

CHAPTER FOUR

The Surgical Treatment of Common Diseases

The Surgical Treatment of Common Diseases

While geographic variation in the use of surgery has long been recognized, not all surgical procedures are equally variable. For example, colon resection (colectomy) exhibits the same low variation pattern seen with hospitalization rates for hip fracture (Chapter Three). Other procedures, such as coronary artery bypass grafting, are highly variable.

What distinguishes low variation from high variation surgery? In general, low variation procedures are non-discretionary; they are used to treat clinical conditions for which physicians agree on the most appropriate treatment strategy. In addition, patient and doctor preferences are aligned — both parties have the same goals. Conversely, high variation procedures involve physician discretion; the variability reflects underlying problems in medical decision making that occur because of inadequate science and failure to take patient preferences into account.

- Sometimes, medical science is inadequate to provide definitive information on which treatment is likely to provide the best outcome for a given patient. In these cases, procedure rates vary because physicians disagree about the effectiveness of surgery.
- Sometimes, the scientific evidence regarding outcomes is adequate, but the available treatments have different risks and benefits, which only the patient can assess. The fact that patient preferences are unevenly incorporated into treatment decisions results in high variation in procedure rates.

In this chapter, we describe how these two factors are reflected in the variation profiles of common surgical procedures. The eight high variation procedures are all performed on members of BCBSM. We then examine the “surgical signatures” which demonstrate the sometimes striking variations in the amount of surgery provided between neighboring hospital service areas. The study is restricted to the 48 hospital service areas where the BCBSM adult membership exceeds 10,000.

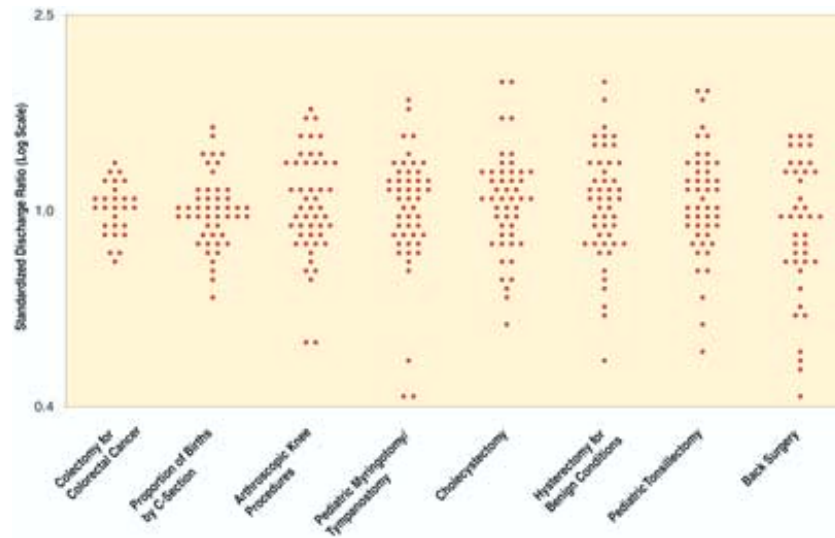


Figure 4.1. Profiles of Surgical Variation of Eight Common Surgical Procedures (1996 and 1997)

The figure provides a visual impression of variability. Table 4.1 reports the corresponding quantitative measures of variability in Michigan hospital service areas. The procedures are ranked from low to high, according to the coefficient of variation (CV). Only those hospital service areas with at least 25 expected events are included in the analysis. The CV of hysterectomy, a high variation procedure, is more than twice that of colectomy; and back surgery is even more variable. The table also reports the extremal ratio, or the ratio of the highest rate to the lowest. The extremal ratio of colectomy is 1.6. The extremal ratio of tonsillectomy is 4.1 times higher in the highest-rate region than in the lowest.

TABLE 4.1. QUANTITATIVE MEASURES OF VARIABILITY OF EIGHT COMMON SURGICAL PROCEDURES BY HOSPITAL REFERRAL REGIONS (1996 AND 1997)

	Colectomy for Colorectal Cancer per 1,000 Medicare Enrollees (1996)	Proportion of Births by Cesarean Section (1997)	Arthroscopic Knee Procedures per 1,000 BCBSM Members (1997)	Myringotomy/Tympanostomy per 1,000 Child BCBSM Members (1997)	Cholecystectomy per 1,000 Adult BCBSM Members (1997)	Hysterectomy for Benign Conditions per 1,000 Adult Female BCBSM Members (1997)	Tonsillectomy per 1,000 Child BCBSM Members (1997)	Back Surgery per 1,000 Adult BCBSM Members (1997)
Index of Variation								
Coefficient of Variation (CV)	12.3	16.6	23.4	23.9	24.4	25.3	26.7	29.6
Ratio to CV of Colectomy for Colorectal Cancer	1.0	1.4	1.9	1.9	2.0	2.1	2.2	2.4
Range of Variation								
Extremal Ratio (highest to lowest region)	1.6	2.2	3.0	3.9	3.2	3.6	4.1	3.4
Interquartile Ratio (75th to 25th percentile region)	1.2	1.2	1.4	1.3	1.4	1.4	1.4	1.5

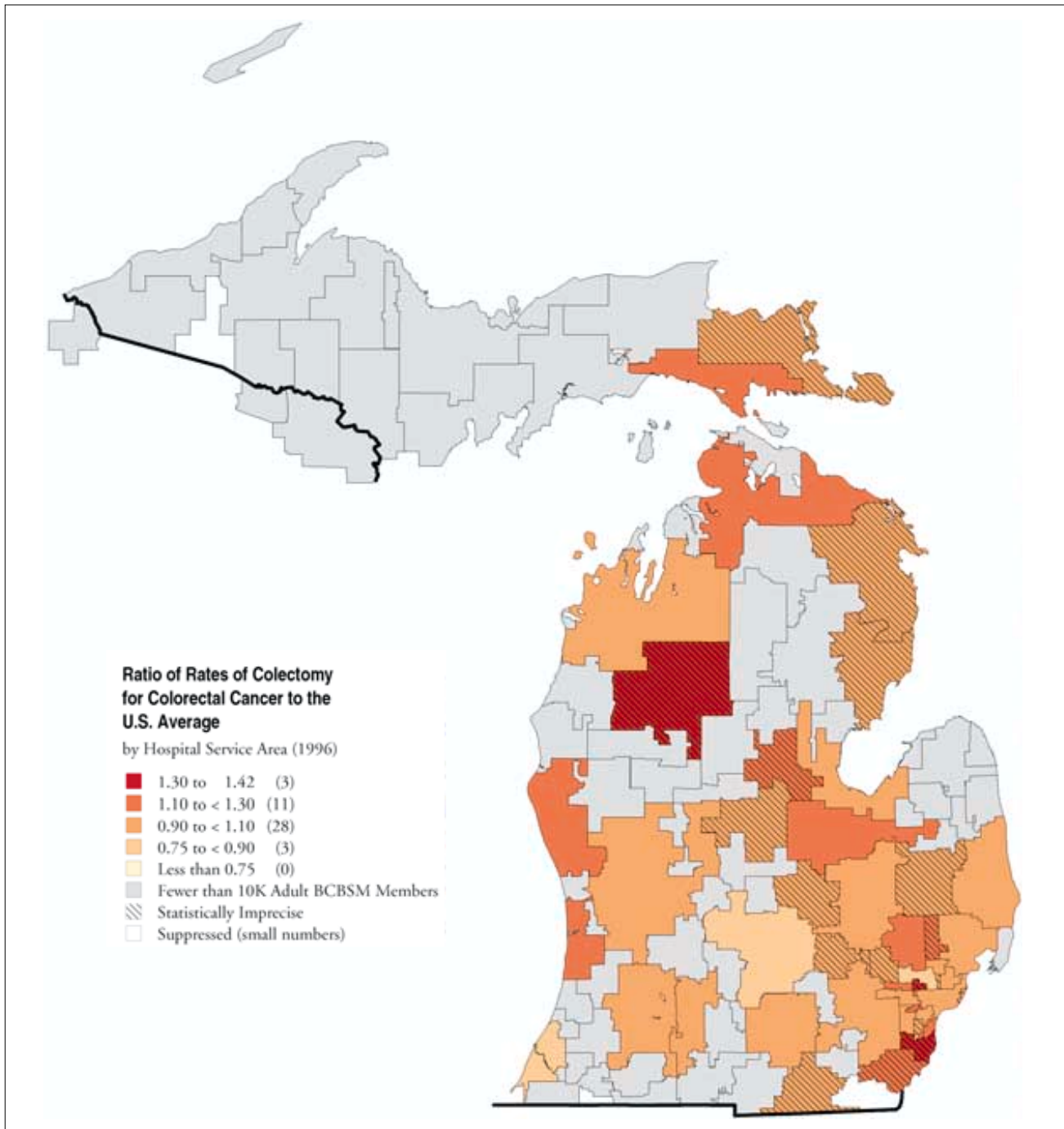
Epidemiologists sometimes use the interquartile ratio as a measure of variation. This statistic is the ratio of the rate in the region ranked at the 75th percentile to the region ranked at the 25th percentile. The interquartile ratio of colectomy is 1.2. Among the procedures listed in the table, the interquartile ratio of back surgery is the highest; the region ranked at the 75th percentile is 1.5 times higher than the region ranked at the 25th percentile.

