QUERI

Evidence Brief: Effects of Small Hospital Closure on Patient Health Outcomes

SUPPLEMENTAL MATERIALS

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Prepared for:
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SEARCH STRATEGIES

PubMed Search (March 6th 2013)

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#24	Search **(#22) OR #23**
#23	Search **(hospital[Title]) OR hospitals[Title]**
#22	Search **(((“Hospital Bed Capacity, under 100”[Mesh]) OR (“Hospitals, Low-Volume”[Mesh] OR “Hospitals, Satellite”[Mesh] OR “Hospitals, Veterans”[Mesh])) OR “Hospitals, Public”[Mesh]) OR “Hospitals, Rural”[Mesh]**
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Ovid MEDLINE and OLDMEDLINE (1946 to March Week 4 2013)

Search	Query
#1	*Health Facility Closure/
#2	*Health Services Accessibility/
#3	1 and 2
#4	Limit 3 to English

PubMed related records searches on the following articles (March 6th 2013):

1. Bindman AB, Keane D, Lurie N. A public hospital closes. Impact on patients’ access to care and health status. *JAMA.* Dec 12 1990;264(22):2899-2904.
2. Buchmueller TC, Jacobson M, Wold C. How far to the hospital? The effect of hospital closures on access to care. *J Health Econ.* 2006;25(4):740-761.

Forward citation searching of the following articles via Google Scholar and Scopus (March 7, 2013)

1. Bindman AB, Keane D, Lurie N. A public hospital closes. Impact on patients’ access to care and health status. *JAMA.* Dec 12 1990;264(22):2899-2904.
2. Buchmueller TC, Jacobson M, Wold C. How far to the hospital? The effect of hospital closures on access to care. *J Health Econ.* 2006;25(4):740-761.
3. Hemmelgarn BR, Ghali WA, Quan H. A case study of hospital closure and centralization of coronary revascularization procedures. *CMAJ.* 2001;164(10):1431-1435.
4. Liu L, Hader J, Brossart B, White R, Lewis S. Impact of rural hospital closures in Saskatchewan, Canada. *Social Science and Medicine.* 2001;52(12):1793-1804.

LIST OF EXCLUDED STUDIES (No original data or no health outcomes reported)

1. AIexander JA, Succi MJ. State legislation and policy affecting rural hospital conversion and closure. *J Rural Health.* 1996;12(5):410-422.
2. Aldrich RR. The merger and closing of an urban hospital. *Case Stud Health Adm.* 1978;1:269-274.
3. Barnett JR. Rationalising hospital services: reflections on hospital restructuring and its impacts in New Zealand. *N Z Geog.* 2000;56(1):5-21.
4. Barnett R, Barnett P. "If you want to sit on your butts you'll get nothing!" Community activism in response to threats of rural hospital closure in southern New Zealand. *Health Place.* 2003;9(2):59-71.
5. Bazzoli GJ, Lee W, Hsieh H-M, Mobley LR. The effects of safety net hospital closures and conversions on patient travel distance to hospital services. *Health Serv Res.* 2012;47(1 PART 1):129-150.
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7. Bolton P, Thompson L. The reasons for, and lessons learned from, the closure of the Canterbury GP After-Hours Service. *Aust Health Rev.* 2001;24(3):66.
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9. Brownell MD, Shapiro E, Roos NP. Re "A critique of an evaluation of the impact of hospital bed closures in Winnipeg, Canada: lessons to be learned from evaluation research methods" by Evelyn Vingilis and Jacquelyn Burkell. *J Public Health Policy.* 1997;18(4):469-471; author reply 472-464.
10. Burda D. Hospital closures aren't closing off access to care. *Mod Healthc.* 1992;22(27):18-20.
11. Burkey ML, Bhadury J, Eiselt HA. A location-based comparison of health care services in four U.S. states with efficiency and equity. *Socio-Economic Planning Sciences.* 2012;46(2):157-163.
12. Capps C, Dranove D, Lindrooth RC. Hospital closure and economic efficiency. *J Health Econ.* 2010;29(1):87-109.
13. Caro FG, Glickman LL, Ingegneri D, Porell F, Stern AL, Verma K. The impact of the closing of three Massachusetts public chronic disease hospitals: a multidimensional perspective. *J Community Health.* Jun 1997;22(3):155-174.
14. Chatwin AL, Miller M, Asensio J, Kerstein MD. Cause of temporary closure of an inner-city trauma center. *Am Surg.* 1995;61(12):1102-1104.
15. Drain M, Godkin L, Valentine S. Examining closure rates of rural hospitals: an assessment of a strategic taxonomy. *Health Care Manage Rev.* 2001;26(4):27-51.

