

Cover Letter

July 15, 1999

Dear Colleague:

We are pleased to share with you a copy of the report *Risk-Adjusted Cesarean Section Rates for California Hospitals: 1995-1997*. This study was sponsored by the Pacific Business Group on Health (PBGH), a business coalition composed of large and small purchasers of health care, and the California Perinatal Quality Care Collaborative (CPQCC), a statewide partnership aimed at improving quality of care and outcomes for infants and mothers. This study is a continuation of a series of c-section analyses sponsored by PBGH since 1991.

Beginning with this year's report, PBGH has joined with CPQCC to build a more comprehensive analytic framework for scientifically evaluating cesarean section practices in California. The two organizations are committed to promoting best practices and performance improvement in perinatal care and outcomes statewide.

The study was motivated by the continued national debate over the appropriate use of cesarean sections. In particular, past research showing significant variation in c-section rates across hospitals had suggested potential over-utilization of the cesarean procedure. This report evaluates the population of nulliparous women to better understand more recent c-section practices in California—at the state, regional and hospital levels.

Using publicly available hospital discharge and vital statistics data collected by the State of California, the study examines the population of single live newborns to nulliparous women in California between 1995 and 1997 to calculate risk-adjusted cesarean section rates. The rates presented in this report are adjusted to take into account differences in maternal clinical and demographic characteristics across hospitals, including race/ethnicity, education level, parity, and maternal complications during pregnancy, labor or delivery. Key findings in this report include:

- Between 1995 and 1997, the overall c-section rate for nulliparous women was approximately 21.8%, while hospital-level *risk-adjusted* c-section rates ranged from 11% to 44.1%. Over the same time period, one-third of California hospitals had *risk-adjusted* c-section rates higher than 25% for nulliparous patients.
- There continues to be significant variation in *risk-adjusted* c-section rates *across regions*. Among nulliparous women between 1995 and 1997, only 0.6% of San Francisco Bay Area hospitals had risk-adjusted c-section rates greater than 30%. In contrast, 22% of Los Angeles area hospitals and 21% of Central California hospitals had *risk-adjusted* c-section rates greater than 30%.

In this package, please find the *Hospital Report*, which presents risk-adjusted c-section rates among nulliparous women for all hospitals in California with at least 10 deliveries in 1995, 1996 and 1997. The report also includes a brief description of methods used in the study and overall results for California.

The companion *Technical Report* provides a detailed description of the analytic methods used to develop risk-adjusted c-section rates. The report is available upon request from PBGH or CPQCC, or may be downloaded from CPQCC's website at www.cpqcc.org/csection.

PBGH member companies actively encourage their employees to use providers that deliver efficient, appropriate and high quality care. Beginning in September, PBGH will disseminate a consumer version of the risk-adjusted hospital c-section rates to its member companies and to California consumers on the PBGH website *California Consumer HealthScope* (<http://www.healthscope.org>).

We hope that your organization will enjoy reviewing the study's findings. We look forward to working with all health care organizations in California to ensure high quality care for California women and infants.

Sincerely,

Cheryl Damberg, PhD
Director of Quality
Pacific Business Group on Health

David Stevenson, MD
For Executive Committee
California Perinatal Quality Care Collaborative

Contacts

Questions for PBGH and written comments about the report should be forwarded to:

Anne Castles, MA, MPH
Senior Manager, PBGH
221 Main Street, Suite 1500
San Francisco, CA 94105
415-273-5875
acastles@mindspring.com

Questions for the CPQCC should be forwarded to:

Cele Quaintance, RN, MS
Project Director, CPQCC
650-723-5763
cele@cpqcc.org

**Risk-Adjusted Cesarean Section Rates
for Nulliparous Patients at California Hospitals 1995 to 1997**

Hospital Report

Prepared by:
Beate Danielsen, PhD
Health Information Solutions

and

Anne Castles, MA, MPH
The Pacific Business Group on Health

Tuesday, June 29, 1999

Prepared for:

The Pacific Business Group on Health

and

The California Perinatal Quality Care Collaborative

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Sponsors

The Pacific Business Group on Health (PBGH)

PBGH is a business coalition of large California employers. PBGH's 32 large private and public sector purchasers represent approximately 2.5 million employees, dependents and retirees and \$3 billion in annual health care expenditures. As of July 1999, PBGH also began to administer Pacific Health Advantage, a small employer purchasing pool representing 150,000 employees and dependents. PBGH's mission is to improve the quality of health care in California while moderating health care costs. PBGH's quality initiatives are designed to: 1) measure the quality of health care services provided by health plans, hospitals and physician groups and 2) institute marketplace incentives that motivate improvements in service delivery among those organizations. Examples of PBGH involvement in quality projects include the medical group-level Physician Value Check Survey to assess patient satisfaction, the health plan-level HEDIS measurement project, the hospital-level California CABG Mortality Reporting Program, and the Quality-Based Provider Payment Initiative designed to financially reward provider organizations that demonstrate superior performance.

The California Perinatal Quality Care Collaborative (CPQCC)

CPQCC is a statewide partnership aimed at improving quality of care and outcomes for infants and mothers. CPQCC is committed to procuring timely and high-quality data on maternal and child health indicators, and using these data for determining benchmarks and promoting best practices and performance improvement in perinatal care and outcomes statewide. Members of the Collaborative include organizations such as the California Association of Neonatologists, the California Department of Health Services, the American College of Obstetrician Gynecologists, the Regional Perinatal Programs of California, and the Office of Statewide Health Planning and Development (OSHPD).

History of the Report

PBGH has monitored c-section rates in California since 1991. Previous PBGH c-section studies have focused on variation in practices among privately-insured patients by examining the ratios of observed to expected c-section rates. In 1999, CPQCC partnered with PBGH to build a more comprehensive analytic framework for scientifically evaluating cesarean section practices in California. PBGH and CPQCC would like to extend special thanks to the following CPQCC members for their extensive assistance in shaping and reviewing the analytic methods presented in this report:

- Robert Chung, PhD, The Office of Statewide Health Planning and Development
- Cheryl Damberg, PhD, The Pacific Business Group on Health
- Jeffrey Gould, MD, MPH, University of California - Berkeley
- Elliott Main, MD, California Pacific Medical Center
- Roderic Phibbs, MD, University of California – San Francisco
- Cecele Quaintance, RN, MS, Stanford University
- David Wirtschafter, MD, Kaiser Permanente

Executive Summary

Background

The appropriate use of the cesarean section procedure has become a compelling quality of care issue over the last decade. Sparking the debate was the observation that national c-section rates had quadrupled between 1970 and 1987, from 5% to 24%. Subsequent research indicating significant variation in risk-adjusted cesarean section rates across hospitals—without apparent differences in outcome—suggested that the cesarean section procedure was being over-utilized. Moreover, studies showing differences in risk-adjusted c-section rates by geography, payer source and provider type created concerns that the decision to perform a c-section was not always based on clinical factors alone.

These findings highlighted potential quality of care issues and led the U.S. Public Health Service to set a target c-section rate of 15% for the year 2000. As the national c-section rate has gradually begun to drop, it has now been suggested that further reductions in the c-section rate could adversely impact maternal and infant outcomes. Unfortunately, efforts to study the association between perinatal health outcomes and delivery mode at the hospital level have been stymied by a lack of high-quality diagnostic data and challenges in developing measures of infant health that accurately reflect the quality of obstetric care.

Regardless of the current lack of consensus on the “right” c-section rate, some California hospitals continue to perform substantially more c-sections than would be expected, even after controlling for case mix. For example, in the period between 1995 and 1997, over one-third of California hospitals had risk-adjusted c-section rates of 25% or higher among their nulliparous patients. Moreover, substantial variation continues to be seen among California hospitals after controlling for case mix. In 1997, risk-adjusted c-section rates for nulliparous women ranged from 11% to 44% across California hospitals. The above findings have motivated efforts to continue analysis and reporting of delivery practices at individual hospitals.

This *Hospital Report* presents the risk-adjusted c-section rates for all California hospitals with at least 10 deliveries in 1995, 1996 and 1997. The report focuses on nulliparous women. Targeting this group may be the most effective method for reducing the c-section rate in the long term: by decreasing the use of c-sections in the primary delivery, c-sections in future deliveries may also be avoided. The results presented here are intended to stimulate discussion of best practices in delivery management among hospitals, with a view to encouraging hospitals to review and adapt their own practices as necessary.

Data

The analysis was based on a linked database made up of data sets publicly available from the California Department of Health Services and the California Office of Statewide Health Planning and Development. The data sets linked included: the infant vital statistics birth record, the infant hospital discharge record, the maternal hospital discharge record, and any infant or maternal hospital discharge records reflecting re-hospitalizations or transfers. The linked database allowed evaluation of a rich set of clinical and demographic risk factors represented in the various individual data sets.

Study Population

The study population consisted of all deliveries of single live births to nulliparous women in California civilian hospitals in 1995, 1996, and 1997 for whom the vital statistics birth record and the infant and

maternal hospital discharge records could be linked. The total study population for the three-year period consisted of 570,598 deliveries at over 300 hospitals.

Methods

A risk-adjustment model was developed for nulliparous women solely. Data elements were initially chosen for evaluation in the model based on the recommendations of a CPQCC expert panel and a literature review. Stepwise logistic regression was used to determine the subset of clinical and demographic variables included in each risk-adjustment model. The final logistic regression model was fit using the Probit link function. The purpose of adjusting for the case mix-of patients at each hospital was to ensure that any variation in the hospital-level c-section rates presented here reflects differences in practice rather than clinical and behavioral differences in patient populations beyond the control of the provider.

Results

All results reported in this document apply to the population of nulliparous patients only. In each of the three study years, average c-section rates were approximately 22% among nulliparous women. Between 1995 and 1997, one-third of California hospitals had c-section rates of 25% or greater *after* adjusting for breech presentation, genital herpes, placental conditions, hypertension/eclampsia, birth weight, maternal age, post-term pregnancy, diabetes, oligohydramnios, premature rupture of membranes, anemia, prenatal care, race and education. 16.5% of hospitals had risk-adjusted c-section rates greater than 30%.

In 1997, among hospitals with at least 100 deliveries, the risk-adjusted c-section rate for nulliparous women ranged from 11% to 44.1%. Variation in the c-section rate also differs among regions. Between 1995 and 1997, only 0.6% of Bay Area hospitals had a risk-adjusted c-section rate greater than 30%. In contrast, 22% of Los Angeles Area hospitals and 21% of Central California hospitals had risk-adjusted c-section rates greater than 30%.

Technical Report and Websites

The **Technical Report** provides a detailed description of the analytic methods used to develop risk-adjusted c-section rates. The report is available upon request from PBGH or CPQCC, or may be downloaded from CPQCC's website at www.cpqcc.org. Hospitals will also be able to view the detailed c-section rate information for both their nulliparous and multiparous populations at www.cpqcc.org/csection.

Beginning in September, PBGH will disseminate a consumer version of the risk-adjusted hospital c-section rates to its member companies and to California consumers on the PBGH website *California Consumer HealthScope* (<http://www.healthscope.org>).

Hospital Report

Background

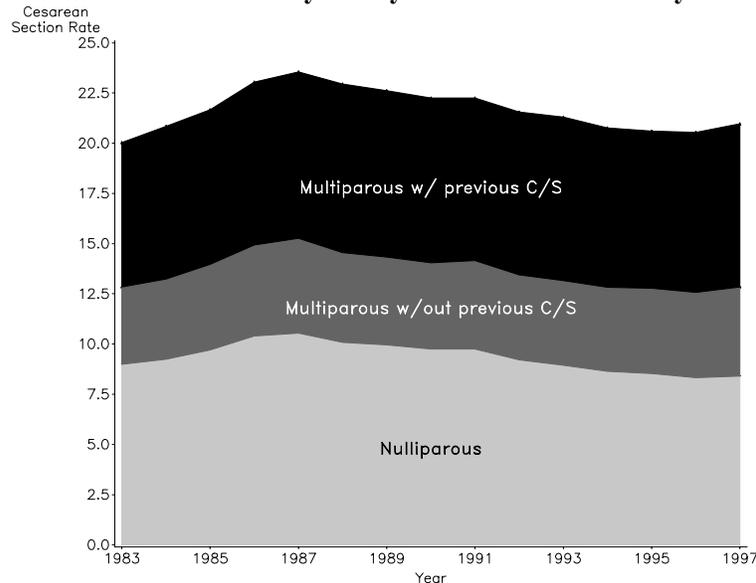
The appropriate use of the cesarean section procedure has become a compelling quality of care issue over the last decade. Sparking the debate was the observation that national c-section rates had quadrupled between 1970 and 1987, from 5% to 24.4% [1]. Subsequent research indicating significant variation in risk-adjusted cesarean section rates across hospitals—without apparent differences in outcome—suggested that the cesarean section procedure was being over-utilized [1] [2]. Moreover, studies showing variation in risk-adjusted c-section rates across geography, payer source and provider type created concerns that the decision to perform a c-section was not based on clinical factors alone [3] [4] [5] [6]. These findings highlighted potential quality of care issues and led the U.S. Public Health Service to set an overall target c-section rate of 15% for the year 2000 [1].

Since 1987, the national c-section rate has slowly decreased—to approximately 23% as of 1993. However, a recent opinion article in the *New England Journal of Medicine* suggested that further reductions in the c-section rate could adversely impact maternal and infant outcomes, and that additional research is needed prior to establishing recommended c-section rates for given conditions [7].

Unfortunately, efforts to study the association between perinatal health outcomes and delivery mode at the hospital level have been stymied by a lack of high-quality diagnostic data and challenges in developing measures of infant health that accurately reflect the quality of obstetric care.

Regardless of the current lack of consensus on the “right” c-section rate, some California hospitals continue to perform substantially more c-sections than would be expected, even after controlling for case mix. For example, in the period between 1995 and 1997, over one-third of California hospitals had risk-adjusted c-section rates of 25% or higher among their nulliparous patients. Moreover, substantial variation continues to be seen among California hospitals after controlling for case mix. In 1997, risk-adjusted c-section rates for nulliparous women ranged from 11% to 44% across California hospitals. The above findings have motivated efforts to continue analysis and reporting of delivery practices at individual hospitals.