Colorectal Cancer

Malignant tumors of the colon or rectum are detected in a number of ways. They can be identified during evaluation of patients presenting with abdominal pain, constipation, or rectal bleeding. Cancers can also be detected by screening asymptomatic patients with fecal occult blood tests (which identify trace amounts of blood in the stool) or endoscopy (examination of the rectum and colon with a lighted scope).

The status of science is, by and large, quite good. Once a cancer is identified, there is universal agreement about the need for surgical removal of the tumor (colectomy). In this procedure, the segment of colon containing the tumor is removed and the remaining bowel is reconnected by an anastomosis. In the case of colectomy, physicians and patients share the common goal of extending life expectancy. Even among patients for whom cure is not possible (because of distant cancer spread), surgery is generally recommended for palliative purposes, such as reducing risks of later bowel obstruction.

The dilemma of choice is virtually a non-issue. Colectomy is the only recognized approach to cancer cure, and the only available alternative for attempting to extend patients' life expectancies. Physicians and patients share the same goals and agree on the need for surgery.



Map 4.1. Colectomy for Colorectal Cancer (1996)

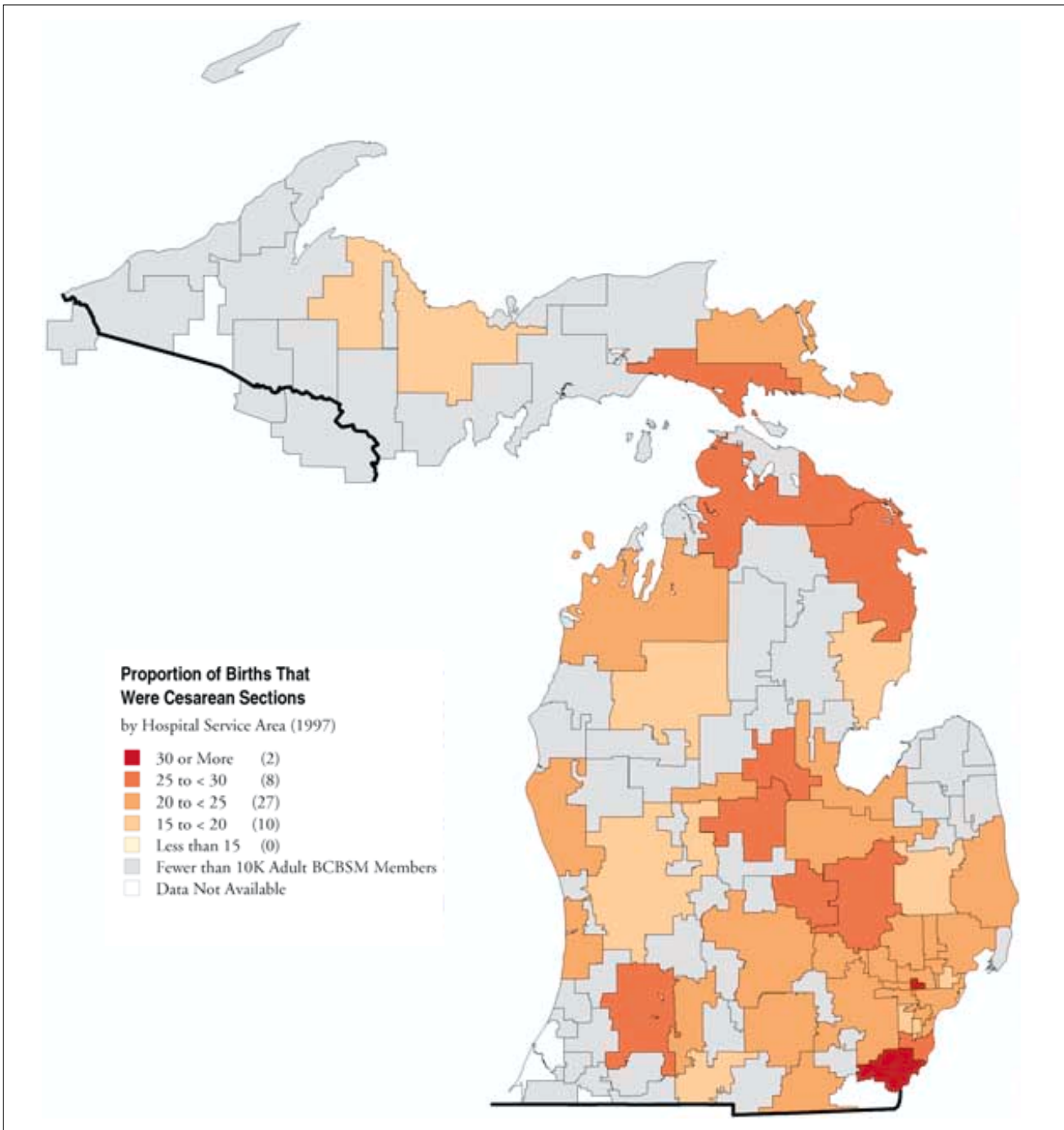
Three hospital service areas had rates of colectomy at least 30% higher than the national average of 2.5 per 1,000 Medicare enrollees. No area had a rate more than 25% below the average. There was little variation in rates of colectomy; rates ranged from 2.0 to 3.2 per 1,000 Medicare enrollees. (Medicare data were used in this analysis due to the small incidence of colectomy in the BCBSM population.)

Childbirth

Until the 1970s, fewer than 10% of children were born with surgical intervention. In the early 1970s cesarean section became increasingly common. In the last three decades, a number of factors have dramatically increased the proportion of infants delivered by cesarean section, including increased use of fetal monitoring, concern about adverse outcomes, fear of litigation, and convenience. These factors have resulted in a current national rate of more than one in five infants being delivered by cesarean section. In some situations, such as severe fetal distress, extremely large infants, infections of the birth canal or certain medical conditions of the mother, cesarean section can be life saving; but the indications are not as clear for all cesarean sections. The Department of Health and Human Services made a national goal of reducing rates of cesarean sections to 12% of all births (primary and repeat) as part of the ‘Healthy People 2010’ promotion.