16. Fleming ST, Williamson Jr HA, Hicks LL, Rife I. Rural hospital closures and access to services. *Hosp Health Serv Adm.* 1995;40(2):247.

17. Goddard K, Burns T, Catty J. The impact of day hospital closure on social networks, clinical status, and service use: a naturalistic experiment. *Community Ment Health J.* Jun 2004;40(3):223-234.

18. Greene J. Study says closure decreased access. *Mod Healthc.* 1990;20(50):2.

19. Hammond L. The closure of Melbourne's Fairfield Hospital. *Aust N Z J Public Health.* Jun 1996;20(3):230-231.

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21. Hart LG, Pirani MJ, Rosenblatt RA. Causes and consequences of rural small hospital closures from the perspectives of mayors. *J Rural Health.* 1991;7(3):222–245.

22. Holmes GM, Slifkin RT, Randolph RK, Poley S. The effect of rural hospital closures on community economic health. *Health Serv Res.* 2006;41(2):467-485.

23. Hsia RY-J, Shen Y-C. Rising closures of hospital trauma centers disproportionately burden vulnerable populations. *Health Aff (Millwood).* 2011;30(10):1912-1920.

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25. Jervis KJ, Goldberg GM, Cutting AC. Inner-city hospital closures: financial decision or impediment to access? *J Health Care Finance.* 2012;38(3):22-39.

26. Jervis KJ, Goldberg GM, Cutting AC. Rights, needs, and equality of opportunity for health care: A financial analysis of morality. *Accounting and the Public Interest.* 2012;12(1):62-86.

27. Klepser DG, Xu L, Ullrich F, Mueller KJ. Trends in community pharmacy counts and closures before and after the implementation of Medicare Part D. *J Rural Health.* 2011;27(2):168-175.

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EVIDENCE TABLES

Data Abstraction of Included Studies

Author Year	Study design N	Closed hospital characteristics	Comparator hospital characteristics	Time period	Patient characteristics	Health outcomes	Data sources	Confounders controlled for in analysis	Results
Bindman 1990	Pre-Post N=219 patients from closed hospital; 195 from comparator hospital	Shasta County General Hospital 73 beds Acute care Public county hospital Semirural area of Northern California	San Luis Obispo County (SLO) Public hospital in a semirural county in central California with comparable urban and rural distribution, total population, physician to population ratio, ethnic mix, and median household income.	Closed 1987 1987-1988	Mean age=49 years 38% male 88% White 32% Medicaid Mean # chronic illnesses: 3.5	Self-reported health status via the Medical Outcomes Study Short Form (MOS-SF): pain, mental health, physical function, health perception, social function, role function. Mortality information from family members and Vital Statistics Registry.	Patient surveys at baseline (just after hospital closed) and 1 year later.	Age, sex, race, work status, insurance status, number of chronic conditions, and baseline response.	Mortality: Shasta=4% vs. SLO=3%, *P*>0.10 MOS-SF: Shasta patients had worse Health Perception (*P*<0.05), Social Function (*P*<0.05), Role Function (*P*<0.05), and Pain (*P*<0.01). But, no significant difference in Physical Function or Mental Health.
Brownell 1999	Pre-Post N NR	Downsizing number of acute beds in Winnipeg hospitals Total acute beds at start of fiscal year (#/% decrease at year-end): 1991=3042 (N/A) 1992=3013 (29/1.0%) 1993=2707 (306/10.2%) 1994=2498 (209/7.7%) 1995=2460 (38/1.5%) 1996=2380 (80/3.3%)	NA	1989-1995	Mortality: Patients hospitalized for acute MI, hip fracture, or cancer surgery Readmissions: Patients treated for 12 medical, surgical, and obstetric categories	Mortality 30, 60, and 90 days from hospital discharge 30-day readmission	Population-based approach used	Age and sex	Mortality rates within 30, 60 and 90 days post-discharge: No statistically significant increases For the subgroup of elderly patients, no increases across the years in mortality. 30-Day Readmission Rates: Only significant increase is for cesarean section in 1995.
Buchmueller 2006	Ecological/Cross Sectional N=23503	Hospitals in the Los Angeles region	Effect of hospital closures through their effect on distance from nearest hospital to outcomes. Compared changes in health among individuals in areas where hospitals closed to changes among otherwise similar individuals in areas where the availability of hospital services remained constant.	1997-2003	Mean age=44 years 56% Male 56% White Household income >75,000 US$: 24% 61% Private Insured Diabetes: 6% Heart Disease: 6% Mean BMI=24.1 Mean self-assessed health (1=excellent, 5=poor): 2.34	Health status, mortality, mortality from heart attacks and unintentional injuries sustained at home.	LA County Health Surveys for health status and zip code (geographic area); death reports from California DHS	For health outcomes (from surveys): income, health insurance coverage, health status, neighborhood characteristics such as number of community health clinics in a zip code and city-level unemployment rates. For deaths: controls for total deaths, deaths by homicide and age distribution of deaths, number of health clinics in a zip code year.	Closures may induce some survival benefit: % change in deaths due to a mile increase in distance to hospital related to closures (per zip code year/ zip code specific time trends): AMI: -11.0%/-22.7% Unintentional injuries, home: -52.7%/-60.8% Chronic heart disease: -2.37%/ -8.13% All cancer: 6.28/9.09

