Geographic Variations in Elderly Hospital and Surgical Discharge Rates, New York State

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Abstract: Hospital and surgical discharges for 1981, as recorded by the uniform hospital discharge data of New York State, were aggregated by county of residence and converted into age-sex adjusted rates. Elderly hospital discharge and surgery rates in New York State, 1981, varied 2.4- and 2-fold, respectively. Discharge rates of elderly with specific surgical procedures showed even greater variation. However, proportions of highly complex and non-elective procedures performed on the elderly were similar in counties with high and low surgical rates. A multiple regression model consisting of independent dimensions of county demographic and medical resources characteristics plus a proxy variable for surgical practice styles was applied to hospital and surgery rates. Variations in elderly surgical discharge rates were found to be related to the supply of medical resources and to surgical practice styles. (*Am J Public Health* 1987; 77:679–684.)

Introduction

Rates of elderly hospitalization and surgery have been increasing nationwide, and after admission the elderly patient stays longer than the rest of the population.[1–3] As a consequence, the elderly account for over 30 per cent of hospital expenditures even though they represent only 11 per cent of the nation's population.[1] Since the size of the elderly population is projected to expand rapidly in the future, the elderly's share of hospital care will increase, although advances in medical technology and reimbursement policies may change how hospitals are used.

The uniform hospital discharge data system in New York State (SPARCS) allowed us to analyze all elderly hospitalizations and surgery in the State. This paper describes and analyzes variation of surgical discharge rates of the elderly by county in New York State in 1981.

The increased hospital use by the elderly, accompanied by higher costs of care and an increased risk when undergoing surgery, have also raised concern over the appropriateness of these trends.[4,5] To compound these questions, small area analysis of surgical use rates by several researchers have revealed geographic variations in the incidence and outcomes of surgery.[6–24] In Manitoba, Roos and Roos found place of residence of the elderly strongly influenced their exposure to major surgical procedures, with surgical rates varying 1.5 times from high to low rate areas.[6]

Roos and Roos' findings[9] have had a significant impact on the literature of small area analysis from a Canadian system perspective. Our analysis will seek to answer many of the same questions but within the context of another health care system and a greater supply of physicians per capita. In New York State in 1980, there were approximately 277 physicians per 100,000 population while, nationwide, the average was 188 physicians per 100,000.

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Editor's Note: See also related editorial p 669 this issue.

Methods

The primary source of hospital inpatient data in New York State is the Statewide Planning and Research Cooperative System (SPARCS). Administered by the New York State Department of Health, this system provides data abstracts of all hospital discharges. For 1981, the SPARCS file contained 2,801,180 discharges of which 687,288 were discharges of patients aged 65 and over. About 45 per cent of these elderly discharges had surgery.

Discharges were aggregated by county of residence in New York State. This procedure does not correct for outmigration of State residents. Elderly discharge rates by county were then adjusted for age and sex using a direct method of standardization based on New York State's population in 1980. For the analysis of the complexity and necessity of surgical discharges, a panel of physicians reviewed procedures of highest frequency for the elderly and selected 38 principal procedures (Appendix A). These selected procedures accounted for 63 per cent of elderly surgical discharges in New York State in 1981. This same panel of physicians also classified 35 of the 38 principal procedures as either elective, nonelective, or diagnostic.

- A *nonelective* procedure was defined as a procedure for which no suitable alternative treatment existed and was generally required to sustain life or remove a malignancy.[6]
- An *elective* procedure was not necessary to sustain life, often had an alternative treatment and did not often involve a malignancy.
- For procedures not easily classified elective or nonelective, the proportion of those procedures with malignancy diagnoses was used as a determining factor.
- All other procedures were classified as *diagnostic*.
- Pacemaker insertion, skin debridement, and skin excision were left unclassified.

Selected procedures were then classified by complexity with the Hernia Equivalent (HE) classifications developed by E.F.X. Hughes.[6,25] A relative value from the New York State Relative Value Scale, effective July 1971,[26] was applied to each procedure. Using the value for herniorrhaphy as the denominator, the hernia equivalent for each procedure was derived by dividing each procedure's relative value by the relative value of herniorrhaphy. The hernia equivalent values for the other procedures ranged from a low of 0.1 for several diagnostic procedures to a high of 4.3 for a vascular bypass (Appendix A).