The status of science is mixed. While there is good data to support cesarean section for certain indications, in many instances research has not shown improved perinatal outcomes. For women with a previous cesarean section, this choice is made more difficult by the recent endorsement by the American College of Obstetricians and Gynecologists of a guideline that could effectively limit vaginal births after cesarean section (VBACs) to large institutions with full time, on-site anesthesiologists.

The dilemma of choice. Fear and anxiety — in parents and providers — often interfere with the “natural” process of childbirth, and the ability to make informed decisions once labor has begun is problematic. Achieving a uniform cesarean section rate would require more research on its effectiveness and a concerted effort to use what is now known — on the part of both providers and parents.



Map 4.2. Cesarean Sections (1997)

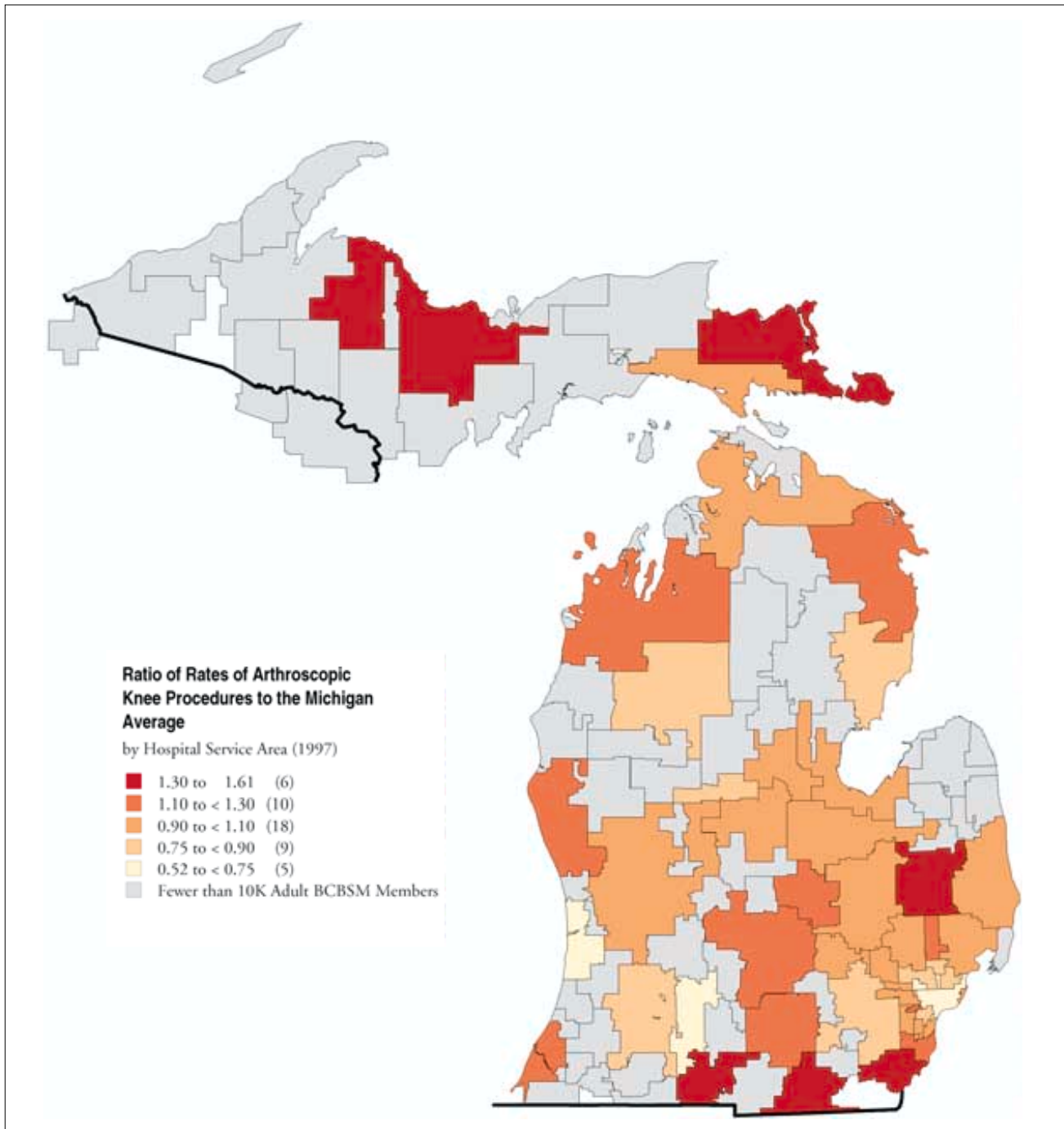
Two hospital service areas had rates of cesarean sections of at least 30%. Ten hospital service areas had rates of less than 20%. The percent of deliveries that were cesarean sections varied by a factor of two, from 15.1% to 33.3% of births. The statewide cesarean section rate was 22.8%; the rate of vaginal birth after a previous cesarean section was 33.4%.

Injuries to the Knee

Knee injuries are among the most common musculoskeletal problems for which diagnostic and therapeutic arthroscopies are performed. The most common of these are meniscal tears and more serious cruciate ligament disruptions. These generally occur as sports injuries in young athletes, and in adults who exercise vigorously but only sporadically. In older patients arthritis is the most common cause of knee symptoms. Non-acute injuries include knee sprains and strains.

The status of science is mixed. There have been no randomized trials of treatment for cruciate injuries. While there is evidence that meniscal repair is an effective treatment for athletes, there is less evidence of benefit from cruciate repair in the non-athlete. Arthroplasty for those with significant arthritis who have failed anti-inflammatories and have difficulty walking has been proven to relieve pain and improve function. Knee replacement surgery has been shown to be highly effective, but like any surgery it is not without risk. There is virtually no evidence of benefit from diagnostic arthroscopy for ill-defined knee pain.

The dilemma of choice. Because there is inadequate science to prove or disprove the value of meniscal and cruciate repair in the general population, decisions about whether to undergo arthroscopy are necessarily made under conditions of uncertainty. While arthroscopy is relatively safe, it involves the same risk as any hospital procedure (such as infection), and can involve several days of recovery time. Newer diagnostic tests such as magnetic resonance imaging can provide good information without invasive procedures, and might be considered as an alternative to more-invasive arthroscopy. Knee replacement surgery can provide substantial improvement in function and pain relief, but involves both major invasive surgery, with its attendant risks, and substantial recovery time.



