37 (5.80-6.97)
Stomach	233 (2.1)	5.97 (5.23-6.76)
Pancreas	430 (3.9)	5.95 (5.40-6.52)
Oral cavity/pharyngeal	135 (1.2)	4.84 (4.06-5.69)
Other cancer	358 (3.3)	4.69 (4.22-5.19)
Lung	1370 (12.5)	4.37 (4.14-4.60)
Esophagus	141 (1.3)	4.17 (3.51-4.88)
All infectious	3197 (8.1)	8.22 (7.94-8.51)
Cardiac	189 (5.9)	14.10 (12.16-16.18)
Abdominal	793 (24.8)	13.41 (12.49-14.35)

Cause of death	No. of deaths (%) (n=39,560)	Standardized mortality ratio (95% CI)
Other infectious	211 (6.6)	12.49 (10.86-14.23)
Neurologic	21 (0.7)	9.55 (5.91-14.05)
Kidney/genitourinary	419 (13.1)	9.00 (8.16-9.89)
Sepsis	614 (19.2)	8.92 (8.23-9.64)
Respiratory	950 (29.7)	5.22 (4.90-5.56)
Other	13,996 (35.4)	6.52 (6.41-6.62)
Diabetic complications	2163 (15.5)	11.16 (10.69-11.63)
Digestive diseases	2182 (15.6)	10.50 (10.06-10.95)
Other	4334 (30.9)	9.80 (9.51-10.09)
Chronic lung disease	1942 (13.9)	5.44 (5.20-5.69)
Suicide/accident	894 (6.4)	3.73 (3.49-3.98)
Neurologic/dementia	2481 (17.7)	3.51 (3.37-3.65)

eTable 5: Association of patient and hospital characteristics with 90-day all-cause mortality

Characteristic	Hazard ratio (95% CI)	
	Unadjusted	Adjusted
Demographic and social factors		
Age (years)		
≤20	1.00 [referent]	1.00 [referent]
21-30	0.82 (0.45-1.53)	0.80 (0.43-1.48)
31-40	1.44 (0.81-2.55)	1.31 (0.74-2.32)
41-50	2.80 (1.62-4.86)	2.38 (1.37-4.12)
51-60	3.95 (2.29-6.82)	3.29 (1.91-5.69)
61-70	4.84 (2.81-8.35)	3.94 (2.28-6.80)
71-85	7.26 (4.21-12.49)	5.04 (2.92-8.69)
≥86	12.60 (7.31-21.70)	7.32 (4.25-12.63)
Female (versus male)	1.03 (1.00-1.05)	0.89 (0.86-0.91)
Rural residence (versus population > 10,000)	1.02 (0.97-1.06)	1.16 (1.12-1.21)
Place of residence prior to index hospitalization		
Community	1.00 [referent]	1.00 [referent]
Rehabilitation facility	0.87 (0.73-1.04)	0.99 (0.82-1.21)
Continuing complex care	2.63 (2.27-3.05)	2.31 (1.99-2.68)
Nursing home care	3.21 (3.11-3.31)	2.91 (2.79-3.03)
Comorbidities		
Coronary artery disease	1.18 (1.15-1.21)	0.96 (0.94-0.99)
Congestive heart failure	1.52 (1.48-1.56)	1.19 (1.16-1.23)
Hypertension	1.02 (0.99-1.05)	0.79 (0.77-0.82)
Diabetes	0.89 (0.87-0.91)	0.89 (0.86-0.91)
Cancer	1.78 (1.73-1.83)	1.61 (1.56-1.66)
Chronic liver dysfunction	1.48 (1.42-1.54)	1.66 (1.59-1.73)
Cerebrovascular disease	1.33 (1.27-1.40)	0.92 (0.88-0.97)
Dementia	2.16 (2.10-2.22)	1.11 (1.07-1.14)
Chronic lung disease	1.12 (1.09-1.15)	0.97 (0.95-1.00)
Healthcare utilization in the year prior to hospitalization with		