TABLE 1—Summary of Variation in Discharge Rates per 1,000 Population by County, with Descriptive Statistics, New York State, 1981

Rate (Age-Sex Adjusted)	Minimum County Value (per 1,000)	Maximum County Value (per 1,000)	Ratio Maximum/ Minimum	Mean	Median	Coefficient of Variation
Discharge rate, all ages	107	213	1.99	163	160	.159
Discharge rate, elderly	205	488	2.38	353	344	.172
Surgical discharge rate, all ages	63	102	1.62	80	78	.125
Surgical discharge rate, elderly	96	180	1.88	137	136	.123
Discharge rate, elderly, selected elective procedures	15	43	2.87	26	26	.177
Discharge rate, elderly, selected nonelective procedures	12	33	2.75	23	22	.153
Cholecystectomy rate, elderly	2	8	5.00	4	4	.306
Prostatectomy rate, elderly males	13	32	2.48	19	18	.240
Herniorraphy rate, elderly	2	6	2.62	4	4	.241
Lens Extraction rate, elderly	4	23	5.40	12	11	.274

SOURCE: New York State Department of Health; SPARCS, 1981.

A set of county-based independent variables was developed representing county health indicators, supply of medical resources and socioeconomic characteristics (Appendix B). As a step to explain the geographic variation of the discharge rates by county, the underlying dimensions of these variables were defined by principal components analysis. The component scores along with a proxy variable for surgical practice styles were then used as independent variables in multiple regression.

Results

In New York State, the hospital discharge rate in 1981 for all ages was 163 discharges per 1,000 population, while the discharge rate for New York's elderly population was 353 per 1,000.

Thirty-eight procedures, totaling 193,689 elderly discharges in 1981, accounted for 63 per cent of all principal procedures performed on the elderly. In order of frequency, lens extractions were first, followed by prostatectomy, cystoscopy, diagnostic procedures on the intestines, excision of large intestine tissue, inguinal hernia, and pacemaker insertion (Appendix A).

In 1981, 75.3 per 1,000 elderly aged 65–74 underwent one of the selected 38 principal procedures; the discharge rate for the 75–84 year age group was 107.6 per 1,000, for the 85 and over 122.6 per 1,000.

Area Variations In Elderly Surgical Discharge Rates

Variations in various types of hospital and discharge rates by the 62 counties in the State are shown in Table 1. The selected elective procedures showed close to a 3-fold variation from a low county rate of 15 per 1,000 to a high rate of 43 per 1,000. The range in discharge rates of selected nonelective procedures of the elderly was only slightly lower than the range in elective rates.

The range of variation in discharge rates becomes even more pronounced when specific procedures are analyzed, namely cholecystectomy, prostatectomy, herniorrhaphy, and lens extraction. Prostatectomy was defined as a highly complex, nonelective procedure and the variation in discharge rates for this procedure is considerably lower than the other selected elective procedures. The discharge rates for lens extractions and cholecystectomies varied 5-fold among New York State counties.

The 62 counties in New York State were aggregated into four groups of low to high rates of surgery based on the county's surgical discharge rate per 1,000 elderly, which are displayed in Table 2. Consistent with findings of Roos and Roos,[6] each surgical rate area had a similar case mix distribution of discharge rates by level of complexity. In the high rate counties, 28.6 per cent of all procedures were of high complexity (HE 2.0 and higher) and 52.2 per cent were low complexity (HE from lowest to 0.9); in the lowest rate counties, 28.2 per cent were of high complexity and 54.2 per cent were low complexity.

High rate counties appeared to have a slightly higher proportion of nonelective procedures than elective procedures performed, while the low rate counties had a more equal distribution between elective and nonelective procedures.