Map 4.3. Diagnostic and Therapeutic Arthroscopies of the Knee (1997)

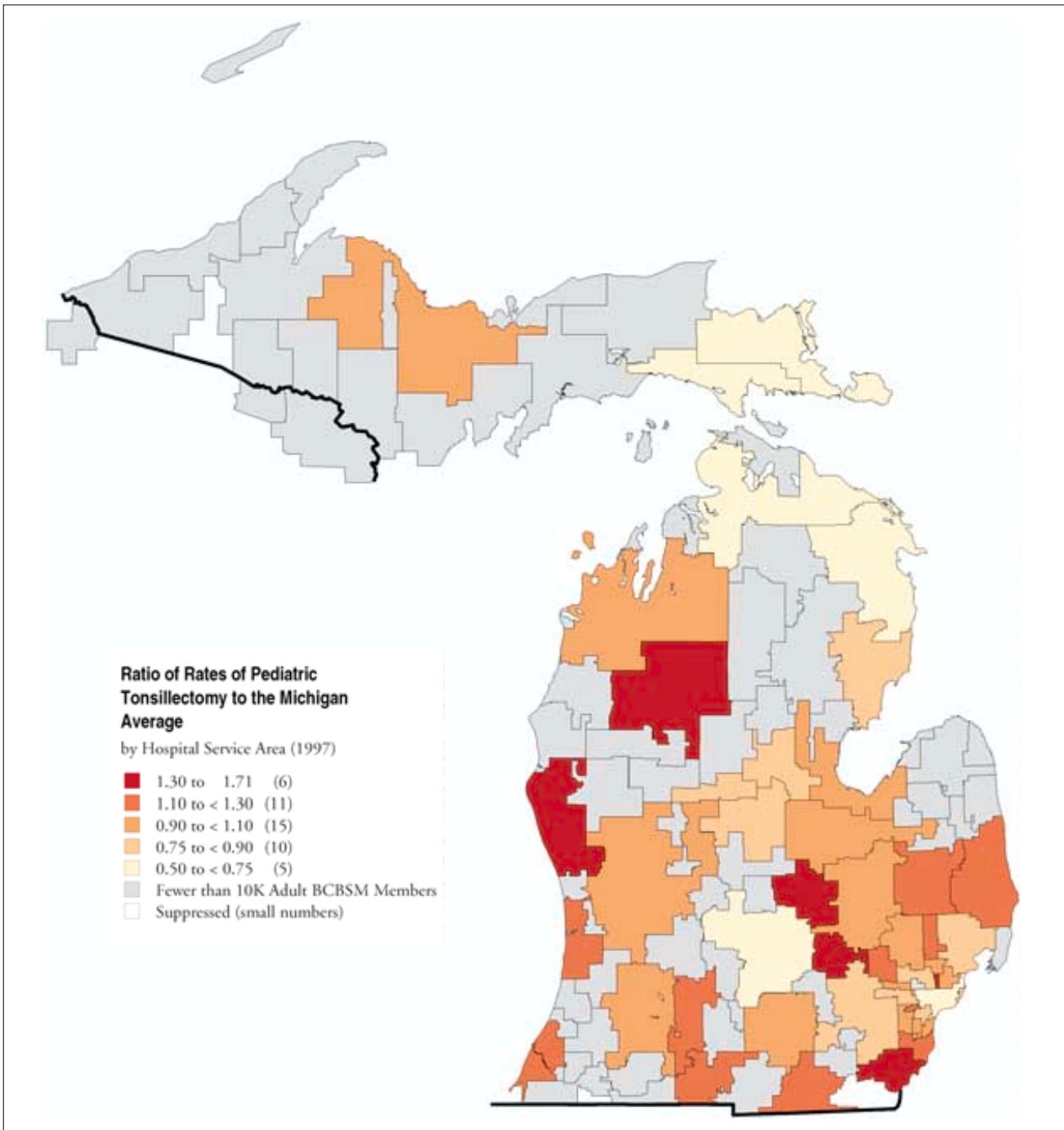
Six hospital service areas had rates at least 30% higher than the state average of 4.0 per 1,000 BCBSM members; five regions had rates more than 25% below the average. Diagnostic and therapeutic arthroscopies of the knee varied by a factor of three, from 2.1 to 6.5 per 1,000 BCBSM members.

Tonsillectomy

While the frequency of tonsillectomy has sharply declined, it remains a common approach to two childhood problems, recurrent throat infections and obstructive sleep apnea. Sore throats are frequent in children and usually herald the beginning of a viral infection. Strep throats and tonsillitis are less common, but can be an annoyance. A more serious problem is when very large tonsils close off the throat during sleep, causing prolonged breathing pauses. Children wake up before suffocating but their sleep is disturbed and not restful. A few children experience oxygen levels that are chronically low enough to cause heart problems.

The status of science is sadly uncertain for a common procedure with such a long history. A 1984 randomized clinical trial showed slightly reduced sore throats in children who had had very frequent throat infections (more than seven in a year) who had a tonsillectomy. This has been interpreted to mean that tonsillectomies should be considered for children with frequent sore throats, although others argue that the slight benefit is outweighed by the small, but not rare, risk of bleeding and infection. When sleep apnea is diagnosed with a sleep study, anecdotal evidence suggests that some children seem to benefit from tonsillectomy. As might be expected, most sleep apnea is diagnosed by parents' observations. Diagnosis through observation has not been validated in scientific studies and the influence of tonsillectomies on short- or long-term outcomes remains unknown.

The dilemma of choice is shared by families and physicians. Many parents, and some physicians, believe that tonsillectomy benefits children with recurrent upper respiratory infections, snoring, or other conditions, and parents often receive different opinions from pediatricians and otolaryngologists whom they consult. Families who are faced with the decision about tonsillectomy need unbiased information, which can be difficult to obtain.



Map 4.4. Pediatric Tonsillectomy (1997)

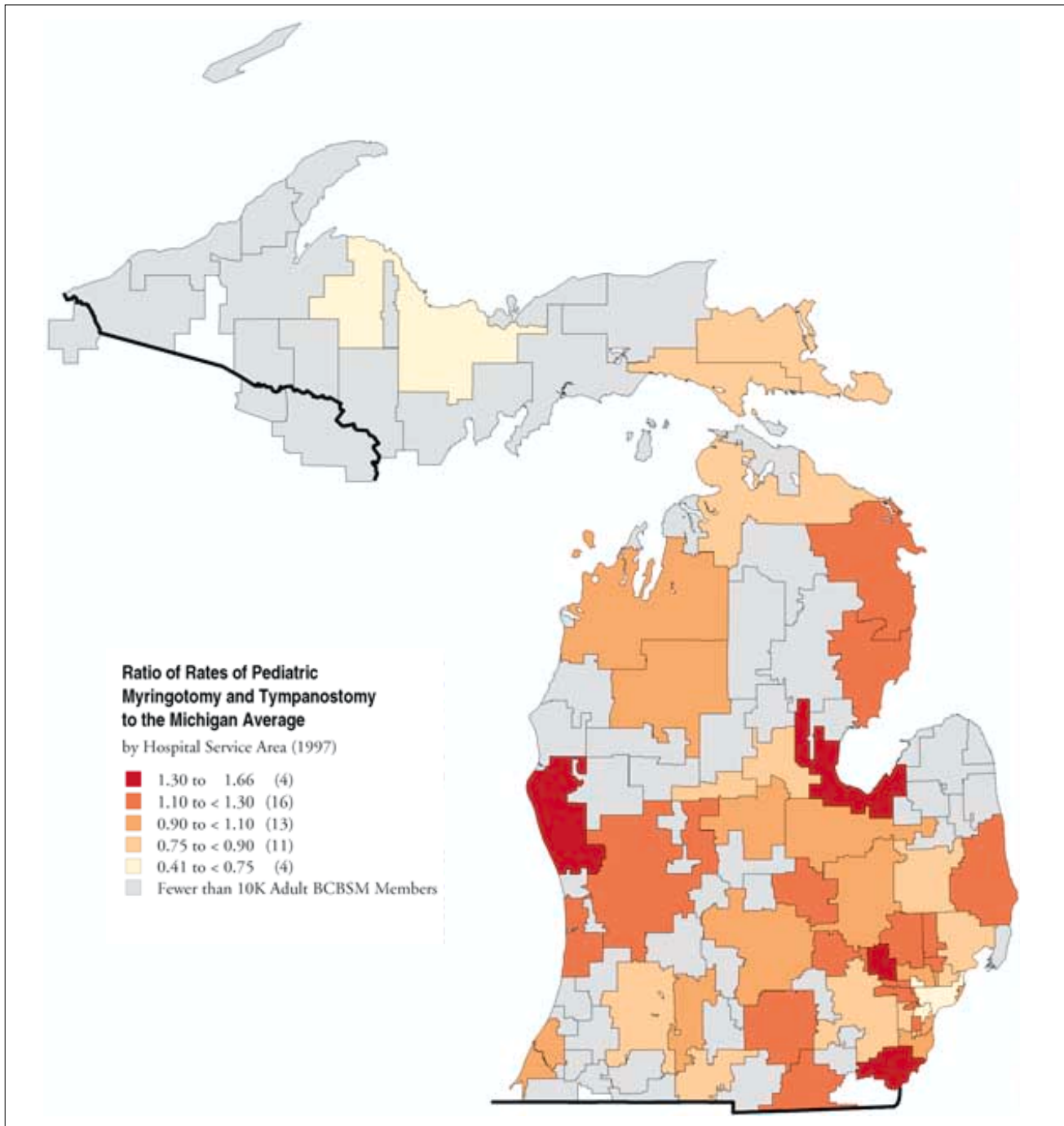
Six hospital service areas had rates at least 30% higher than the state average of 7.9 per 1,000 child BCBSM members. Five regions had rates more than 25% below the average. Rates of tonsillectomy varied by a factor of more than three, from 4.0 to 13.4 per 1,000 child BCBSM members.