Author Year	Study design N	Closed hospital characteristics	Comparator hospital characteristics	Time period	Patient characteristics	Health outcomes	Data sources	Confounders controlled for in analysis	Results
Curtis 2005	Time series? Sample sizes for within vs. outside St. John's (1995-96/1998-99/2000-01): Acute myocardial infarction (AMI): 202/284 vs. 271/274/280 Community acquired pneumonia(CAP): 226/336/264 vs. 108/122/110 Cerebrovascular accident (CVA): 241/274/175 vs. 85/109/116	Implementation of program-based management, closed hospitals and aggregated services both within and outside of the largest health board of Newfoundland and Labrador (St. John's region)	NA	Regionalization occurred between 1995 and 1997. Evaluated outcomes at the beginning (1995/96), during (1998/99) and shortly after (2000/01) restructuring.	AMI Mean age 68 years 60% male 32% diabetes 16% CHF CAP Mean age 68 years 56% male 21% diabetes 71% Pneumonia Severity Index Class III-V CVA Mean age 71 years 56% male	In-hospital mortality	Data from medical records abstracted by trained research nurses	None	In-hospital mortality rate for hospitals inside vs. outside of St. John's Region (1995-96/1998-99/2000-01): AMI: 14%/12%/NR, *P*=NS vs. 10%/15%/9%, *P*=NS CAP: 9%/11%/10%, *P*=NS vs. 12%/6%/9%, *P*=NS CVA: 22%/20%/20%, *P*=NS vs. 25%/22%/18%, *P*=NS
Hemmelgarn 2001	Pre-Post Before closure: 1053 CABG, 2340 PTCA patients After closure: 1529 CABG, 3099 PTCA patients	Large city hospital in Calgary	After closure, coronary revascularization procedures were amalgamated from 2 facilities into a single facility, including the addition of 2 new coronary catheterization labs and an increased number of postoperative ward beds and monitored step-down beds at the single facility.	July 1994-March 1998 (21 months preceding and 24 months following the March 1996 closure of the hospital)	% patients undergoing CABG or PTCA: Age >65 years: 59%/43% Male: 78%/74% Unstable angina: 50%/36% Recent MI: 24%/40% Chronic pulmonary disease: 16%/7% Diabetes: 16%/14% Congestive heart failure: 22%/8%	For CABG and PTCA, number of discharges per month, burden of comorbidity, length of hospital stay and in-hospital mortality	Calgary Regional Health Authority administrative hospital discharge data	Age, sex, urgency of admission, prior procedures, and comorbidities	Adjusted mean LOS CABG patients: Before closure: 16.1 days After closure: 14.9 days *P*=0.004 PTCA patients Before closure: 5.1 days After closure: 4.1 days *P*<0.001 Adjusted in-hospital rates of death CABG patients: Before closure: 4.6% After closure: 4.3% *P*=0.67 PTCA patients Before closure: 1.8% After closure: 1.9% *P*=0.83
Hsia 2012	Cohort N=785,385 (of which 67,577 experienced an increase in distance to their nearest ED)	Nonfederal hospitals in California (emergency departments only). All admissions for acute MI, stroke, sepsis, and asthma or COPD	Calculated distance from each patient's home to the nearest ED. Compared patients with an increase in distance to the nearest ED during the time period to those without	1999-2009	% patients in age category (years): 18-44=7%, 45-64=26%, 65-74=21%, 75-84=28%, >85=18% 46% male 66% Non-Hispanic White 15% Hispanic 65% Medicare 59% Hypertension 24% Diabetes	Inpatient mortality	Patient-level data from the California Office of Statewide Health and Planning Development Patient Discharge Data. Use data from state to document which hospitals had ED closures. Data on hospital-level characteristics from hospital financial and use reports.	Age, race or ethnicity, sex, and insurance status, comorbidity index to adjust for baseline mortality risk, case mix of each hospital to control for hospital-level differences in patient acuity.	Inhospital mortality for all time-sensitive conditions of patients experiencing stepwise increasing distances to their nearest ED compared with those having no change or a decrease, adjusted OR (95% CI): Increase of <2 miles: 1.04 (0.99 to 1.09) Increase of 2-5 miles: 1.03 (0.91 to 1.16) Increase of >5 miles: 1.09 (0.95 to 1.26) For cause-specific inhospital mortality, only significant increase was for stroke for patients who experienced an increase of >5 miles: 1.22 (1.02 to 1.47) Only 8.6% of patients experienced an increase in distance, and among them the median distance was 0.8 miles (range 0.1 to 33.4 miles).