Explanation of Variation

Before attempting to explain the observed variations, the elderly surgical discharge rates and the elderly county population at risk were analyzed to assess the effects of outmigration and statistical stability of the data.[13,14,21–24] Although outmigration of patients from New York State to hospitals in contiguous states was excluded, undercounting in border counties did not appear to be a problem since only four of the 15 lowest rate counties were border counties and 10 of the 15 highest rate counties bordered on other states.

The surgical discharge rates (Table 2) were not correlated with population size ($r = .06$), as confirmed by a Chi square test of a 2×2 contingency table with population size and surgery rates expressed as high, low variables. We also compared the observed number of surgical procedures performed on the elderly for each county with an expected number (calculated by multiplying each county's elderly population by the surgery rate for the state as a whole). The resulting Chi square value was significantly different from zero. These results were also supported by the application of McPherson, *et al's*, systematic component of variation measure.[13,14] Since the significance tests for variation in the rate of specific procedures are sensitive to sample size, four procedures of high frequency—cholecystectomy, prostatectomy, herniorrhaphy, and lens extraction—were included in the regression model.

To determine the effects of county health indicators, availability of medical resources, socioeconomic and urban characteristics, and surgical styles of area physicians on

TABLE 2—County Specific, Age-Sex Adjusted Rates of Surgery per 1,000 Population Ages 65+ and Population at Risk (1980 Census), New York State, 1981

County	Surgical Discharge Rate	Elective Surgery Discharge Rate	Nonelective Surgery Discharge Rate	Population Age 65+
Warren	180.41	33.22	31.19	7222
Franklin	179.26	28.83	32.98	5731
St. Lawrence	172.39	31.84	26.19	12252
Allegany	162.54	42.62	20.93	5979
Chemung	161.15	29.91	27.09	12500
Orleans	158.53	27.60	26.55	4649
Broome	157.72	30.36	24.51	27645
Richmond	157.13	21.93	25.98	35125
Rockland	153.01	26.90	28.10	22082
Livingston	152.82	29.89	26.25	5998
Genesee	151.27	36.67	25.73	7031
Essex	151.02	22.86	23.46	5269
Wyoming	151.01	20.01	29.45	4543
Jefferson	150.16	34.13	23.26	11518
Westchester	147.00	27.72	25.96	114159
Orange	146.60	25.71	25.00	28184
Schuyler	146.13	25.65	21.95	2196
Steuben	145.97	31.39	22.54	12670
Schenectady	144.14	27.49	22.03	21632
Niagara	142.64	28.78	24.73	27127
New York	142.57	25.54	22.51	204437
Erie	141.30	27.14	25.32	126176
Bronx	140.73	25.79	23.86	151298
Rensselaer	139.83	24.83	21.98	18949
Delaware	139.07	24.18	21.85	6867
Nassau	138.86	26.98	24.26	140396
Cattaraugus	138.85	32.88	28.42	10784
Montgomery	138.20	24.65	27.57	9090
Lewis	137.77	19.24	21.80	2913
Albany	137.15	27.01	20.88	38594
Saratoga	136.39	23.61	20.31	14058
Hamilton	135.59	27.78	17.76	837
Otsego	134.88	25.83	23.93	8487
Clinton	133.85	21.25	22.79	6905
Yates	133.21	33.10	22.18	3266
Madison	133.08	28.91	23.15	6590
Wayne	132.81	23.60	22.95	9126
Washington	132.21	24.62	21.58	6825
Chautauqua	132.07	27.12	22.95	20879
Fulton	131.61	22.78	20.96	8238
Cayuga	131.61	26.60	21.49	10447
Chenango	130.55	23.95	26.20	6162
Monroe	130.44	30.99	23.47	76976
Putnam	129.55	21.95	21.50	7330
Kings	129.03	24.39	22.34	279544
Suffolk	127.68	25.83	22.30	115828
Herkimer	127.13	20.52	21.10	9265
Sullivan	127.11	17.66	19.56	9835
Ulster	126.68	25.05	24.82	20460
Greene	126.63	24.85	22.34	6945
Queens	124.72	24.06	21.17	281328
Ontario	122.33	29.17	19.18	10313
Oneida	119.69	23.68	22.05	33984
Dutchess	119.16	26.80	18.42	27146
Oswego	118.60	26.32	17.93	11120
Columbia	117.73	27.90	21.65	9421
Schoharie	113.89	19.95	16.13	3872
Tompkins	111.74	18.75	18.99	7252
Seneca	110.32	21.13	19.61	4424
Cortland	107.34	25.48	21.21	5429
Onondaga	102.50	24.28	18.06	50848
Tioga	96.38	15.40	12.36	4611