California Cesarean Section Rates by Parity and Previous Delivery Mode: 1983-1997



In this Report

This report presents risk-adjusted c-section rates for all hospitals in California with at least 10 deliveries for the years 1995, 1996 and 1997. The report focuses on nulliparous women. Targeting this group may be the most effective method for reducing the c-section rate in the long term: by decreasing the use of c-sections in the primary delivery, c-sections in future deliveries may also be avoided.

PBGH and CPQCC, the sponsors of this report, are dedicated to promoting quality improvement among health care organizations through publication of methodologically-sound performance data for use in benchmarking and quality improvement. The comparative data presented here are intended to stimulate discussion of best practices in delivery management among California hospitals, with a view to encouraging hospitals to review and adapt their own practice behavior as necessary.

Data Sources

The analysis was based on a linked database made up of data sets publicly available from the California Department of Health Services and the California Office of Statewide Health Planning and Development. Records were linked from the infant vital statistics birth record, the infant hospital discharge record, the maternal hospital discharge record, and any infant or maternal hospital discharge records reflecting re-hospitalizations or transfers. The linked database allowed evaluation of a rich set of clinical and demographic risk factors represented in the various data sets.[16, 17].

Study Population

This report focuses on the population of nulliparous women. C-section rates for nulliparous women are highlighted for a number of reasons. First, significant hospital to hospital variation continues to exist for this group. Presentation of comparative c-section data for nulliparous women may therefore help hospitals gauge new opportunities to safely reduce their own cesarean section rates. Second, because nulliparous women are not at risk for rupturing a previous cesarean incision, clinical indicators alone should predict the decision to perform a cesarean section. In other words, neither provider nor patient concerns about uterine rupture will play a role in determining the mode of delivery. Third, this is the group most logically targeted for reducing c-section rates over the long term. Promoting vaginal delivery among this group of women not only reduces the likelihood of a cesarean section in the primary delivery, but also in any future deliveries the woman may undergo.

The study population consisted of all deliveries of single live births to nulliparous women in California civilian hospitals in 1995, 1996, and 1997 for whom the vital statistics birth record and the infant and maternal hospital discharge records could be linked (about 97% of all single live births in hospitals reporting to OSHPD). Note that we did not include multiple gestation deliveries since at this time the linkage for these cases has not yet been validated.¹ The total study population for the three-year period consisted of 570,598 deliveries at over 300 hospitals.

¹ We excluded 20,225 multiple gestation deliveries in California civil hospitals from the study. The cesarean section rate for these deliveries was 60.84%. The unadjusted odds ratio for a cesarean section outcome for multiple compared to single births was 6.09 (lower 95% confidence limit: 5.92; upper 95% confidence limit: 6.27).

Methods of Cesarean Section Risk Adjustment

A risk-adjustment model was developed for nulliparous women. Data elements were initially chosen for evaluation in the models based on the recommendations of an expert panel drawn from CPQCC members and a review of the relevant literature [8-15]. Stepwise logistic regression was used to determine the subset of clinical and demographic variables to be included in each risk-adjustment model. All models were initially based on an estimation set that consisted of a random sample of 50% of all observations; and they were validated using the remaining observations. The final logistic regression model was fit based on all observations using the Probit link function.

Final Cesarean Section Risk-Adjustment Model

Among nulliparous women, breech presentation was found to be the most important predictor of cesarean section. Other than maternal age, demographic characteristics were of far less importance than clinical characteristics. The total set of variables included in the final risk-adjustment model appears below. Note that interaction terms were only included if they were significant for all three study years. The model development is described in detail in the *Technical Report* (available upon request or on the CPQCC website at www.cpqcc.org/csection)

List of Variables Included in Final Risk-Adjustment Model and their Adjusted Odds Ratios (1997 Data)

Clinical Variables	OR	Demographic Variables	OR
▪ Breech Presentation	1269.51	▪ No High School Degree (Mother)	1.07
▪ Placenta Abruptio/Previa	7.62	▪ No Prenatal Care	0.73
▪ Genital Herpes	6.93	▪ Maternal Age	
▪ Insulin-dependent Diabetes	3.19	□ Age < 20	0.72
▪ Hypertension/Eclampsia/Pre-Eclampsia	2.51	□ Age 25-<30	1.33
▪ Oligohydramnios	2.26	□ Age 30-<35	1.73
▪ Postterm Pregnancy	1.92	□ Age 35-<40	2.44
▪ Premature Rupture of Membranes	1.85	□ Age >=40	3.53
▪ Intrauterine Growth Retardation	1.62	▪ Race	
▪ Gestational Diabetes	1.43	□ Native American	1.24
▪ Large for Gestational Age	1.37	□ Hispanic	1.31
▪ Anemia	1.33	□ Other Race	1.27
▪ Quadratic term in birth weight	1.02	□ Other Asian	1.03
▪ Uncorrected Birth Weight (grams)	0.71	□ South East Asian	1.08
▪ Hypertension and Oligohydramnios	0.63	□ African American	1.6
Interaction Terms			
▪ Hypertension and Birth Weight < 1,500 grams	9.16	▪ Breech and Birth Weight 1,500-<2,500	0.55
▪ Hypertension and Birth Weight 1,500-<2,500	1.89	▪ Breech and Birth Weight < 1,500 grams	0.02

In attempting to identify hospitals with very high c-section rates, the final model was designed to control for variables reflecting patient clinical and behavioral characteristics that predict the risk of a cesarean section, and to exclude any variables reflecting provider practice decisions. The purpose of adjusting for the case mix-of patients at each hospital was to ensure that any variation in the hospital level c-section rates presented here reflects differences in practice rather than clinical and behavioral differences in patient populations beyond the control of the provider.

Given the above, payer source and prolapsed cord were excluded from the final model. While payer source is significantly associated with an increased risk of a c-section, patient insurance coverage is not a clinical indicator for a cesarean and was therefore excluded. Prolapsed cord was excluded because it may indicate a practice decision (provider rupture of the membranes when the head is too high) rather

than an underlying patient characteristic. A variable for dystocia was not included, due to the poor definition of the term and the concern that dystocia may be a function of the obstetric care delivered.

It was ultimately decided however, to include the race/ethnicity variable in the models. Race/ethnicity was found to be an independent and statistically significant predictor of the c-section event in nulliparous women in this analysis. In other words, when controlling for all other variables, nulliparous African-American and Hispanic women were significantly more likely to undergo a c-section. To the sponsors, it is unclear whether this effect is physiological, or one reflective of care decisions made by the provider. In the absence of data that refute a physiological mechanism, race/ethnicity was included in the model. Comparisons of this model to one that did not adjust for race/ethnicity showed only minor differences in risk-adjusted c-section rates at the hospital level. Regardless, research will be required to explore this association at more length. In particular, it will be important to ensure that inclusion of race/ethnicity does not hide potential differences in quality of care delivered to minority populations.

Hospital-Specific Cesarean Section Rate Calculations

For each California hospital with at least 10 deliveries and 3 cesarean sections, we tabulated the *observed* and *risk-adjusted* cesarean section rates for the years 1995 through 1997.

Observed c-section rate: the crude c-section rate calculated by dividing the number of c-sections performed by the number of live births. Columns (1) and (2) display the hospital-level and statewide *observed* c-section rates respectively.

Expected c-section rate (Column 3): the rate that reflects hospital casemix. Developed by summing the likelihood of a c-section for each of the hospital's patients, based on the logistic regression model.

Casemix index (Column 4): calculated as the ratio of the *observed statewide* c-section rate and the hospital-level *expected* c-section rate and obtained by dividing column (2) by column (3). The casemix index is larger than one if a hospital's casemix resulted in an *expected* c-section rate lower than the *observed statewide* c-section rate. In other words, if a hospital's casemix suggested that fewer c-sections are needed when compared to the statewide c-section rate, the casemix index is greater than one.

Risk-adjusted c-section rate (Column 5): obtained by multiplying the *observed* hospital-level c-section rates (Column 1) by the hospital casemix index (Column 4).

Observed to expected ratio or O/E ratio (Column 6): obtained by dividing the observed number of c-sections by the expected number of c-sections (column 1 divided by column 3). An O/E ratio of less than 1 indicates that the hospital performed fewer cesarean sections than would have been expected based on the statewide average; an O/E ratio of more than one indicates that the hospital performed more c-sections than would have been expected based on the statewide average.

The estimation process is explained by three examples in the table below. Hospital A had an *expected* cesarean section rate of 28.9%, higher than the statewide cesarean section rate of 21.9%. Compared to the overall state population, this hospital's casemix might have included a larger percentage of breech babies or older mothers. That is, its casemix suggested that the hospital was likely to perform a greater number of cesarean sections. This is reflected by a casemix index of less than one. The *observed* c-section rate was thus adjusted downward to result in a lower *risk-adjusted* cesarean section rate. In contrast, Hospital B had an *expected* c-section rate of 14.4%, suggesting a casemix that would result in fewer cesarean sections than if the statewide casemix prevailed at Hospital B. The casemix index was therefore larger than 1, and the *observed* c-section rate was scaled up to result in a higher *adjusted* rate.

Hypothetical Example of the Calculation for Hospital Risk-Adjusted Cesarean Section Rate

	Hospital Level Observed C-Section Rate (1)	California Observed C-Section Rate (2)	Hospital Level Expected C-Section Rate Derived from Logistic Regression (3)	Casemix Index (4) = (2)/(3)	Risk Adjusted C-Section Rate (5) = (1)*(4)	Observed to Expected (O/E) Ratio (6) = (1)/(3)
Hospital A	25.5 %	21.9 %	28.9 %	0.76	19.4 %	0.88
Hospital B	17.4 %	21.9 %	14.4 %	1.52	26.5 %	1.21
Hospital C	22.1 %	21.9 %	21.9 %	1.00	22.1 %	1.01

The mathematical formulation of the calculation of risk-adjusted cesarean section rates is outlined in the Technical Report which can be downloaded from www.cpqcc.org/c-section.

Measure of Infant Outcomes

Between 1987 and 1993, the national c-section rate gradually decreased from 24.4% to approximately 23%. However, a recent opinion article in the New England Journal of Medicine suggested that further reductions in the c-section rate could adversely impact maternal and infant outcomes [7]. Complicating the debate over the appropriate use of c-sections is the lack of high-quality data about the health outcomes associated with the two modes of delivery. The sponsors of this report believe that it is important to report measures of infant health outcome in conjunction with risk-adjusted cesarean rates in order to more comprehensively evaluate hospital performance. Several such measures were formulated as part of this work, but more research is needed to develop measures that are methodologically-sound and that accurately reflect the quality of obstetric care. The sponsors are committed to continuing research that will develop infant health outcome measures to report in tandem with c-section rates in the future.

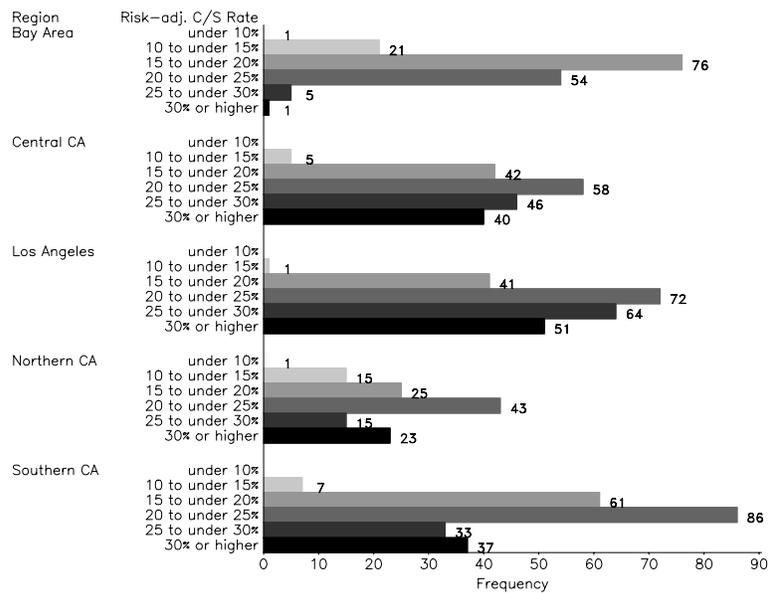
Overall Results

In each of the three study years, average c-section rates were approximately 22% among nulliparous women. Between 1995 and 1997, one-third of California hospitals had c-section rates higher than 25% for nulliparous patients *after* adjusting for breech presentation, genital herpes, placental conditions, hypertension/eclampsia, birth weight, maternal age, post-term pregnancy, diabetes, oligohydramnios, premature rupture of membranes, anemia, prenatal care, race and education. 16.5% of hospitals had risk-adjusted c-section rates greater than 30%.

In 1997, among hospitals with at least 100 deliveries, the risk-adjusted c-section rate for nulliparous women ranged from 11% to 44.1%. Variation in the c-section rate also differs among regions. In 1997, the average c-section rate for San Francisco Bay Area hospitals was 19.7%, while that for Los Angeles County hospitals was 24.1%. Moreover, between 1995 and 1997, only 0.6% of Bay Area hospitals had a risk-adjusted c-section rate greater than 30%. In contrast, 22% of Los Angeles Area hospitals and 21% of Central California hospitals had risk-adjusted c-section rates greater than 30%. (See figure below).

Small and/or rural facilities were also much more likely to have c-section rates greater than 30%. Forty percent of small/rural hospitals had c-section rates over 30% during the three-year study period, in contrast to 0% of teaching hospitals and 16% of all other hospitals.

Risk-Adjusted Cesarean Section Rates by California Region: 1995-1997



Websites

The following is available on the companion website to this report:

- Technical Report (available at www.cpqcc.org/csection as of July 1999).
- Risk-adjusted hospital level results for nulliparous women (available in this report and at www.cpqcc.org/csection as of July 1999).
- Risk-adjusted hospital level results for multiparous women, both with and without previous c-section (available at www.cpqcc.org/csection as of July 1999).
- Consumer version of risk-adjusted results (available at www.healthscope.org/csection as of September 1999).