Author Year	Study design N	Closed hospital characteristics	Comparator hospital characteristics	Time period	Patient characteristics	Health outcomes	Data sources	Confounders controlled for in analysis	Results
Liu 2001	Pre-Post N=47 communities in the closure group with a total population of over 56,000 per year	Saskatchewan communities in which hospitals funded for <8 beds were closed in 1993. Unit of analysis was the communities, not hospital.	Compared closure communities to: 1) rural communities that never had a hospital, 2) rural communities that still have a hospital, and 3) the rest of Saskatchewan	1990-1996	NR	Mortality: overall, premature, and cause-specific (acute MI, motor vehicle injury, and stroke) Hospital use (number of people hospitalized, not number of discharges) Self-reported health status	Saskatchewan Ministry of Health administrative data. Patient surveys and interviews for health status.	Age and sex	All-cause mortality per 100,000 people, 1990-92/1993-96 (change): Communities affected by 1993 hospital closures: 803.1/754.4 (-48.7) Communities still with small hospitals: 853.3/833.1 (-20.1) Communities that never had a hospital: 684.9/651.1 (-33.8) Rest of Saskatchewan: 788.3/774.8 (-13.5) No increases in cause-specific mortality. Closures did not adversely affect health status of residents. Mortality rates declined throughout the province, with largest decreases in the closure communities. Residents self-reported that closures did not adversely affect their health.
Rosenbach 1995	Time series 11 hospitals (3 publicly owned, 4 private non-profits, 4 for-profit)	Rural hospitals in 6 US states 6 had fewer than 50 beds, only 1 had more than 100 beds. Medicare-certified, short-term, general acute-care facilities which closed in either 1986 or 1987. Closure defined as the cessation of inpatient care. Hospitals that converted from acute care to non acute-care status were included, as were mergers that resulted in a conversion to a non-acute-care facility.	Compared outcome measures in the year before closure, the year of closure, and the 2 years following closure. Comparators were Medicare beneficiaries in areas that had no hospital closures, openings, mergers, or conversions during the study period; and those in areas in which there were no hospitals during the entire study period.	1985-1989	NR	Mortality		Age and sex	Number of deaths per 1,000 Medicare beneficiaries for one year before closure/year of closure/1-year post-closure/2-years post-closure/ percent change: Closure: 36.4/38.4/37.6/38.1/ 4.7% No closure: 36.5/36.2/35.9/24.9/ -4.4% No hospital: 33.7/36.7/35.3/34.7/3.0% None of the 4-year trends was statistically significant. Profile analysis shows no significant effects from the closure.