Middle Ear Disease

Infections of the middle ear (the tiny space behind the tympanic membrane) are one of the most common causes of illness in young children that result in a physician visit. Most children experience at least one infection before the age of five, but up to a third have three or more. Some of these children will be plagued with chronic fluid in the middle ear, leading to temporary but prolonged difficulty in hearing and learning. Treatment of recurrent ear infections and chronic middle ear fluid includes antibiotics, watchful waiting, tympanostomy (surgical creation of drainage in the ear) and myringotomy tubes.

The status of science concerning myringotomy tubes and tympanostomy is mixed. The procedures are intended to drain middle ear fluid, improve hearing, and reduce the risk of infection. Some studies, but not all, have shown an attendant improvement in language development and school performance. There have been no randomized clinical trials. The Agency for Health Care Policy and Research guidelines recommend tubes for children with four to six months of fluid and bilateral hearing loss. There is disagreement among physicians about the relative effectiveness of myringotomy, tympanostomy, antibiotics and watchful waiting for children who are less severely affected.

The dilemma of choice. While the evidence suggests a benefit in some instances, the fact that middle ear disease usually resolves itself introduces considerable uncertainty about the value of tubes. Myringotomy and tympanostomy are one-day procedures with slight anesthesia risks. In some children the tubes are extruded prematurely and in a small percent the tubes leave a perforation of the tympanic membrane, necessitating additional surgery. Expressing preferences can be difficult for families when the science is uncertain and there is disagreement among physicians. Stresses from lack of sleep and missed workdays caused by children's repeated ear infections can influence parents' decisions about treatment versus waiting for the problem to resolve itself.



Map 4.5. Pediatric Myringotomy and Tympanostomy (1997)

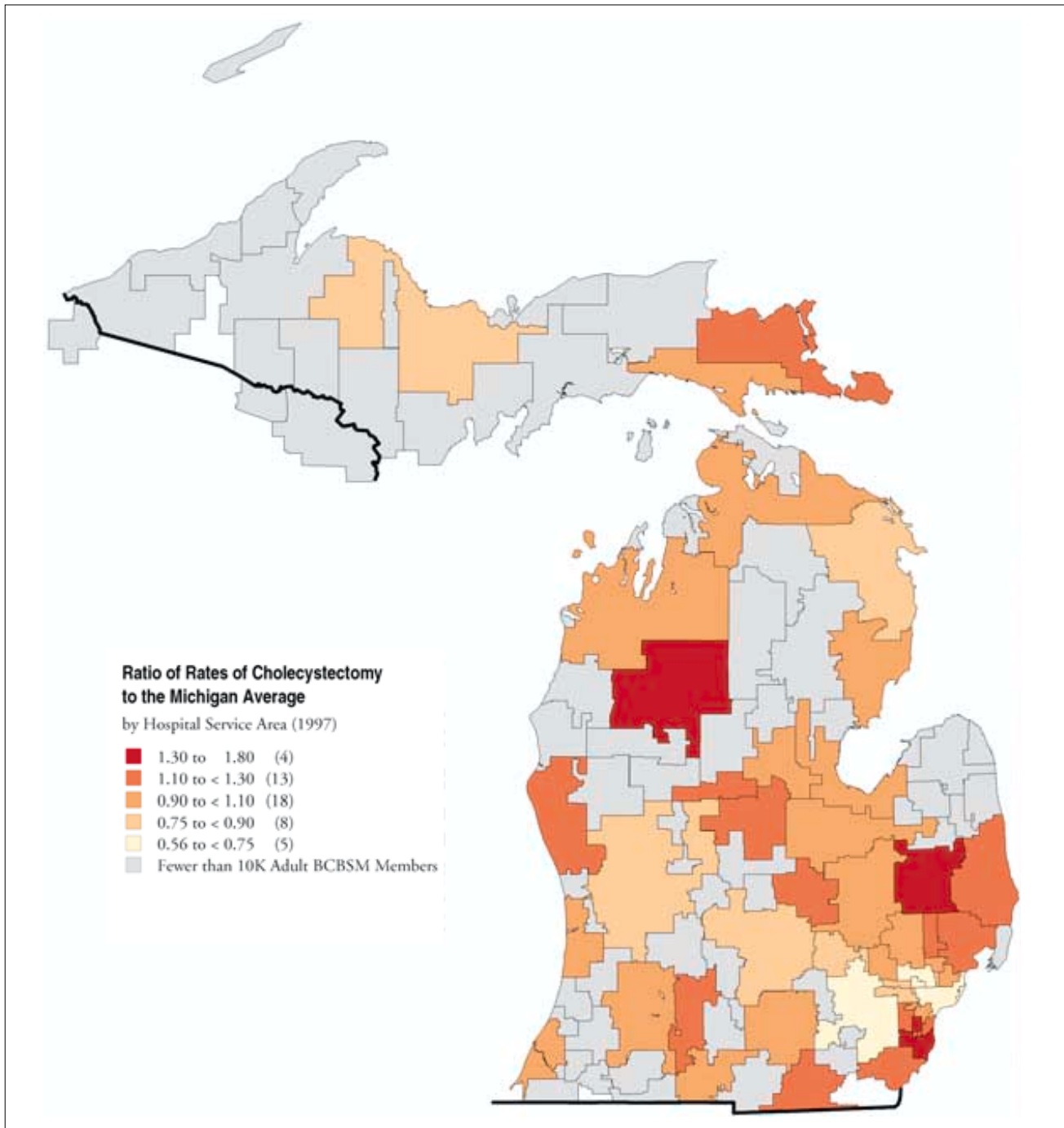
Four hospital service areas had rates at least 30% higher than the state average of 9.4 procedures per 1,000 child BCBSM members. Four regions had rates more than 25% below the average. Rates of placement of myringotomy tubes and tympanostomy ranged from 3.9 to 15.5 per 1,000 child BCBSM members.

Cholecystectomy

Gallstones are common in the United States, particularly in women and in the elderly. More than 25% of women over age 60 have gallstones. Because gallstones usually do not cause symptoms, most people are unaware they have them, and asymptomatic gallstones are sometimes detected incidentally via abdominal imaging performed for unrelated reasons. Typical symptoms include intermittent pain or cramps in the upper abdomen (chronic cholecystitis), sometimes exacerbated by particular foods. More severe symptoms (acute cholecystitis) include unrelenting pain, fever, and vomiting.