Endnotes

1. Centers for Disease Control and Prevention, *Rates of Cesarean Delivery - United States, 1993*. MMWR, 1995. **44**(15): p. 303-7.
2. Notzon, F.C., *International differences in the use of obstetric interventions*. JAMA, 1990. **263**: p. 3286-91.
3. Haynes de Regt, R., H.L. Minkoff, and J. Feldman, *Relationship of private or clinic care to Cesarean birth rate*. New Engl J Med, 1986: p. 619-24.
4. Oleske, D.M., *et al.*, *The Cesarean birth rate: Influence of hospital teaching status*. HSR, 1991: p. 324-337.
5. Stafford, R.S., *The impact of non-clinical factors on repeat cesarean sections*. JAMA, 1991: p. 59-63.
6. Goyert, G.L., S.F. Bottoms, and M.C. Treadwell, *The physician factor in Cesarean birth rates*. New Engl J Med, 1989: p. 708-9.
7. Sachs, B.P., *et al.*, *The risks of lowering the cesarean-delivery rate*. New England Journal of Medicine, 1999. **340**(1): p. 54-7.
8. Aaron, C.A., *et al.*, *Impact of risk-adjusting cesarean delivery rates when reporting hospital performance*. JAMA, 1998. **279**(24): p. 1968-72.
9. Elliott, J.P., M.M. Russell, and L.A. Dickason, *The labor-adjusted cesarean section rate - A more informative method than the cesarean section "rate" for assessing a practitioner's labor and delivery skills*. Am J Obstet Gynecol, 1997. **177**(1): p. 139-43.
10. Gilbert, W.M., T.S. Nesbitt, and B. Danielsen, *Childbearing beyond age 40: Pregnancy outcomes in 24,032 cases*. Obstetrics & Gynecology, 1999. **93**(1): p. 9-14.
11. Keeler, E.B., *et al.*, *Adjusting cesarean delivery rates for case-mix*. HSR, 1997. **32**: p. 511-28.
12. Lieberman, E. and L.J. Heffner, *Assessing the role of case mix in cesarean delivery rates*. Obstetrics & Gynecology, 1998. **92**(1): p. 1-7.
13. Parrish, K.M., *et al.*, *Effect of changes in maternal age, parity, and birth weight distribution on primary cesarean delivery rates*. JAMA, 1994. **271**(6): p. 443-7.
14. Stafford, R.S., *Cesarean section use and source of payment: An analysis of California hospital discharge abstracts*. Am J Public Health, 1990. **80**(3): p. 313-5.
15. Williams, R.L. and P.M. Chen, *Controlling the rise in cesarean section rates by dissemination of information from vital records*. Am J Public Health, 1983. **73**(8): p. 863-7.
16. Herrchen-Danielsen, B. and J.B. Gould, *User Manual and Technical Report: Linkage of Vital Statistics Linked Birth/Infant Death, Infant, and Maternal Hospital Discharge File.*, . 1996, UC Berkeley: Berkeley.
17. Herrchen, B., J.B. Gould, and T.S. Nesbitt, *Vital Statistics Linked Birth/Infant Death and Hospital Discharge Record Linkage for Epidemiological Studies*. Computers and Biomedical Research, 1997. **30**: p. 290-305.

Hospital Level Results: Graphics and Tables

The graphics and tables attached to this report present risk-adjusted c-section rates for all California hospitals for each study year in which the hospital reported a minimum of 10 deliveries and 3 cesarean sections among the nulliparous population. The tables include only civilian hospitals reporting to the OSHPD.

Rates are reported on an annual basis, rather than as one aggregated rate. The annual breakdown allows hospitals to observe patterns in their performance over the three-year study period. An aggregated c-section rate would hide changes in practice patterns that the hospital might have undertaken over the years. Also, because the sample size over the three year period is much larger than that for any single year, hospitals labeled as average scorers in each of the three years could potentially be labeled as having a significantly higher or lower than expected *aggregated rate*—a potentially confusing situation to consumers.

Regional Divisions and Subdivisions Used for Hospital Graphics and Tables

Region	Subregion	Graphics Page	Tables Page
Northern California	▪ El Dorado, Placer, Sacramento, Yolo	14	35
	▪ Alpine, Amador, Butte, Colusa, Del Norte, Humboldt, Lake, Lassen, Mendocino, Modoc, Nevada, Plumas, Shasta, Sierra, Siskiyou, Sutter, Tehama, Trinity, Yuba	15	36
Bay Area	▪ Alameda, Contra Costa	16	39
	▪ Marin, Napa, Solano, Sonoma	17	40
	▪ San Francisco	18	42
	▪ San Mateo, Santa Clara	19	42
Central California	▪ Calaveras, Fresno, Madera, Mariposa, Merced, Mono, San Joaquin, Stanislaus, Tuolumne	20	44
	▪ Inyo, Kern, Kings, Tulare	21	46
	▪ Monterey, San Benito, Santa Cruz	22	47
	▪ Ventura, Santa Barbara, San Luis Obispo	23	48
Los Angeles	▪ Antelope Valley	24	50
	▪ Burbank/Pasadena/San Gabriel Valley	25	50
	▪ East Los Angeles County	26	51
	▪ San Fernando Valley	27	52
	▪ South Bay/Long Beach/Torrance	28	53
	▪ West Los Angeles and LA Proper	29	55
Southern California	▪ Orange	30	57
	▪ Riverside	31	59
	▪ San Bernadino	32	60
	▪ San Diego/Imperial	33	62

Graphics

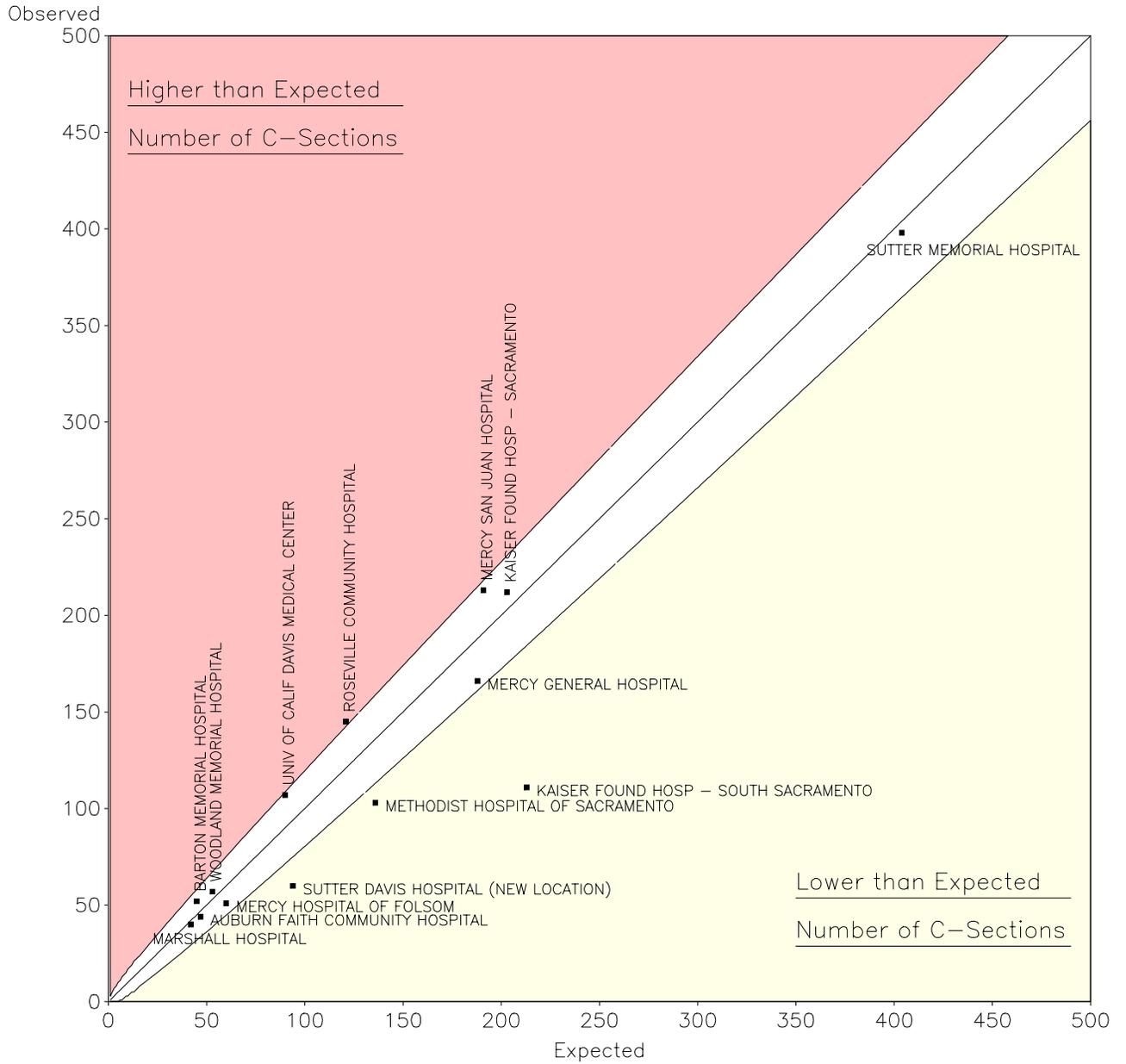
Reading the Graphics

The graphics that follow show the observed versus the expected number of cesarean sections for each hospital in each sub-region.

- Placement in the *white area* (defined by the 95% confidence bands around the 45-degree line) indicates that the hospital had an observed number of c-sections that was no different from the number expected.
- Placement in the *light gray* shaded area indicates that a hospital had a lower than expected number of c- sections
- Placement in the *dark gray* shaded area indicates that a hospital had a higher than expected number of c-sections.

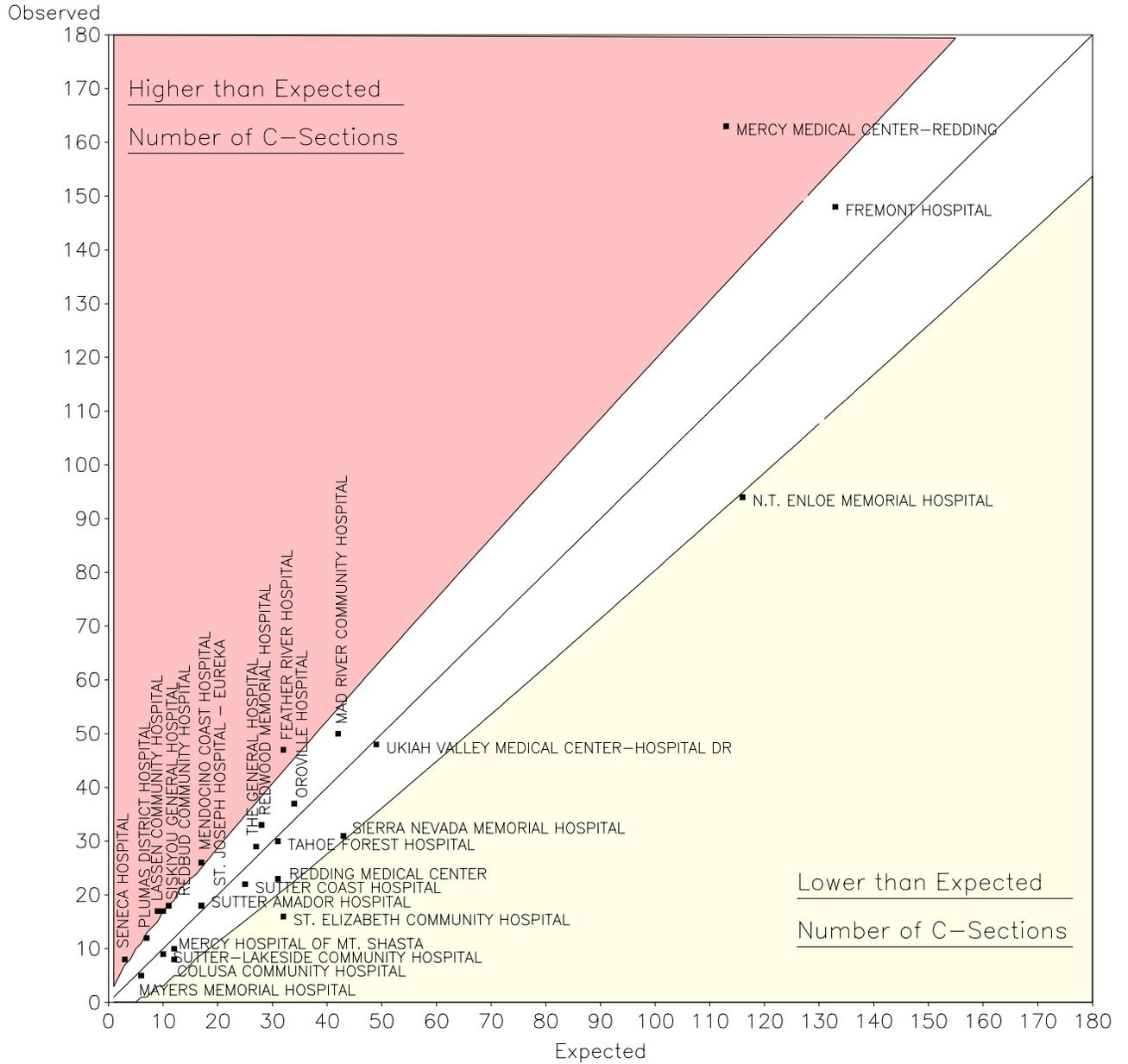
Note that since we used numbers rather than percentages in these diagrams, by definition hospitals with a higher volume of deliveries will be located further to the right.