Author Year	Study design N	Closed hospital characteristics	Comparator hospital characteristics	Time period	Patient characteristics	Health outcomes	Data sources	Confounders controlled for in analysis	Results
Shen 2012	Ecological/Cross Sectional N=1.49 million patient-year observations	ED's in the U.S.	Compared effect of ED closures through their effect on driving time to closest ED between 2 groups: 1) people living in zip codes with no increase in driving time and 2) people in zip codes with <10, 10 to 30, or >30 minute increases in driving time.	1995-2005	Acute myocardial infarction: 51% female Mean age 78.54 years 89% White Peripheral vascular disease: 8% Chronic pulmonary disease: 22% Dementia: 4% Chronic renal failure: 2% Diabetes: 27% 76% urban location (range, 17% to 75%) No. of hospitals within 10-mile radius: 2.70 (range, 1.03 to 4.22) Government hospitals: 12%	30-day to 1-year mortality rates	ED availability from American Hospital Association annual surveys Patients' AMI diagnoses, mailing ZIP codes and outcomes from Medicare claims	Subgroup analyses based on differences in baseline access to hospitals	Change in mortality rate at 7 days, 30 days, 180 days, and 1 year by increased drive time for whole sample: <10 min: -0.0002, 0.0029, 0.0046, 0.0061 (P<0.10), 0.0037 10-30 min: -0.0063, -0.0098, -0.0061, -0.0026, -0.0072 >30 min: 0.0172, 0.0123, 0.0258, 0.0449 (P<0.10), 0.0565 (P<0.05) Closest hospital has catheterization lab: -0.0046 (P<0.05), -0.0047 (P<0.05), -0.0034, -0.0026, -0.0036 Subgroup analyses: Patients with ≤2 hospitals within 10-mile radius: Significant increases in mortality across all time points when driving increased by <10 minutes, but not for other groups with higher increases in driving time. But, increases in mortality are transitory, peaking at the time period of 1 year before to 1 year after change and then decreasing beyond initial 3-year window.

Quality Assessment of Included Studies

Author Year	Did the study attempt to enroll all (or a random sample of) patients meeting inclusion criteria, or a random sample (inception cohort)?	Were the groups comparable at baseline on key prognostic factors (e.g., by restriction or matching)?	Did the study use accurate methods for ascertaining exposures and potential confounders?	Were outcome assessors and/or data analysts blinded to the exposure being studied?	Did the article maintain comparable groups (report attrition, contamination, adherence, and cross-over)?	Did the study perform appropriate statistical analyses on potential confounders?	Was there acceptable differential loss to follow-up and or overall high loss to follow-up?	Were outcomes pre-specified and defined, and ascertained using accurate methods?	Quality rating
Bindman 1990	Unclear. Attempted to enroll all patients meeting inclusion criteria. 72% of those in Shasta and 65% of those in the comparison county were contacted and enrolled; those who were not contacted were likely to have moved (and were thus ineligible).	No. Differences between groups on demographic and clinical risk factors.	Unclear. Patient surveys at baseline (just after hospital closed) and 1 year later.	No for health status (self-reported). Unclear for mortality (from vital statistics registry and family members, but no information on blinding of data collectors).	Unclear.	Yes. Age, sex, race, work status, insurance status, number of chronic conditions, and baseline response.	Yes. 88% of Shasta residents and 84% of comparison county residents completed baseline surveys; 87% and 89% of those were followed up.	Yes. Self-reported health status via the Medical Outcomes Study Short Form (MOS-SF): pain, mental health, physical function, health perception, social function, role function. Mortality information from family members and Vital Statistics Registry.	Fair
Brownell 1999	Unclear. Gives inclusion criteria and time frame, but not clear if all eligible were included.	Unclear.	Unclear. Categorized patients by their place of residence, not where they received their care.	Unclear. Mortality and readmission from hospital discharge data; no information on blinding of data collectors.	NA.	No. Age and sex only.	Unclear. No information on missing data.	Unclear. Does not report if outcomes mortality and readmission were prespecified.	Poor
Buchmueller 2006	Unclear. Survey response rates NR.	No. Demographic and socioeconomic differences between groups.	Unclear. Calculated changes in travel distance using zip code data. Accuracy of confounder ascertainment unclear due to use of self-report data without validation.	Unclear. Death reports from California's DHS, but no information on blinding of data collectors.	NA.	Unclear. For health outcomes (from surveys): income, health insurance coverage, health status, neighborhood characteristics such as number of community health clinics in a zip code and city-level unemployment rates. For deaths: controls for total deaths, deaths by homicide and age distribution of deaths, number of health clinics in a zip code year; no adjustment for SES and demographic differences.	Unclear. No information on missing data.	Yes. LA County Health Surveys for health status and zip code (geographic area); death reports from California DHS.	Fair
Curtis 2005	Unclear. All patients meeting criteria were studied, but not all sites contributed to assessment of quality for each area of care.	Unclear. Similar on most characteristics except for differences in smoking history (outside St. John's region) and prior congestive heart failure (St. John's region).	Yes. Trained research nurses collected information from medical records.	Unclear. No information on blinding of data collectors.	NA. Different patient groups compared.	No. No control for confounders.	Unclear. No information on missing data.	Unclear. Used prespecified quality of care indicators specific to diagnosis, but indicators were chosen partly based on availability of collectible data.	Fair