Characteristic	Hazard ratio (95% CI)	
	Unadjusted	Adjusted
acute kidney injury		
Number of outpatient physician visits		
≤10	1.00 [referent]	1.00 [referent]
11-20	1.39 (1.33-1.45)	1.14 (1.09-1.20)
21-30	1.62 (1.55-1.69)	1.24 (1.18-1.30)
31-40	1.82 (1.74-1.92)	1.30 (1.23-1.37)
41-50	2.09 (1.98-2.21)	1.35 (1.27-1.43)
51-60	2.50 (2.36-2.65)	1.45 (1.35-1.55)
≥61	2.71 (2.58-2.85)	1.45 (1.36-1.54)
Number of hospitalizations		
0	1.00 [referent]	1.00 [referent]
1	1.45 (1.40-1.49)	1.14 (1.10-1.18)
≥2	1.74 (1.69-1.80)	1.29 (1.24-1.34)
Characteristics of index hospitalization		
Cardiac surgery	0.28 (0.24-0.34)	0.41 (0.34-0.49)
Aortic aneurysm surgery	0.46 (0.33-0.64)	0.64 (0.46-0.89)
Mechanical ventilation	0.66 (0.63-0.69)	0.86 (0.82-0.90)
Chemotherapy administration	1.70 (1.55-1.86)	1.67 (1.51-1.84)
Sepsis	1.00 (0.97-1.04)	0.95 (0.91-0.99)
Renal replacement therapy use		
None needed	1.00 [referent]	1.00 [referent]
Needed during AKI hospitalization only	0.73 (0.67-0.80)	0.98 (0.90-1.08)
Needed during AKI hospitalization and after hospital discharge	0.67 (0.61-0.74)	0.87 (0.78-0.96)
Length of Stay (in days)		
≤5	1.00 [referent]	1.00 [referent]
6-10	1.26 (1.21-1.30)	1.13 (1.08-1.17)
11-15	1.57 (1.51-1.64)	1.40 (1.34-1.46)
16-20	1.71 (1.63-1.79)	1.53 (1.45-1.60)
≥21	1.67 (1.61-1.74)	1.46 (1.40-1.53)

Characteristic	Hazard ratio (95% CI)	
	Unadjusted	Adjusted
Site of care after hospital discharge		
Same as pre-hospitalization	1.00 [referent]	1.00 [referent]
Community site pre-hospitalization to rehabilitation/complex continuing care/nursing home post-hospitalization	2.36 (2.29-2.44)	2.30 (2.21-2.38)
Rehabilitation/complex continuing care/nursing home pre-hospitalization to community site post-hospitalization	1.48 (1.34-1.63)	0.59 (0.53-0.66)

eTable 6: International Classification of Diseases, Ninth Revision codes used to define causes of death

Cause of Death	ICD-9 Diagnosis Code^a
<i>All Cardiovascular</i>	
Arrhythmia	426, 427, 785.0
Cerebrovascular	362.3, 430, 431, 432, 434.0, 434.1, 434.9, 435, 436
Heart failure	428
Ischemic heart disease	410-414, 429.6, 429.7
Valvular	394, 395, 396, 397.0, 397.1, 424.0, 424.1, 424.2, 424.3
Other cardiovascular	401, 402, 404, 405, 424.9, 425, 429.1, 429.2, 429.3, 429.4, 429.5, 429.8, 429.9, 433, 437, 438, 440, 441, 442, 443.1, 443.81, 443.89, 443.9, 444, 996.0, V45.0, V53.3
<i>All Cancer</i>	
Bladder	188, 223.2, 223.3
Breast	174, 175, 217
Colorectal	153, 154, 211.3, 211.4
Esophagus	150, 211.0
Gynecologic	179-184, 218-221
Kidney	189, 223.0, 223.1
Leukemia	203-208
Liver/biliary	155, 156, 211.5
Lung	162, 163, 212.2-212.4
Lymphoma	200-202
Oral cavity/pharyngeal	140-149, 160, 161, 210, 212.0, 212.1
Pancreas	157, 211.6, 211.7
Prostate	185, 222.2
Stomach	151, 211.1
Unknown primary	159, 165, 195-199, 229
Other cancer	152, 158, 164, 170-173, 176, 186, 187, 190-194, 209, 211.2, 211.8, 211.9, 212.5-212.9, 213-216, 222.0, 222.1, 222.3-222.9, 223.8, 223.9, 224-228
<i>All Infectious</i>	
Abdominal	001-009, 070, 540-543, 572.0, 574-576
Cardiac	397.9, 420-422, 424.9
Kidney/genitourinary	090-099, 590, 599.0

Cause of Death	ICD-9 Diagnosis Code^a
Neurologic	036, 045-049, 062-064, 320-324
Respiratory	010-012, 033, 460-466, 475, 480-488, 510, 513
Sepsis	038
Other infectious	013-018, 020-027, 030-032, 034, 035, 037, 039, 040-044, 050-059, 060, 061, 065, 066, 071-079, 080-088, 100-129, 130-134, 136.0, 136.2, 136.3, 136.4, 136.5, 136.8, 136.9, 137-139, 681-686
<i>Other Causes</i>	
Chronic lung disease	416.8, 416.9, 491-496, 500-505, 506.4, 506.9, 508.1, 515-517, 518.5, 518.8, 519.8, 519.9
Diabetic complications	250, 251.0, 251.1, 251.2
Digestive diseases	520-539, 550-569, 570, 571, 572.1, 572.2, 572.3, 572.4, 572.8, 573, 577-579, 997.4
Neurologic/dementia	290, 294.1, 294.8, 294.9, 325-327, 330-337, 742, 780.5, 784.0, 797, 997.0
Suicide/accident	E000-E030, E800-E899, E900-E999
Other	Any other ICD-9 diagnosis code not listed above

^aIf a higher-level code is listed, all lower-level codes are also included