Figure 1: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital
El Dorado-Placer-Sacramento-Yolo, 1997



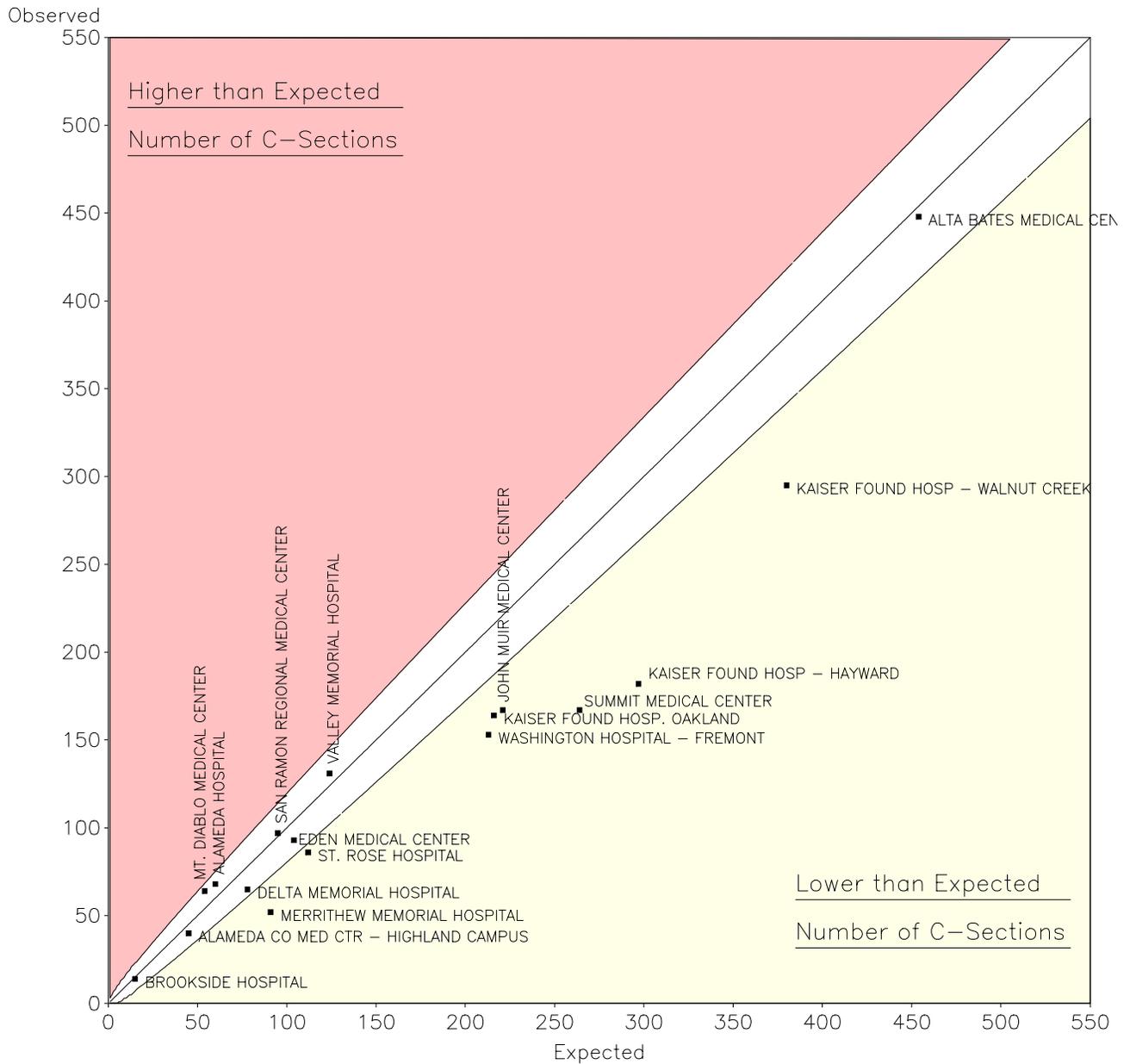
Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Figure 2: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital
Northern California Counties, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

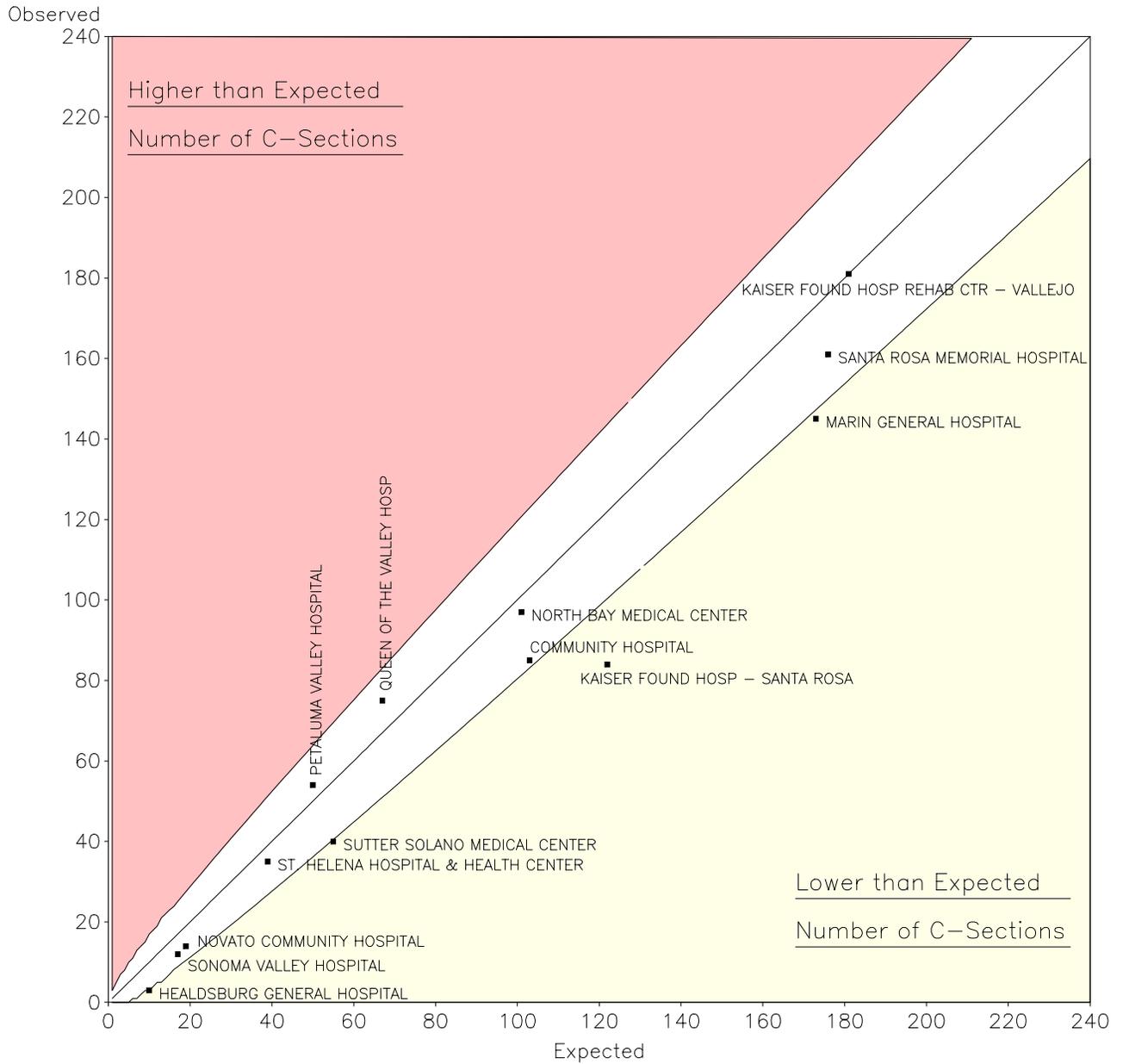
Figure 3: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital
East Bay, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Figure 4: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital

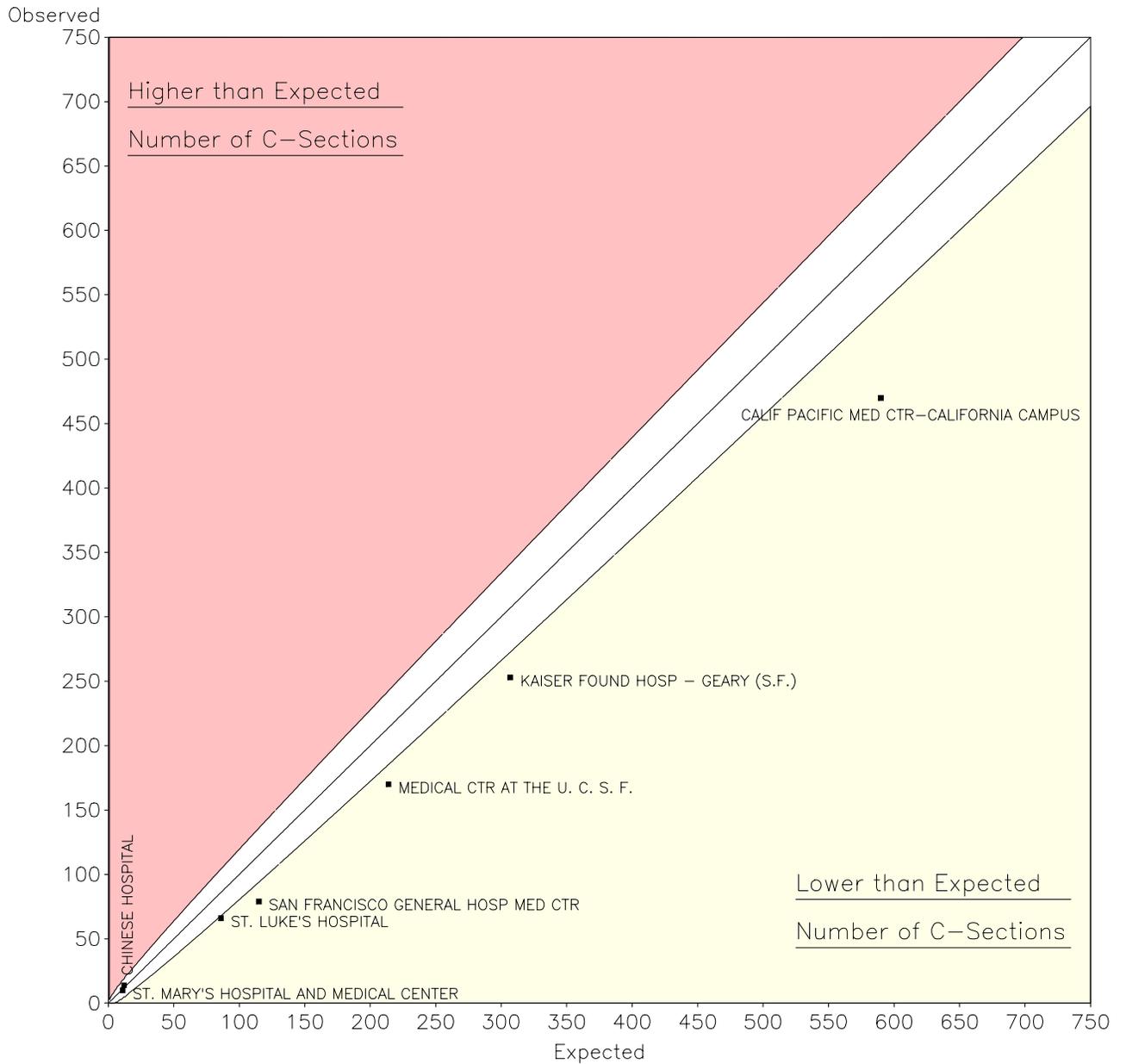
Marin-Napa-Solano-Sonoma, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Figure 5: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital

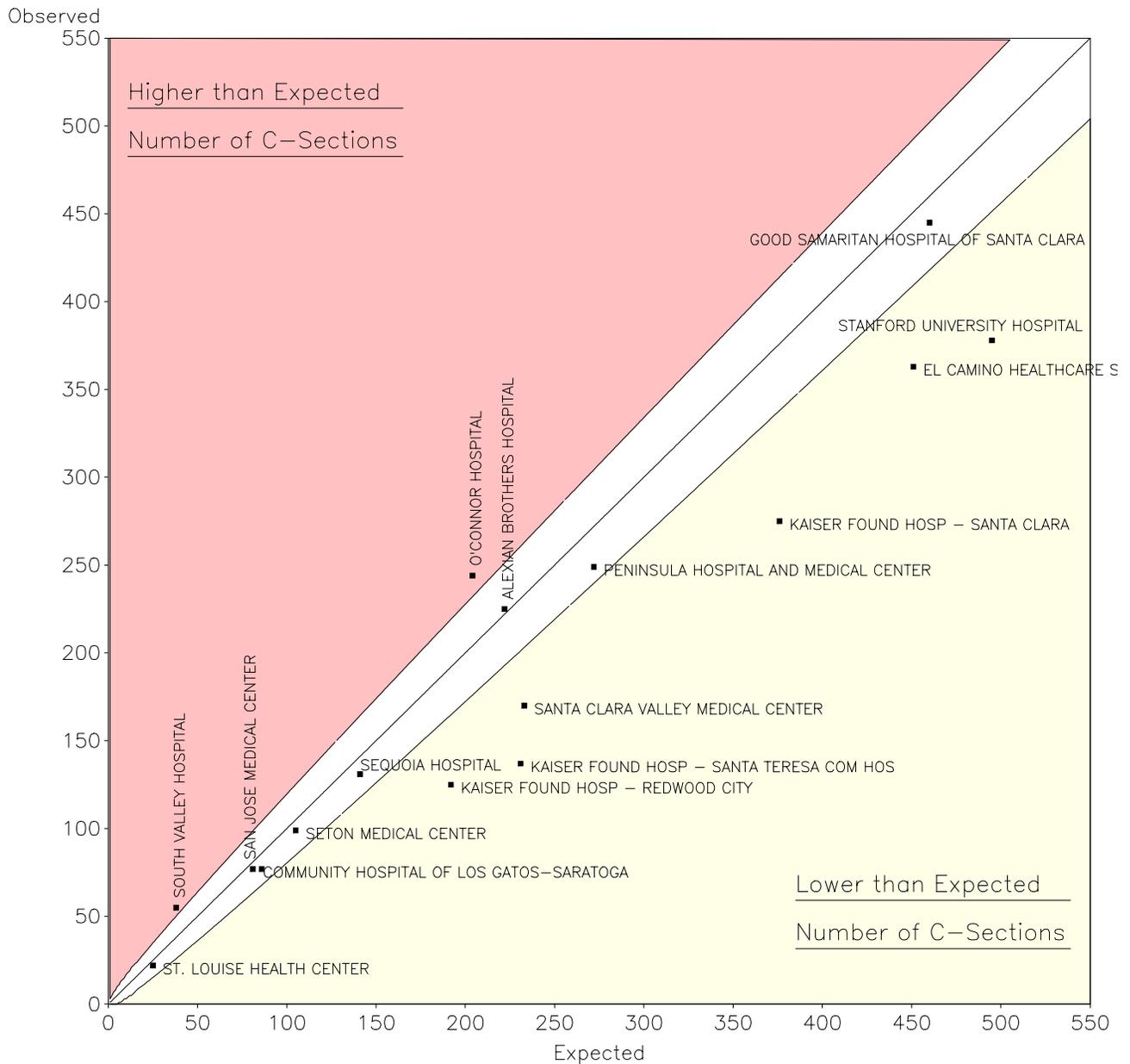
San Francisco, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Figure 6: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital

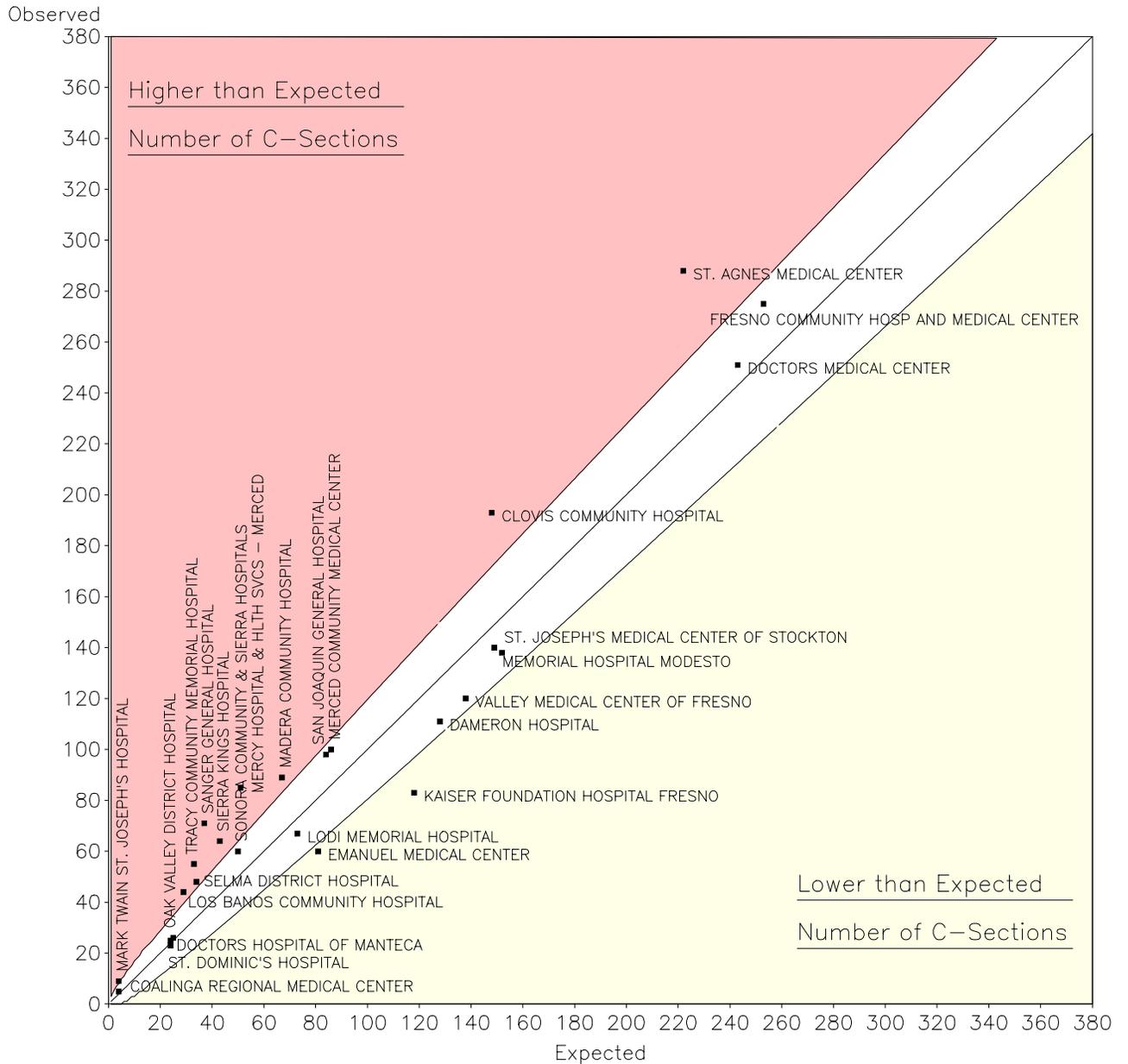
South Bay and San Jose, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

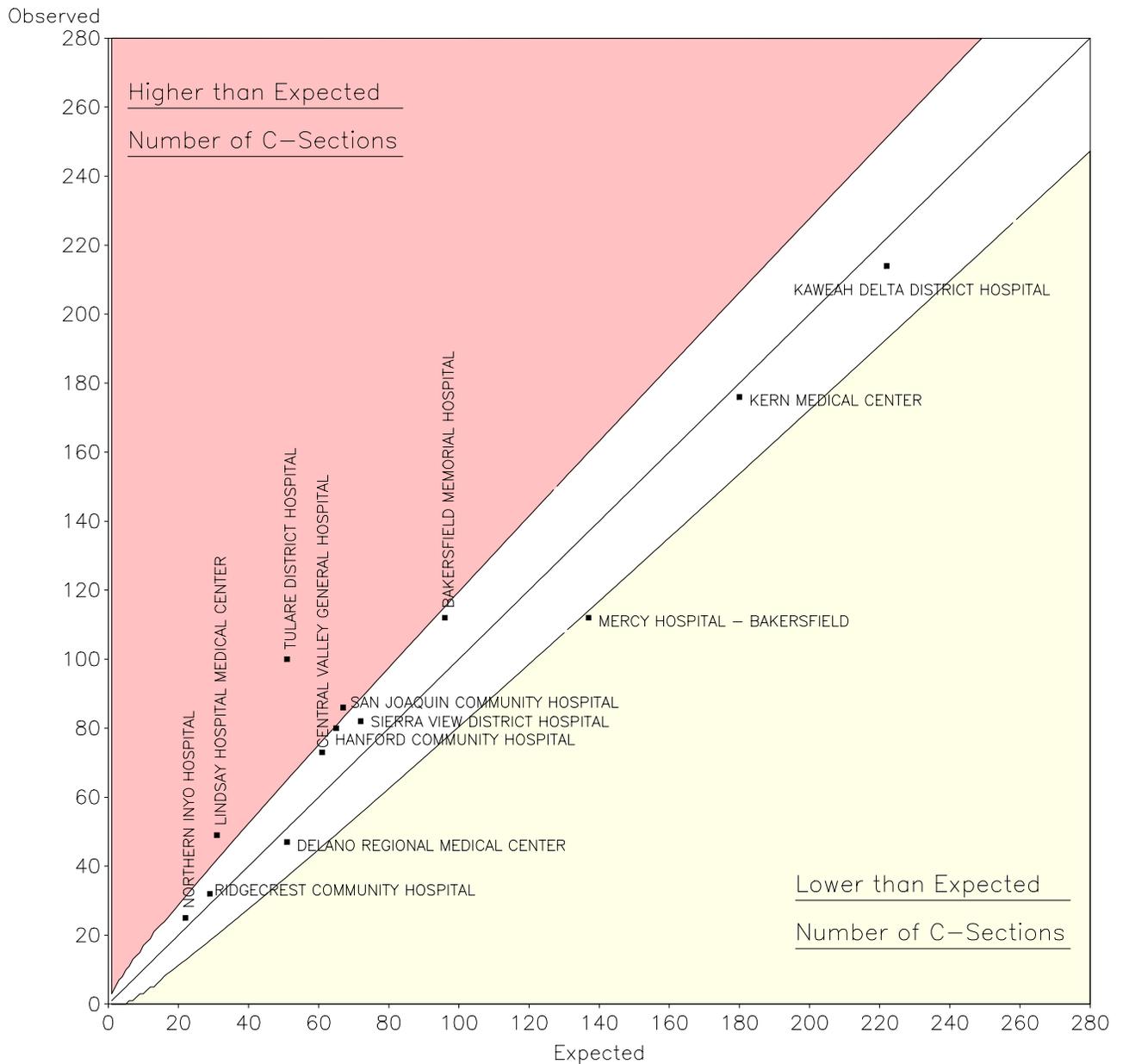
Figure 7: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital

Central Valley, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

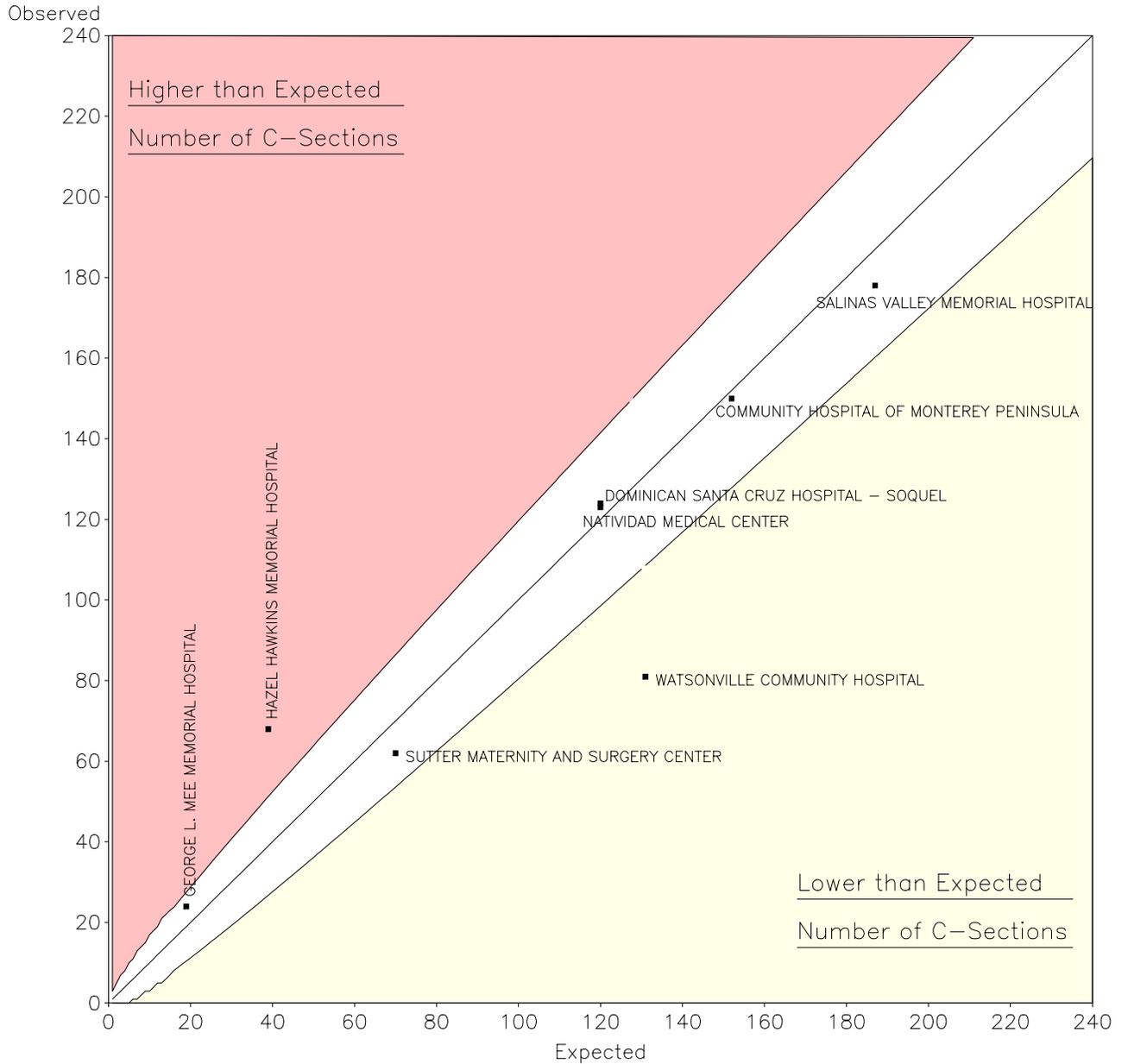
Figure 8: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital
Inyo-Kern-Kings-Tulare, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Figure 9: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital

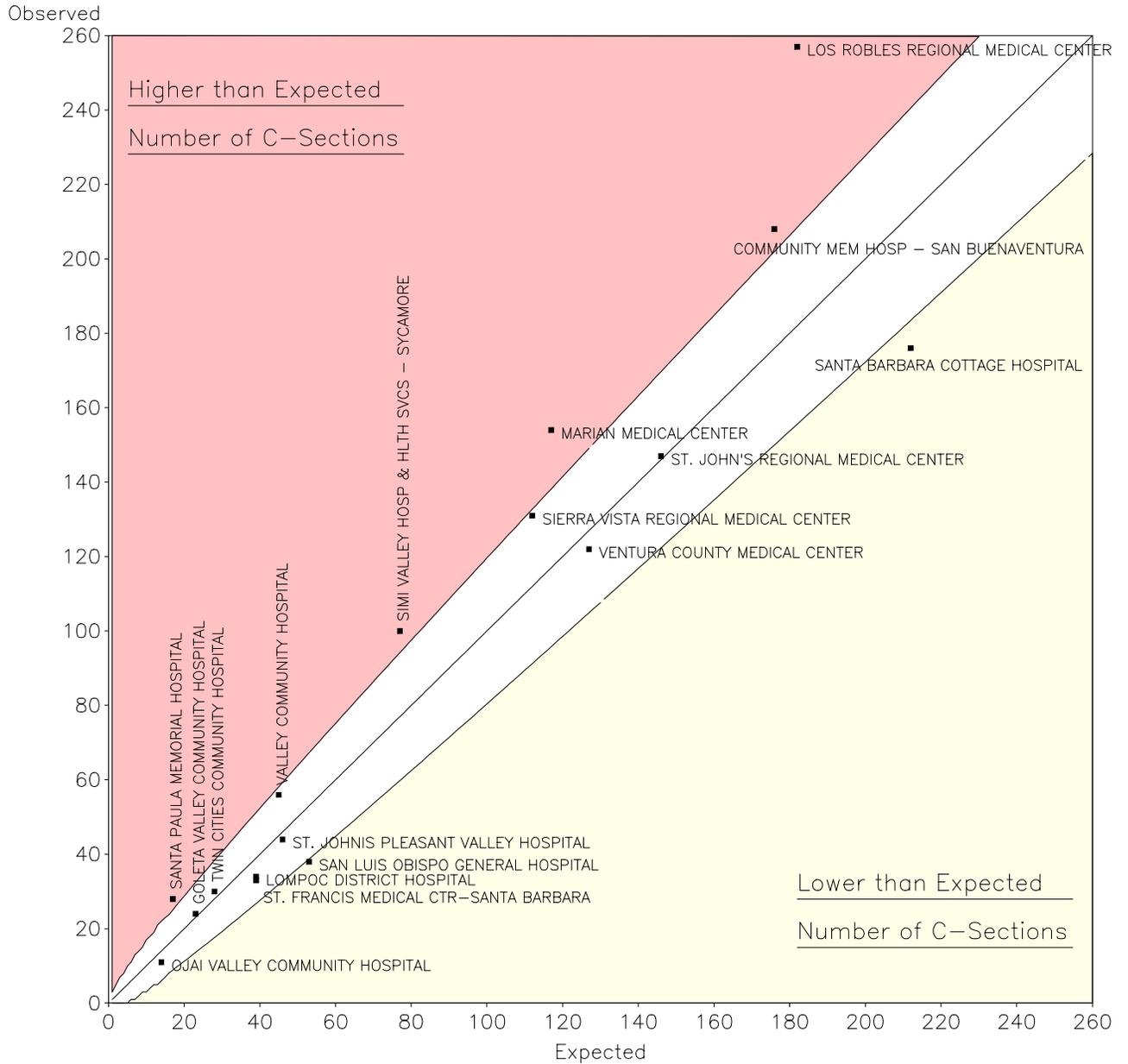
Monterey-San Benito-Santa Cruz, 1997



- Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
- 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Figure 10: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital

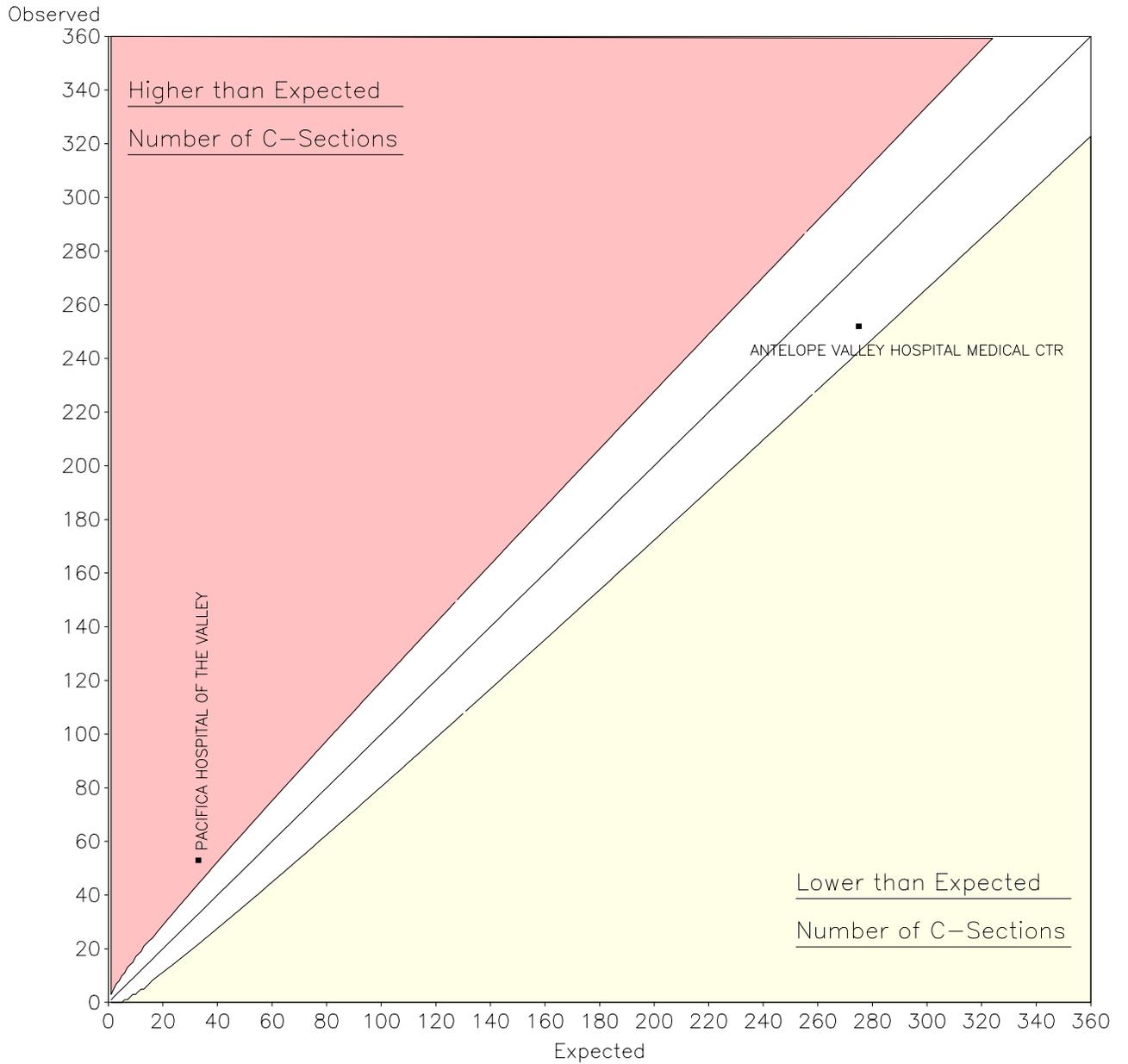
Ventura-Santa Barbara-San Luis Obispo, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

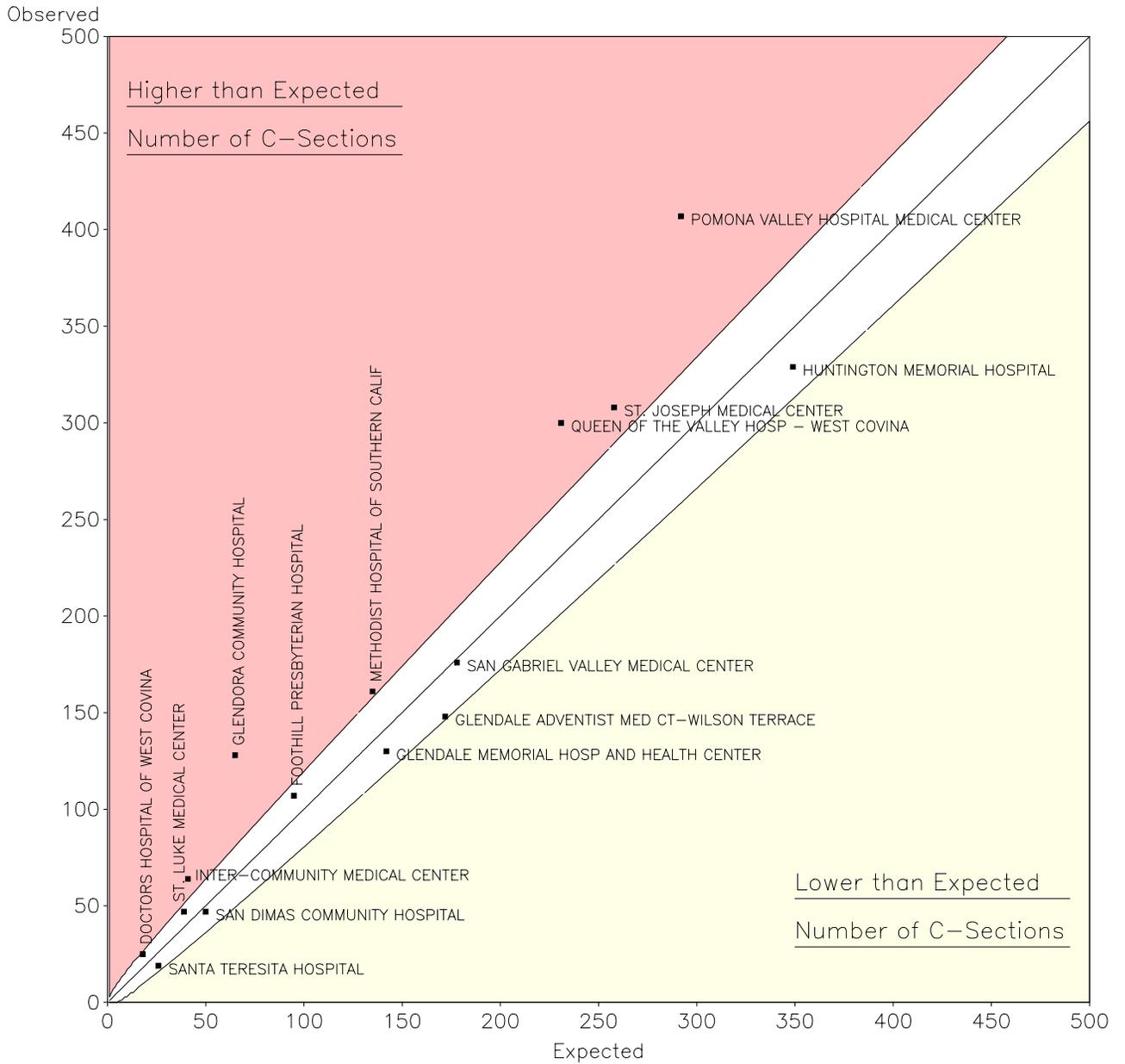
Figure 11: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital

Antelope Valley, 1997



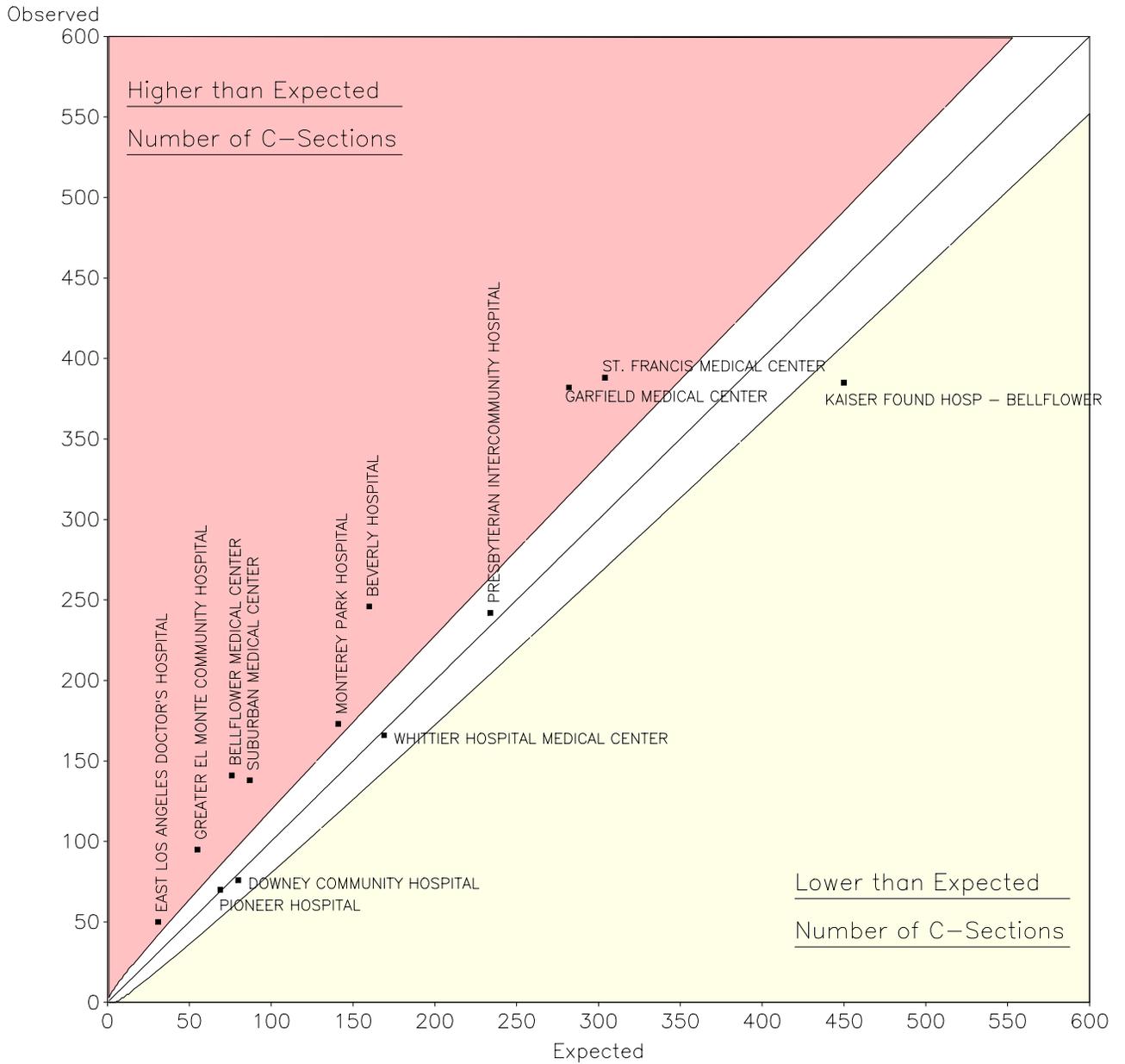
Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Figure 12: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital
Burbank-Pasadena-San Gabriel Valley, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