SOURCE: New York State Department of Health, SPARCS, 1981; and US Bureau of the Census, 1980.

variations of surgical discharge rates of the elderly in New York State, 23 county-based variables were initially selected. In an attempt to quantify what Wennberg has referred to as the "practice style factor," the rate of tonsillectomies per 1,000 children ages 1–19 was selected as the proxy variable for surgical styles in a county.[8,10,16,27–30]

The analysis proceeded by first using principal components analysis to reduce the original set of explanatory variables, excluding tonsillectomy rate, into a smaller set of major dimensions. Four factors defined by 18 variables resulted (Appendix B). The factors are independent by definition, and the absence of multicollinearity was confirmed by an inter-correlation matrix of the factors (data not shown, available from authors on request). Three variables loaded negatively: median income and per cent of veterans with factor 4, socioeconomic characteristics, and medical-surgical occupancy rate with county health indicators. A high per cent of population below poverty is reasonably associated with low median incomes and a low per cent of veterans in the population. Low medical-surgical occupancy rates can be related to high death rates or poor health, particularly in the rural counties in the state where hospitals are small and occupancies tend to be lower than the larger, urban counties.

Surgical practice style (the rate of tonsillectomies), excluded from the principal components analysis, was included in the regression model of the elderly discharge rates. This variable was moderately negatively correlated with urban characteristics, but this factor had poor explanatory power with and without the surgical practice style variable.

Regression Results

The four factors, plus the surgical practice style variable, were used in multiple regression models in an attempt to explain the variations in discharge and surgery rates of the elderly among the 62 counties in New York State. The regression model limited to the four factors only (since tonsillectomies were part of the dependent variable) was also applied to the discharge and surgery rates for all ages combined.

Medical resources, in the case of all patients, and both medical resources and surgical practice styles, in the case of the elderly, were important determinants of county variations of surgery rates in New York State in 1981 (Table 3). The importance of these variables outweighed measures of urban characteristics, county health indicators, and socioeconomic characteristics.

To investigate whether population size could still have been a factor in the regression and thereby introduce a spurious result, a regression model not dependent on rates was also tested. The log of the number of elderly surgical procedures was regressed against the log of the number of medical-surgical beds in the county while controlling for the log of county population age 65+. The relationship between procedures and resources (beds) was still significant. A similar result was found for the number of lens extractions and beds.

An analysis of the variation in surgical discharge rates for specific procedures of cholecystectomy, herniorrhaphy, prostatectomy, and lens extractions showed a mixed pattern of related variables when the regression model was applied (Table 3). The four factors and surgical practice styles explained 33 per cent of the variation in the rate of cholecystectomies, 32 per cent of the variation in herniorrhaphies, and 35 and 26 per cent of the variation in discharge rates for prostatectomies and lens extractions, respectively.

County health indicators were related to the variation of each of these procedures while socioeconomic characteristics appeared to have little relationship with surgical use rate

TABLE 3—Explanation of Variation in Discharge Rates, New York State, 1981, Using Multiple Regression Analysis