The status of science There is general agreement among physicians that no treatment is required for patients without symptoms. There is also consensus that patients with severe symptoms or acute cholecystitis should undergo cholecystectomy (surgical removal of the gallbladder and stones). Decision making is most difficult for patients with very mild symptoms of chronic cholecystitis, or symptoms that might or might not be attributable to gallstones. For patients with these symptoms, options include watchful waiting—no treatment unless worse symptoms develop. Although it is now used infrequently, dissolution therapy (gallstones are “dissolved” with medications or ultrasound) is another option. Finally, patients can undergo laparoscopic cholecystectomy, a procedure in which the gallbladder is removed through very small incisions.

The dilemma of choice There are no randomized clinical trials establishing the “best” treatment for patients with mild chronic cholecystitis. Although laparoscopic cholecystectomy is associated with relatively low risks and short recovery times, only patients can decide whether their symptoms are bothersome enough to warrant surgery.



Map 4.6. Cholecystectomy (1997)

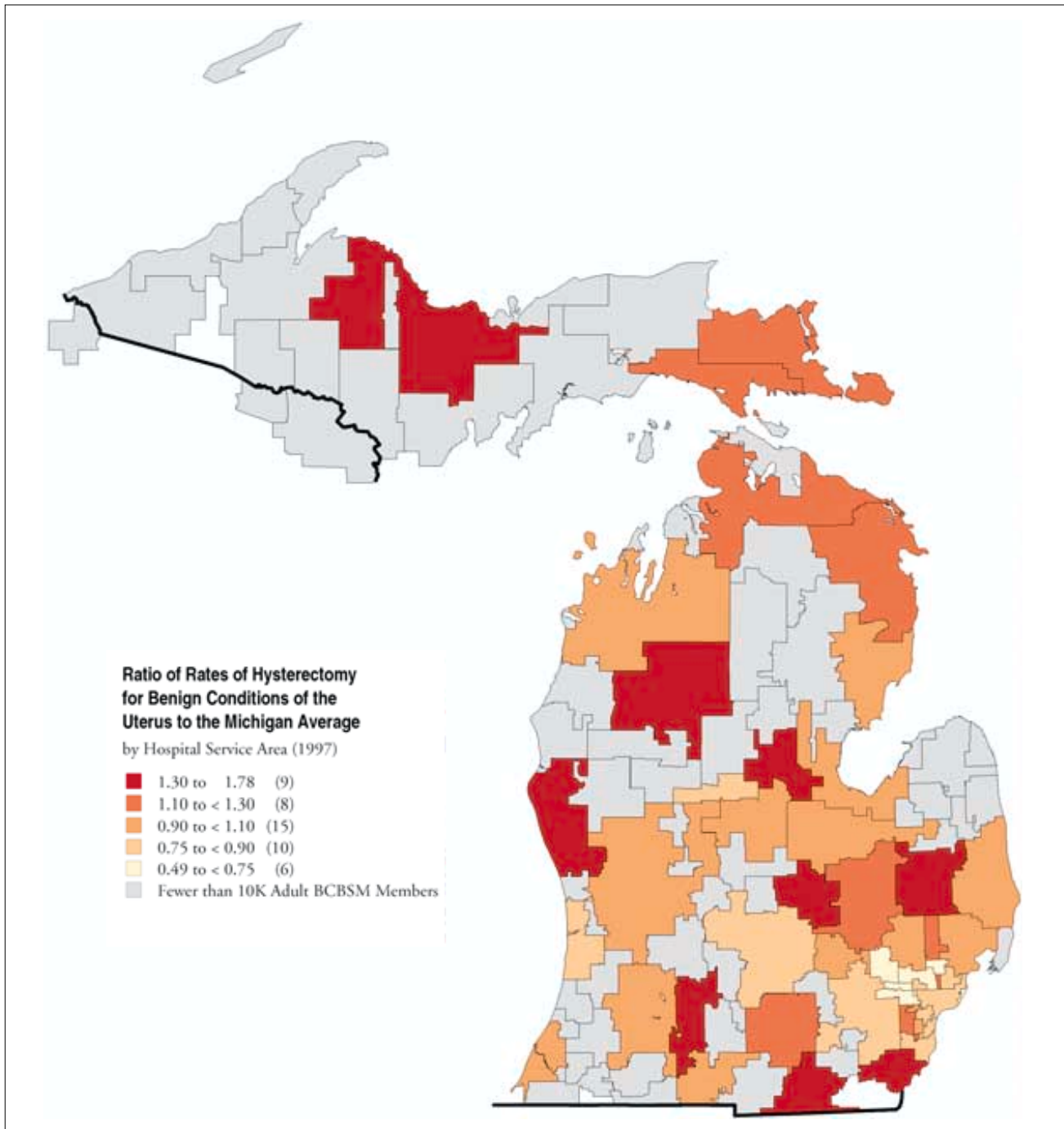
Four hospital service areas had rates at least 30% higher than the state average of 4.1 per 1,000 adult BCBSM members. Five regions had rates more than 25% below the average. The number of cholecystectomy procedures (open and laparoscopic) varied by a factor of more than three, from 2.3 to 7.4 per 1,000 adult BCBSM members.

Benign Conditions of the Uterus

Benign conditions of the uterus, including dysfunctional bleeding, leiomyomas, endometriosis, chronic pelvic pain and prolapsed uterus, are some of the most common conditions affecting women, and their symptoms can significantly impact the quality of life. There are three basic methods of treating these conditions: watchful waiting; medical therapy with such agents as hormone replacement, nonsteroidal anti-inflammatory agents or analgesics; and hysterectomy, the surgical removal of the uterus. Hysterectomy, with or without oophorectomy, is the most common non-obstetrical surgical procedure in the United States.

The status of the science is good. Several large outcomes studies have established that all three management strategies are viable options. Watchful waiting or medical management are both very effective for women with mild to moderate symptoms. For many women with more severe symptoms, hysterectomy is more effective in reducing symptoms than is medical treatment. However, the procedure is not risk free, and many women with severe symptoms respond to medical management without hysterectomy.

The dilemma of choice Dysfunctional bleeding, leiomyomas, endometriosis, chronic pelvic pain and prolapsed uterus are all conditions for which personal preference is the most important criteria in the selection of treatment. These conditions do not progress rapidly and they remain benign. Physicians' preferences and practice patterns can heavily influence patients' decision making about hysterectomy, because women considering hysterectomy often have had longstanding relationships with their obstetrician/gynecologists. For many other surgical procedures, that relationship begins only when a medical problem emerges.