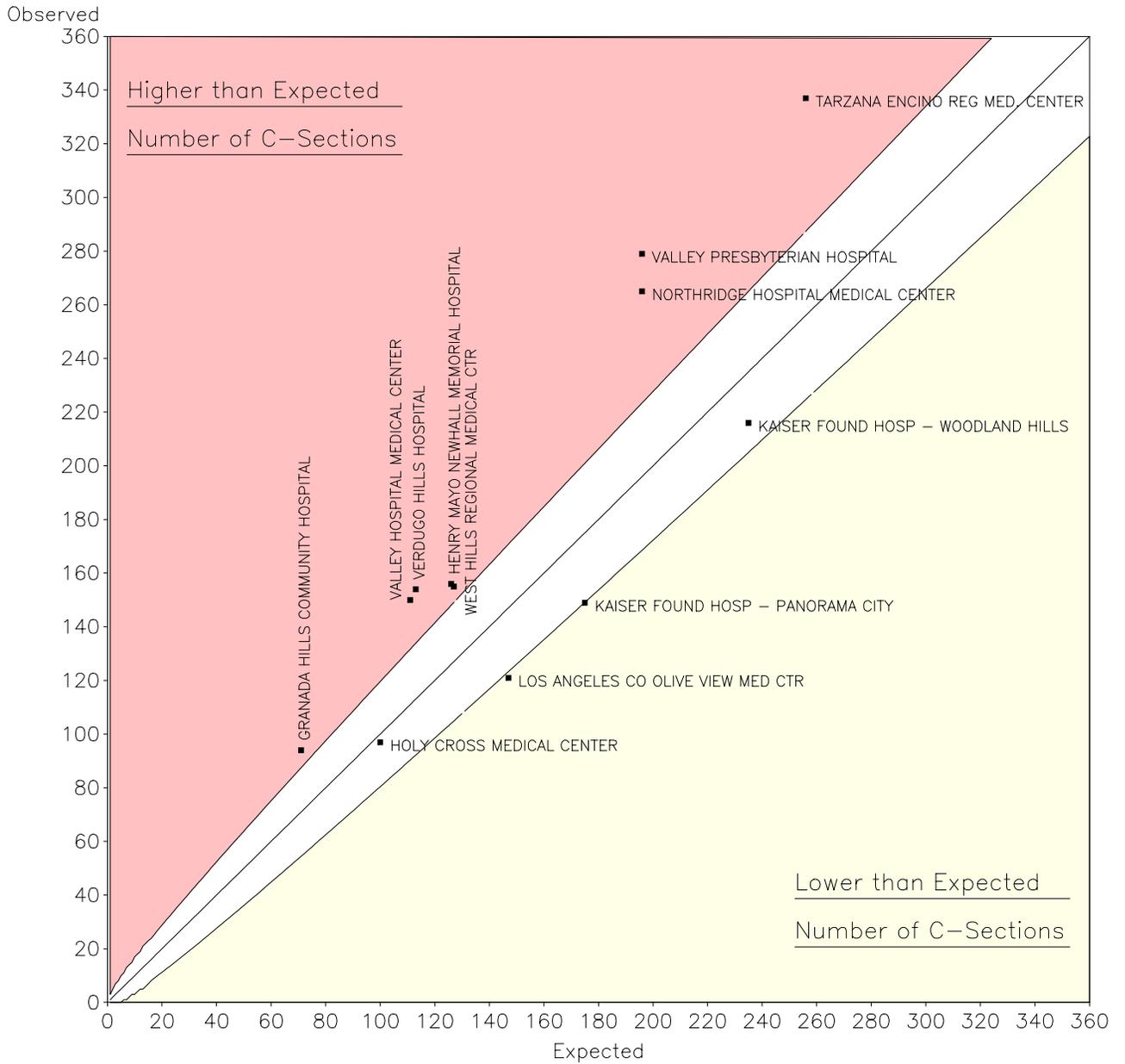
Figure 13: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital
East Los Angeles County, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Figure 14: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital

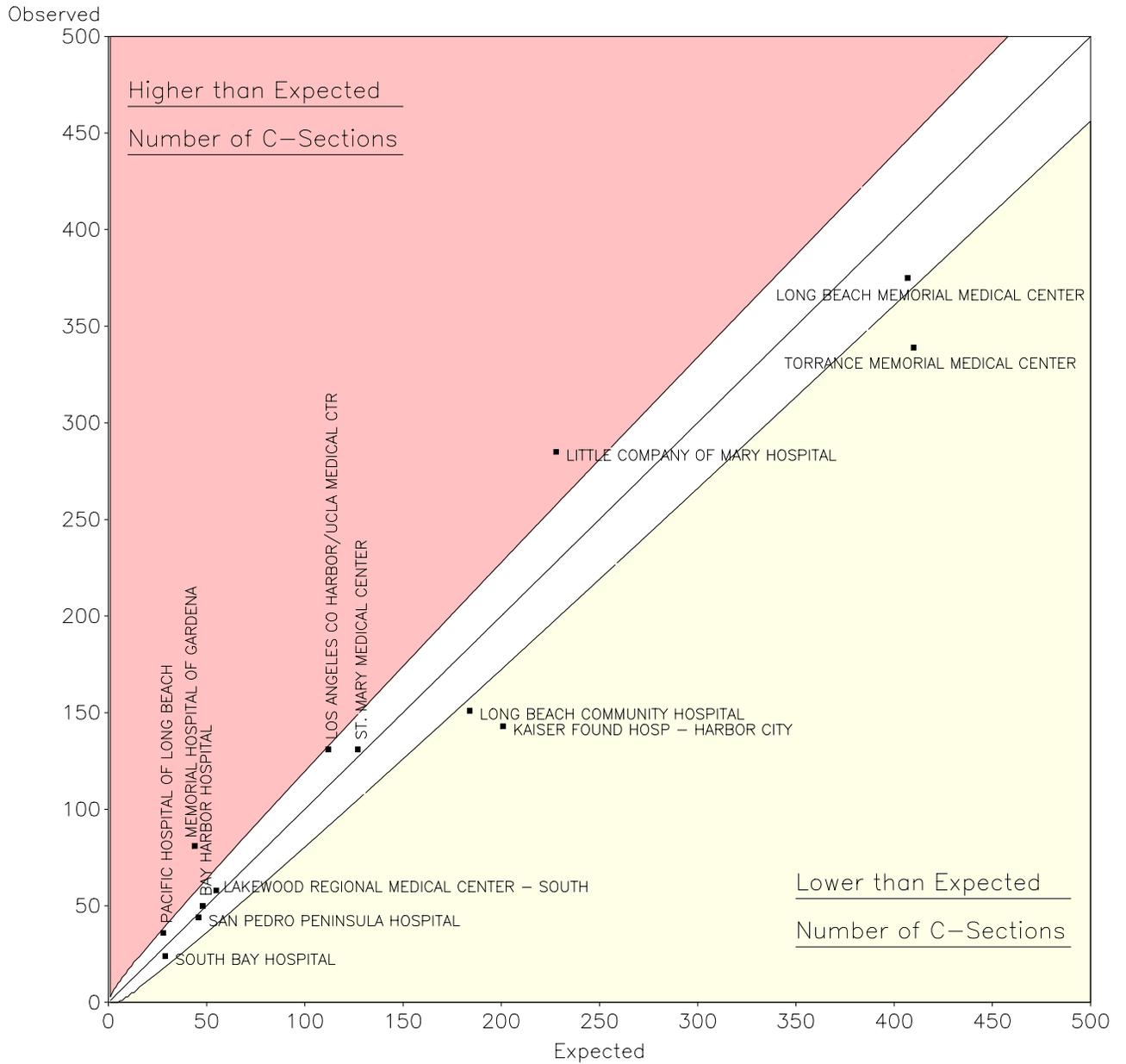
San Fernando Valley, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Figure 15: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital

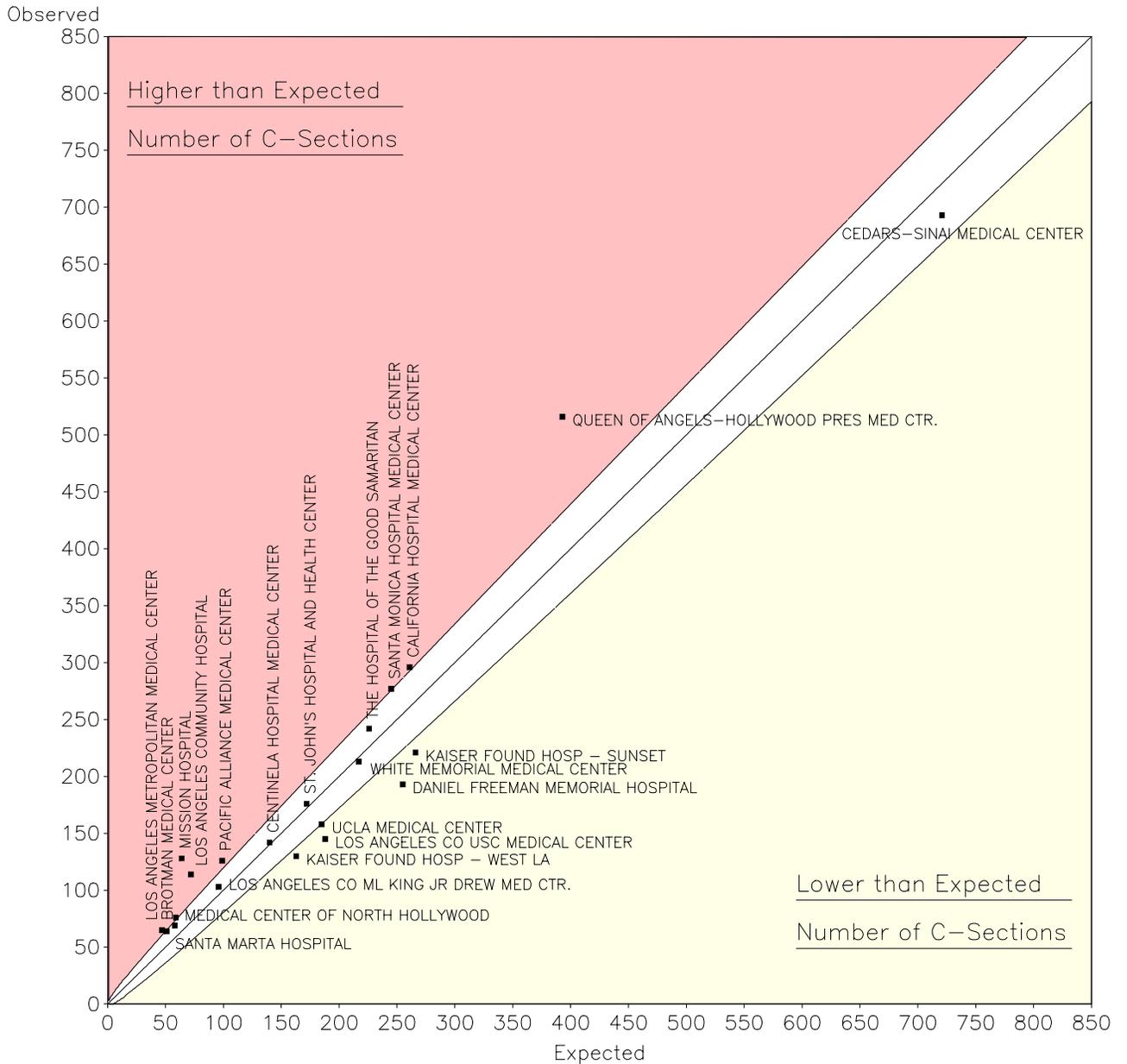
South Bay-Long Beach-Torrance, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Figure 16: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital

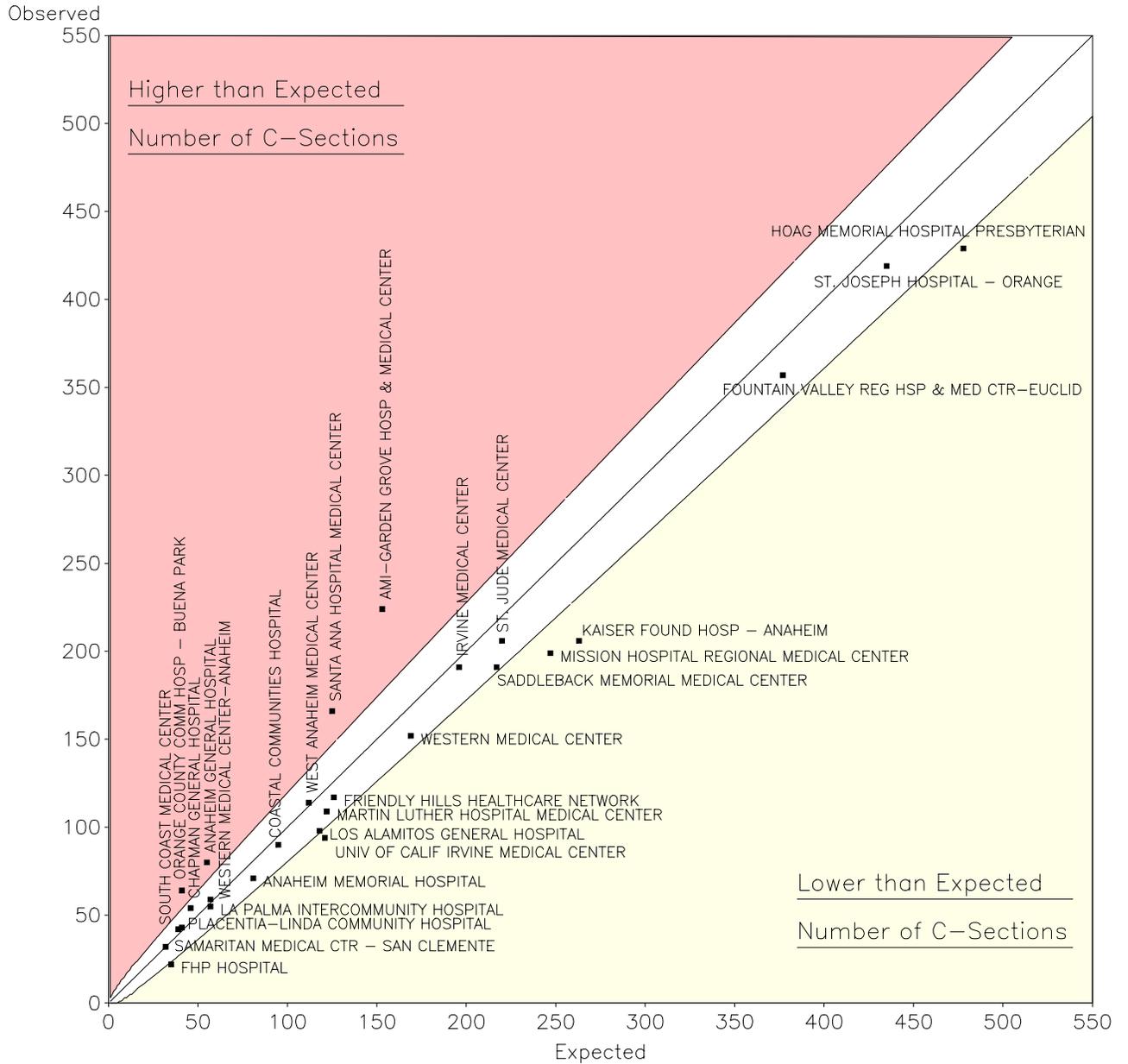
West Los Angeles and Los Angeles Proper, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Figure 17: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital

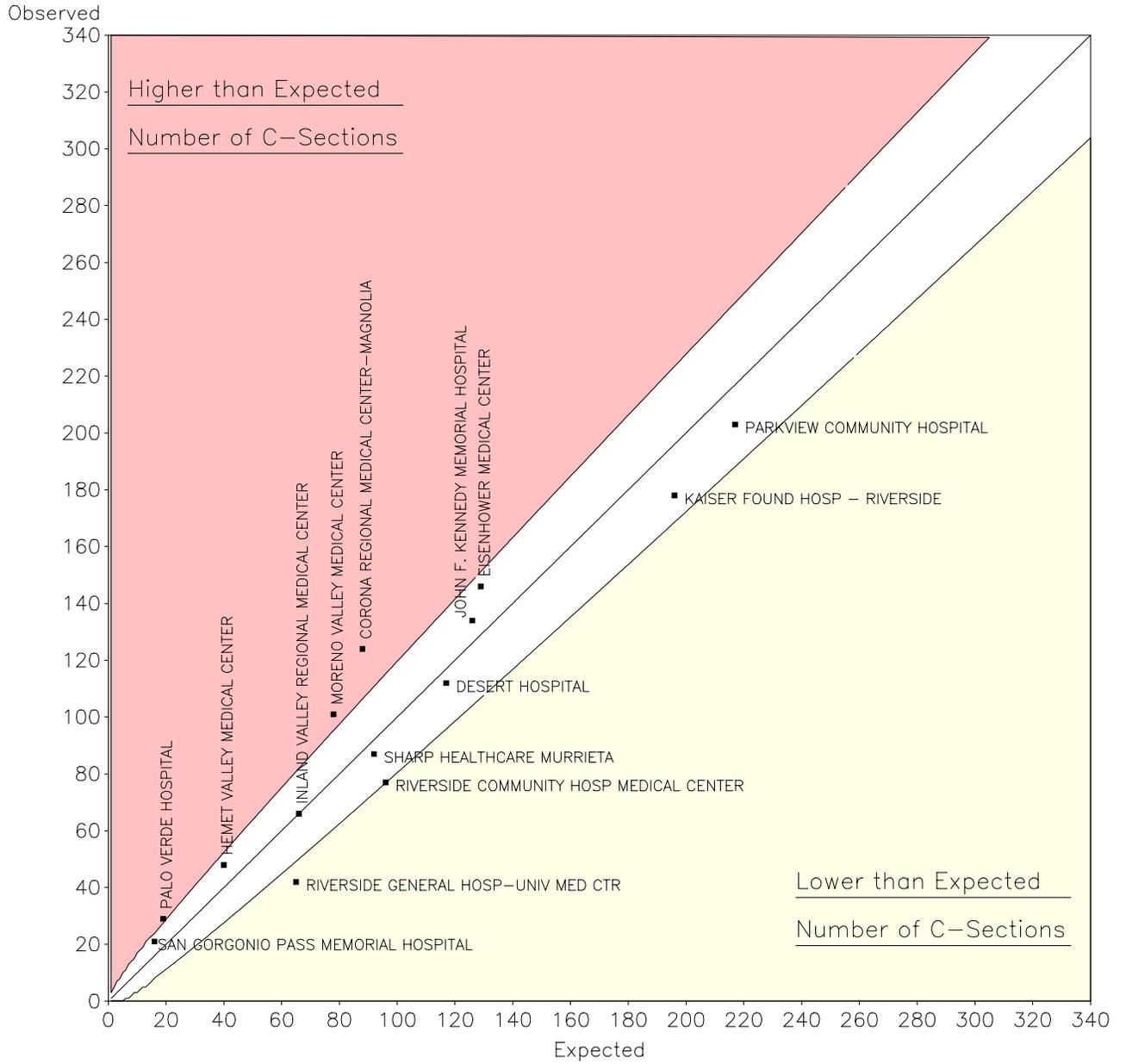
Orange County, 1997



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

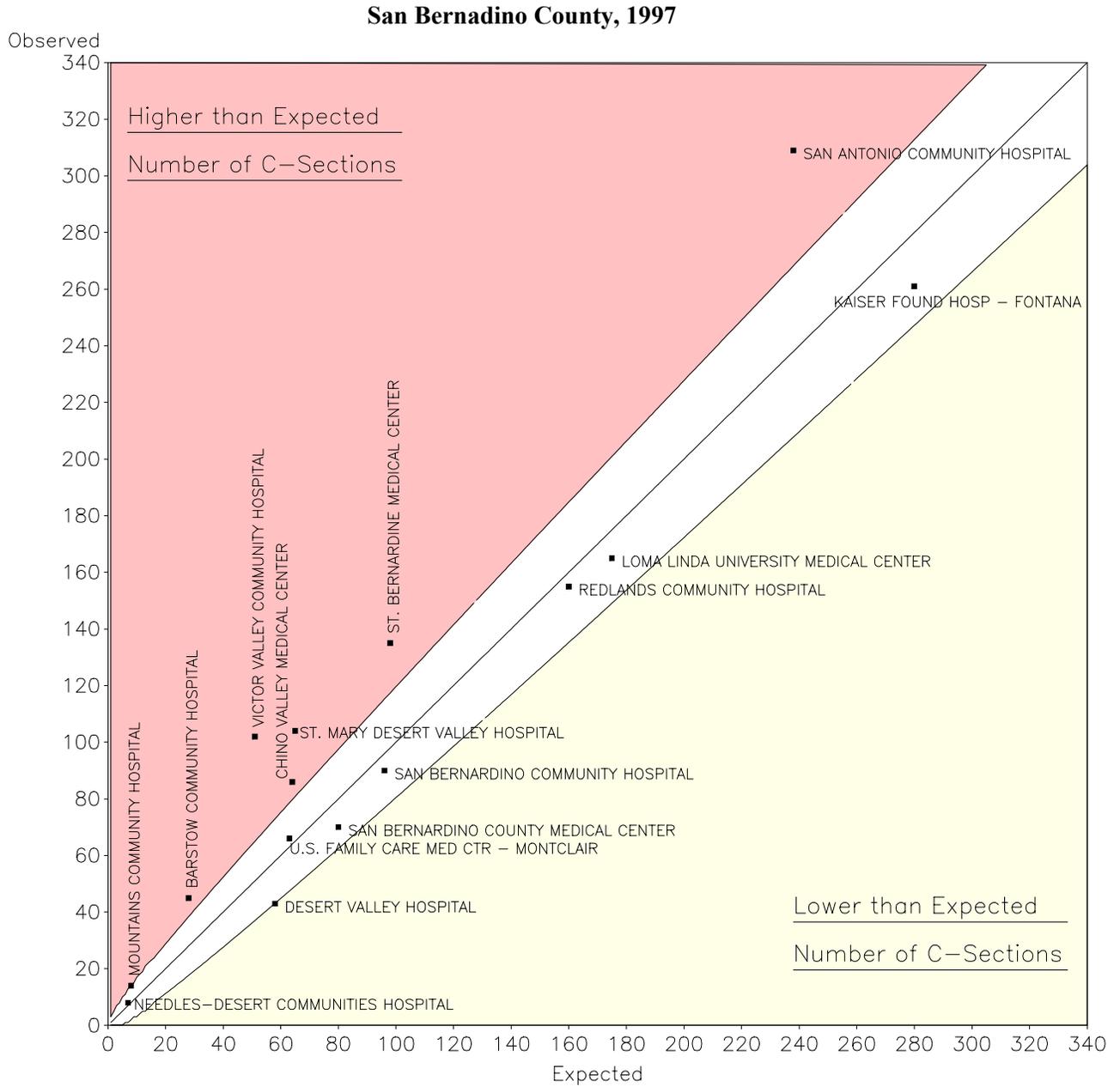
Figure 18: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital

Riverside County, 1997



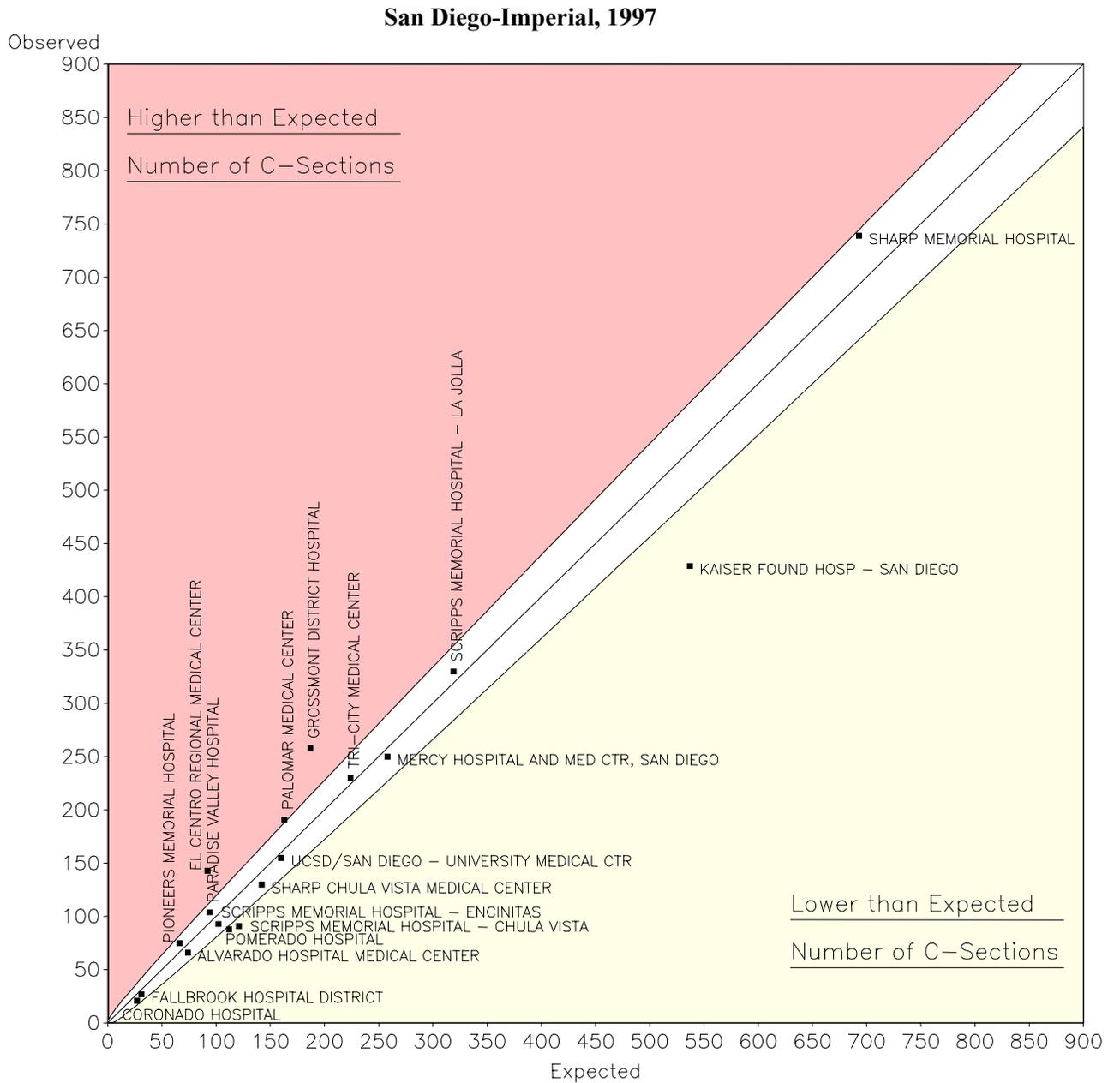
- Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
- 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Figure 19: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Figure 20: Observed versus Expected Cesarean Sections for Nulliparous Women by Hospital



Notes: 1. Hospitals with 10 or fewer deliveries or 2 or fewer observed cesarean sections were excluded.
 2. The higher the volume of deliveries in a hospital, the further to the right the hospital appears in the chart.

Tables

Hospital-level tabulations of cesarean section rates are available on the [CPOCC website](#) for the following categories women:

- nulliparous women
- multiparous women without previous cesarean section
- multiparous women with previous cesarean section

Reading the Tables

Explanation of Columns in Hospital Tables

Column	Heading	Explanation
1	County	The county location of the hospital.
2	Hospital ID	6-digit identifier of hospital provider used by OSHPD.
3	Hospital Name	Name of provider
4	Year	Year for which calculations are valid
5	Result ²	Rating of hospital's risk-adjusted cesarean section rate: <input type="checkbox"/> statistically significantly lower than expected <input type="checkbox"/> not significantly different than expected <input type="checkbox"/> statistically significantly higher than expected
7	At Risk Population	Number of deliveries for each hospital
8	Observed Rate	Observed cesarean section rate (Number of cesarean sections divided by the number of deliveries)
9	Expected Rate	The rate that reflects the hospital's casemix. Developed by summing the likelihood of a c-section for each of the hospital's patients, based on the logistic regression model. (Expected number of cesarean sections divided by the number of deliveries multiplied by 100)
10	Adjusted Rate	Risk-adjusted cesarean section rate obtained by multiplying the <i>observed</i> hospital-level c-section rate by the hospital casemix index (calculated as the ratio of the observed statewide c-section rate to the expected c-section rate.)
11	Observed To Expected Ratio	Ratio of observed to expected number of cesarean sections. An O/E ratio of less than 1 indicates that the hospital performed fewer cesarean sections than would have been expected based on the statewide average. A ratio of more than one indicates that the hospital performed more c-sections than would have been expected based on the statewide average.
12	Ratio (LCL)	Lower 95% confidence boundary for the ratio of observed to expected number of cesarean sections
13	Ratio (UCL)	Upper 95% confidence boundary for the ratio of observed to expected number of cesarean sections

Notes:

1. The tables include only civilian hospitals reporting to the OSHPD.
2. Data for a hospital were excluded if:
 - There were fewer than 10 deliveries in the study population for the study year listed, or
 - The hospital performed 3 or fewer cesarean sections in the study year listed.

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