Rates (Age-sex adjusted)	% of Variation Explained R^2	Beta Weights (Standard Error) Medical Resources	Urban Characteristics	County Health Indicators	Socio-economic Characteristics	Surgical Practice Style
Discharge Rate, all ages	32	.194 (.109)	−.425 (.109)	.125 (.109)	.296 (.109)	*
Discharge Rate, elderly	47	.086 (.098)	−.432 (.109)	.083 (.098)	.195 (.098)	.339 (.110)
Surgical Discharge rate, all ages	15	.284 (.122)	−.200 (.122)	.104 (.122)	.132 (.122)	*
Surgical Discharge rate, elderly	23	.322 (.117)	.084 (.131)	.084 (.117)	.047 (.118)	.396 (.131)
Cholecystectomy	33	−.058 (.110)	−.263 (.122)	.401 (.110)	−.037 (.110)	.215 (.123)
Herniorrhaphy	32	−.061 (.110)	.225 (.123)	.528 (.110)	−.078 (.110)	.176 (.123)
Prostatectomy	35	.118 (.108)	.100 (.120)	.441 (.108)	.029 (.108)	.443 (.121)
Lens Extraction	26	.296 (.115)	.337 (.129)	−.224 (.115)	.035 (.116)	.289 (.129)

*Not entered in model.
SOURCE: New York State Department of Health, SPARCS, 1981.

variations. While the higher the health indicator (or mortality rates) the higher the likelihood of cholecystectomy, prostatectomy, or herniorrhaphy being performed, counties with lower mortality rates would have higher occurrences of lens extractions. The surgical style variable had a substantial beta weight when applied to the rate of cholecystectomies, prostatectomies, and lens extractions. Urban characteristics were positively related to the rate of herniorrhaphies and lens extractions, but negatively related to cholecystectomies. This may reflect a high rate for this procedure for rural county residents.

Discussion

Medical resources, county health indicators, and surgical practice styles were related to elderly surgical discharge rates, but they could only explain less than one-half of the variation in county rates. Based upon similar analysis of hospital use by small areas in New England, Wennberg and his colleagues concluded that differences among physicians in either their diagnostic style or their belief in the efficacy of specific treatment contributed substantially to the observed variation in hospital admission rates.[14,31,32] They also noted a pattern of variation related to the degree of professional uncertainty concerning the diagnosis or treatment of conditions for which surgery was one possible treatment. While counties of New York State are larger in population and served by more physicians, this observation was partly borne out by New York State's data. For example, the range in variation of discharge rates for a procedure, such as cholecystectomy, was far greater than a primarily nonelective operation such as prostactectomy. Other studies have found that surgical practice style tends to vary by specific procedures leading to distinct geographic patterns; we found that tonsillectomy rates, serving as an indicator of surgical practice style, were related to variations in elderly surgery rates. This finding, plus the level of unexplained variation and the wide variations in rates of specific surgical procedures, suggests that decisions made by the physician and/or surgeon largely determine the course of patient treatment.

ACKNOWLEDGMENTS

This study was presented in a poster session at the 1984 Annual Meeting of the American Public Health Association, Anaheim, California. The authors would like to thank the following for their contributions and consultations: Dr. Jane Moss, Mt. Sinai Medical School; Dr. Alfred Gellhorn, New York Department of Health; Brian Hendricks, Executive Deputy Director, Office of Health Systems Management, Department of Health; and Edward J. Dowling, New York State Department of Health.

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APPENDIX A
Selected Procedures, ICD-9-CM Code, Hernia Equivalent Procedure Categorization and Number of Elderly Discharges, New York State, 1981