Map 4.7. Hysterectomy for Benign Conditions of the Uterus (1997)

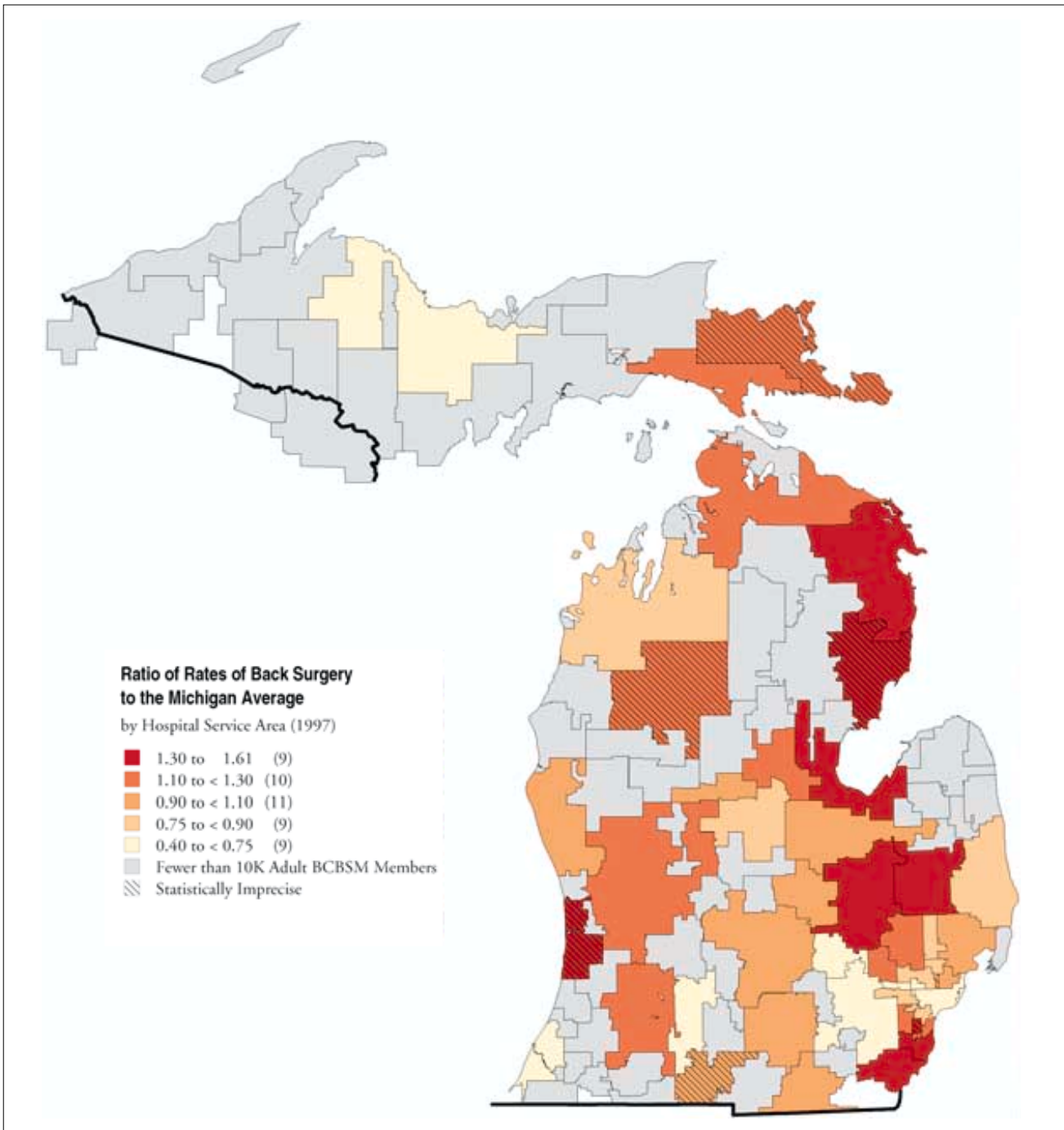
Nine hospital service areas had rates at least 30% higher than the state average of 7.7 per 1,000 female BCBSM members. Six regions had rates more than 25% below the average. The number of hysterectomies varied by a factor of more than four, from 3.8 to 13.7 per 1,000 female BCBSM members.

Back Pain

For most people who have the common problem of back pain, symptoms are self-limited and the precise cause is never established. In some people, however, the pain is caused by spinal stenosis (narrowing of the bony spine, leading to pressure on the spinal cord) or herniated discs (which “pinch” nerves exiting the spinal cord). These conditions can also cause neurological symptoms, such as leg weakness and numbness. When symptoms or findings on physical examination suggest spinal stenosis or a herniated disc, the diagnosis can be supported by imaging procedures such as computed tomography or magnetic resonance imaging.

The status of science concerning back surgery for spinal stenosis and herniated discs is poor. First, the clinical significance of anatomic abnormalities is unclear — the same X-ray findings are frequently noted in patients without any back pain or neurological symptoms. Second, the effectiveness of back surgery in resolving the symptoms of spinal stenosis and herniated discs has not been established by randomized clinical trials. Although recent studies suggest that symptoms and functional status in some patients with herniated discs are initially improved after surgery, the long-term effectiveness of surgery is still unknown and hotly debated. Moreover, little is known about the natural history of these conditions when treated without surgery.

The dilemma of choice Like any procedure aimed at improving symptoms, patient preferences are central to decision making in back surgery. Only the patient can determine how back-related symptoms affect function and quality of life. In addition, physicians and patients might not always share the same goals; for example, a physician might recommend surgery because of leg weakness, while the patient is primarily concerned with back pain.



Map 4.8. Back Surgery (1997)

Nine hospital service areas had rates at least 30% higher than the state average of 2.2 per 1,000 adult BCBSM members; nine regions had rates more than 25% below the average. The number of back surgery procedures varied by a factor of more than three, from 0.9 to 3.1 per 1,000 adult BCBSM members.

The Surgical Signature

The “surgical signatures” of regions differ substantially from medical signatures. In the case of medical conditions, rates tend to be consistent; a region that has a high rate of admissions for a particular medical condition, such as congestive heart failure, usually has high rates of most other medical admissions.

Surgery, however, varies idiosyncratically; rates of admission for any given surgical procedure are not likely to be strongly correlated with rates of admissions for other procedures. Typically, hospital referral regions have distinct patterns, such as high rates of back surgery, low rates of knee surgery, and rates of hysterectomy that are about average; some areas have more consistently high or low rates of surgical procedures.

For example, the chance of having back surgery is about 30% higher than the state average among residents of the Petoskey hospital service area; and residents of Petoskey undergo back surgery at a rate more than twice the rate among BCBSM adults living in the Detroit hospital service area. By contrast, the risk that a child living in this area will have a tonsillectomy is relatively low — the rates for tonsillectomy are only 56% of the state average — and less than one-third the rate among children living in Muskegon. There does not seem to be a connection between rates which are specific to types of surgeons (by specialty) within areas; surgical signatures are characteristically much more idiosyncratic than medical signatures.

The rate of back surgery among BCBSM members living in Flint is twice the rate among BCBSM members living in Detroit. Indeed, Detroit is well below the state average for each of the five operations; by contrast, Muskegon is higher than average for four of the five procedures displayed in Figure 4.2. This is an interesting contrast to medical admissions, which are far more common among adult BCBSM members living in Detroit; the implication is that general rates of illness are not the primary driver of surgical rates, a pattern that would be consistent with other studies which show that surgical rates are more influenced by individual physicians’ practice patterns than by relative supplies of medical resources.

The reasons for this variation in rates of surgery among regions should be studied further. The reasons why clinicians in some such areas, such as Muskegon, seem to perform surgery so much more frequently than surgeons in other areas warrants further investigation; and it has been demonstrated that when surgeons are made aware of differences in surgical rates, they can actively engage in an effort to assess the “best practice” model of specific surgical interventions.