Author Year	Did the study attempt to enroll all (or a random sample of) patients meeting inclusion criteria, or a random sample (inception cohort)?	Were the groups comparable at baseline on key prognostic factors (e.g., by restriction or matching)?	Did the study use accurate methods for ascertaining exposures and potential confounders?	Were outcome assessors and/or data analysts blinded to the exposure being studied?	Did the article maintain comparable groups (report attrition, contamination, adherence, and cross-over)?	Did the study perform appropriate statistical analyses on potential confounders?	Was there acceptable differential loss to follow-up and or overall high loss to follow-up?	Were outcomes pre-specified and defined, and ascertained using accurate methods?	Quality rating
Hemmelgarn 2001	Yes. Stated inclusion criteria, screened all discharge records within stated time period.	No. Differences between groups on several clinical risk variables.	Yes. Used ICD-9 codes from hospital discharge data.	Unclear. No information on blinding of data collectors.	NA. Different patient groups compared.	No. Controlled for age, sex, urgency of admission, prior procedures, and comorbidities. But no control group; did not assess the potential impact of concurrent events; unable to determine whether any observed changes exceeded what would be naturally expected over time.	Unclear. No information on missing data.	Yes. Calgary Regional Health Authority administrative hospital discharge data.	Poor
Hsia 2012	Yes.	No. Differences between groups on several clinical risk variables, in race, and insurance status.	Yes.	Unclear. No information on blinding of data collectors.	NA. Different patient groups compared.	Yes. Age, race or ethnicity, sex, and insurance status, comorbidity index to adjust for baseline mortality risk, case mix of each hospital to control for hospital-level differences in patient acuity.	Unclear. No information on missing data.	Yes. Patient-level data from the California Office of Statewide Health and Planning Development Patient Discharge Data. Use data from state to document which hospitals had ED closures. Data on hospital-level characteristics from hospital financial and use reports.	Fair
Liu 2001	Yes for mortality. Used database containing all overnight hospitalizations during the time period. Unclear for telephone survey. Random sample, but more respondents were female.	No. Differences between groups on several clinical risk variables.	Yes.	Unclear for mortality (blinding not reported). No for health status (self-reported).	NA. Different patient groups compared.	No. Controlled for age and sex only; matched on some variables; no control for comorbidities.	Unclear. No information on missing data.	Yes for mortality (Saskatchewan Ministry of Health administrative data). Unclear for health status (patient surveys and interviews).	Poor
Rosenbach 1995	Unclear. Gives inclusion criteria and time period, but not clear if all eligible hospitals were included.	Unclear. All had Medicare, but other characteristics not reported.	NA.	Unclear. No information on blinding of data collectors.	NA. Different patient groups compared.	No. Controlled for age and sex only.	Unclear. No information on missing data.	Unclear. Mortality, but data source not reported.	Poor
Shen 2012	Unclear. Stated inclusion and exclusion criteria, screened all discharge records within stated time period meeting criteria but did not report number eligible and enrolled.	Yes.	Unclear. MedPAR records but no information on data collectors.	Unclear. No information on blinding of data collectors.	NA.	Yes. Controlled for demographics and clinical risk factors.	Unclear. No information on missing data.	Yes. Mortality from MedPAR records.	Fair