ICDA-9	Procedure	Hernia Equivalent	Procedure Type	Number of Procedures
13.19, 13.59, 13.41	Extraction of Lens	.9**	E	29,081
31.1, 31.2	Tracheostomy	.6	N	1,352
33.2	Bronchoscopy	.4	D	7,478
34.9	Thoracentesis	.1	D	2,573
37.2	Diagnostic Procedures—Heart	1.0	D	3,894
37.7	Pacemaker Insertion	2.9	*	8,559
37.8	Pacemaker Repair	1.2	N	2,011
38.12	Endarterectomy	3.4	N	1,403
39.2	Vascular Bypass	4.3	N	3,090
39.95	Hemodialysis	NA	N	1,130
41.31	Bone Marrow Biopsy	.1	D	6,265
44.1	Gastroscopy	.4	D	6,161
45.13, 45.23, 45.24	Diagnostic Procedures—Intestines	.4	D	13,750
45.4, 45.7	Excision of Large Intestine Tissue	2.3	N	9,327
46.1	Colostomy	1.4	N	1,138
49.46	Hemorrhoidectomy	.6	E	1,004
50.1	Diagnostic Procedures—Liver	.1	D	1,920
51.2	Cholecystectomy	1.7	E	7,352
53.0	Inguinal Hernia	1.0	E	9,262
54.5	Lysis of Peritoneal Adhesions	1.1	N	1,078
57.3	Cystoscopy	.2	D	14,066
57.4	Excision or Destruction of Bladder Tissue	1.7	N	6,351
57.9	Bladder Sphincterotomy	.4	E	1,430
60.1	Prostate Biopsy	.1	D	1,797
60.2–60.4	Prostatectomy	2.3	N	16,332
68.4	Abdominal Hysterectomy	1.7	E	1,738
68.5	Vaginal Hysterectomy	1.7	E	1,102
69.0	D & C	.4	D	2,597
81.41	Knee Replacement	2.3	E	1,280
81.5–81.6	Hip Arthroplasty	2.9	E	6,329
84.10, 84.15, 84.17	Leg Amputation	1.4	N	2,420
85.2	Excision of Breast Tissue	.4	N	1,822
85.41–85.44	Simple Mastectomy	.9	N	3,032
86.22	Skin Debridement	.1	*	2,301
86.3	Skin Excision	.1	*	3,359
04.4	Decompression of Adhesions Cranial/Peripheral Nerves	.9	N	1,207
79.15	Femur Fracture—Closed Reduction	1.1	N	1,005
79.35	Femur Fracture—Open Reduction	2.3	N	7,669

*Categorized as neither elective (E), nonelective (NE), or diagnostic (D).
**Value adjusted downward from relative value scale to reflect improved technology in performing this procedure.
SOURCE: New York State Department of Health, SPARCS, 1981.

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APPENDIX B
Factor Definitions and Variables with High Loadings

Factor 1: Medical Resources
- Acute care beds per 1,000 population
- Medical-surgical beds per 1,000 population
- Surgeons per 1,000 population
- Physicians per 1,000 population
- Obstetrician-Gynecologists per 1,000 population
- Opthalmologists per 1,000 population
- Urologists per 1,000 population

Factor 2: Urban Characteristics
- Per cent of population non-White
- Per cent of population in SMSA
- Existence of teaching hospitals
- Medicare dollars spent per enrollee

Factor 3: County Health Indicators
- Death rate from malignant neoplasms
- Death rate from home accidents
- Overall mortality rate
- Medical-surgical occupancy rate

Factor 4: Socioeconomic Characteristics
- Per cent of population below poverty
- Median income
- Per cent of veterans in population

SOURCE: New York State Department of Health, 1981.

NIH Consensus Development Conference: Magnetic Resonance Imaging

A Consensus Development Conference on Magnetic Resonance Imaging will be held in Masur Auditorium in the Warren Grant Magnuson Clinical Center, National Institutes of Health, Bethesda, Maryland, October 26–28, 1987. This open forum, sponsored by the NIH Warren Grant Magnuson Clinical Center, Diagnostic Radiology Department, and by the NIH Office of Medical Applications of Research, will focus on the efficacy of magnetic resonance imaging (MRI). It will address the following questions:

- Are there contraindications to or risks of MRI?
- What are the technological advantages and limitations (disadvantages) of MRI?
- What are the clinical indications for MRI, and how does it compare with other diagnostic modalitites?
- What are the directions for future research in MRI?

Consensus Development Conferences at NIH bring together medical experts and others to assess the safety and efficacy of drugs, devices, and procedures. These conferences differ from standard scientific meetings in that a panel of medical specialists and generalists and the audience consider data presented by experts on the specific technology of issue under review.

A consensus statement, written by a panel, addresses a set of questions regarding the safety and effectiveness of the technology being evaluated. The statement is circulated widely to the medical profession, the public, the lay media, and medical publications.

To register for the conference or to obtain further information, contact: Sharon Feldman, Prospect Associates, Suite 500, 1801 Rockville Pike, Rockville, Maryland 20852. Tel: 301/468–6555.