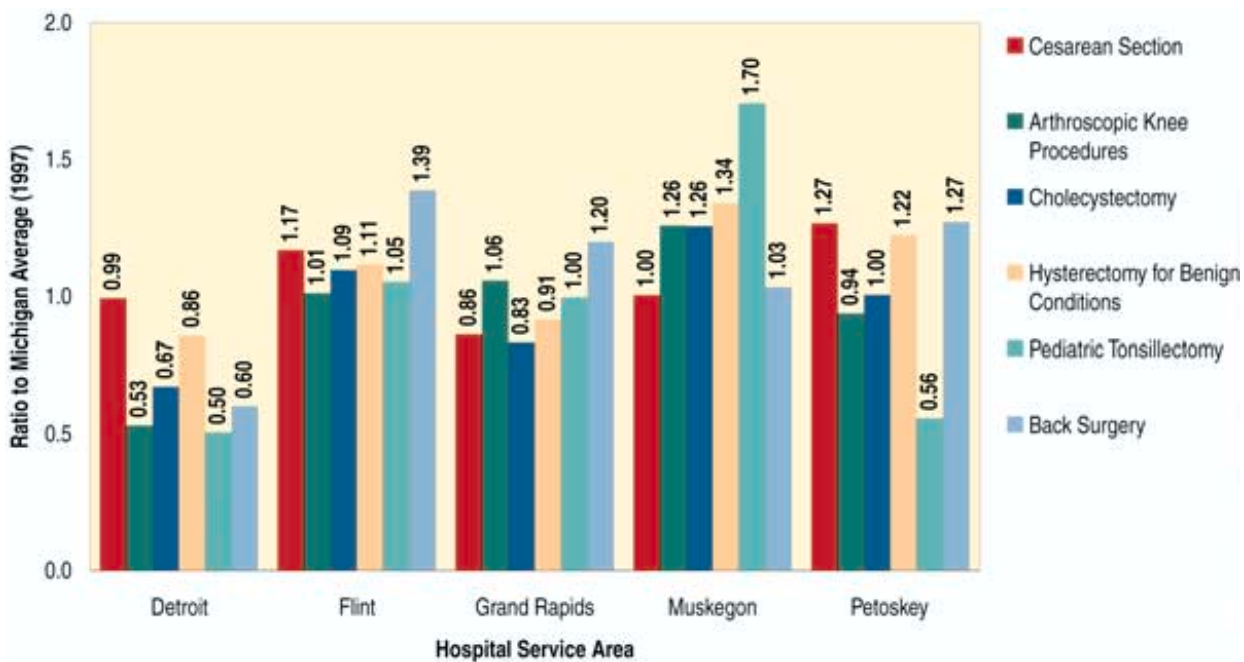


Figure 4.2. The Surgical Signatures of Five Michigan Hospital Service Areas

The figure gives the ratio of the rates to the state average for each of five procedures. Detroit is uniformly low for all five procedures; Muskegon's rates are higher than the state average for all procedures save cesarean sections. Rates in Petoskey are higher than average for back surgery, hysterectomies and cesarean sections, but below average for knee procedures and pediatric tonsillectomies. Rates for Grand Rapids are high for back surgery and low for cholecystectomy. Flint also has high rates for back surgery.

Chapter Four
Table Note

All rates are age and sex adjusted, and are expressed as rates per 1,000 BCBSM members or Medicare enrollees. Cesarean section rates are expressed as a proportion of all births. Rates are for BCBSM members in 1997, and Medicare enrollees in 1996. Rates of hysterectomy are sex-specific (the denominator is adult female BCBSM members). Medicare data exclude enrollees who were members of risk bearing managed health organizations.

Specific codes used to define the numerator for rates, and methods of age, sex (and in the case of Medicare data, race) adjustment are included in the Appendix on Methods.

CHAPTER FOUR TABLE

Rates of Surgical Treatment of Common Diseases by Hospital Service Areas (1996 and 1997)

HSA City	BCBSM Members (All Ages) Included in Data Analysis (1997)	Adult BCBSM Members Included in Data Analysis (1997)	Adult Female BCBSM Members Included in Data Analysis (1997)	Child BCBSM Members Included in Data Analysis (1997)	Medicare Enrollees (1996)	Colectomy per 1,000 Medicare Enrollees (1996)	Proportion of Births That Were Cesarean Sections (1997)	Athroscopic Knee Procedures per 1,000 BCBSM Members (All Ages) (1997)	Tonsillectomy per 1,000 Child BCBSM Members (1997)	Mylringotomy and Tympanostomy per 1,000 Child BCBSM Members (1997)	Otology/otomastoidectomy per 1,000 Adult BCBSM Members (1997)	Hysterectomy for Benign Conditions of the Uterus per 1,000 Adult Female BCBSM Members (1997)	Back Surgery per 1,000 Adult BCBSM Members (1997)
Adrian	25,012	17,761	8,958	7,252	8,259	(2.6)	23.4	5.7	9.5	11.6	4.7	10.1	2.1
Albion	3,720	2,805	1,439	915	2,014			(4.0)			(4.7)		
Allegan	4,987	3,534	1,768	1,453	2,852			(5.1)	(12.3)	(12.5)	(4.0)	(10.8)	
Alma	18,574	13,300	6,783	5,274	6,335	(2.6)	29.5	4.3	6.2	8.7	4.8	8.2	1.8
Alpena	22,579	16,648	8,460	5,931	8,619	(2.7)	28.2	5.1	4.9	10.4	3.4	9.3	3.1
Ann Arbor	106,312	80,828	41,080	25,484	39,968	2.5	20.6	3.6	6.4	8.1	2.8	6.1	1.7
Bad Axe	6,848	4,966	2,537	1,881	3,292		28.0	3.3	(13.4)	(9.0)	(6.5)	(5.0)	(2.7)
Battle Creek	28,041	20,415	10,248	7,627	14,698	2.5	23.2	3.0	9.2	9.7	5.0	10.7	1.4
Bay City	43,376	32,463	16,157	10,913	17,054	2.6	21.9	3.9	8.2	13.4	4.1	8.1	3.1
Berrien Center	226	165	84	61	209								
Big Rapids	8,550	6,382	3,277	2,168	3,925		20.0	2.9	(8.5)	(19.1)	5.0	(8.0)	(2.4)
Cadillac	15,240	10,902	5,609	4,338	6,855	(3.5)	16.3	3.2	10.9	9.6	7.4	10.4	(2.6)
Caro	5,448	4,026	2,017	1,422	1,709		22.4	(5.0)	(8.7)	(9.5)	(6.5)	(8.4)	
Carson City	5,698	4,135	2,057	1,563	1,754		28.6	(4.1)	(9.5)	(11.7)	(5.2)	(9.2)	(3.0)
Cass City	3,762	2,745	1,404	1,017	1,459			(4.6)			(9.9)		
Charlevoix	8,658	6,214	3,118	2,443	2,624		26.4	3.6	(4.4)	(4.2)	(4.0)	(8.1)	(2.8)
Charlotte	7,681	5,641	2,847	2,041	2,571		25.5	5.1	(6.1)	(9.3)	(6.2)	(8.4)	(2.1)
Cheboygan	7,147	5,311	2,767	1,836	2,833	(4.9)	36.7	3.5	(7.7)	(10.4)	(4.7)	(7.2)	(3.0)
Chelsea	4,949	3,716	1,867	1,234	2,229		31.3	(3.4)				(9.4)	
Clare	10,926	8,064	4,137	2,862	5,409		31.7	3.5	(7.7)	7.6	4.9	8.9	(3.1)
Coldwater	14,931	10,574	5,366	4,358	5,655		18.5	6.1	9.6	7.4	4.3	7.2	(2.2)
Crystal Falls	1,738	1,296	670	443	1,269			(6.3)					
Dearborn	32,845	24,489	12,412	8,356	26,294	2.7	22.2	3.5	6.5	7.0	4.2	6.4	1.8
Deckerville	1,936	1,373	694	563	860								
Detroit	176,133	133,298	70,745	42,835	124,463	2.6	22.7	2.1	4.0	3.9	2.8	6.6	1.3
Dowagiac	3,499	2,545	1,340	954	2,179			(3.5)			(5.9)		
Escanaba	11,205	8,164	4,242	3,040	6,483	(2.9)	25.5	5.2	(9.6)	7.4	3.1	11.3	
Farmington Hills	26,622	19,963	10,273	6,659	11,698	2.9	23.7	3.7	7.5	11.7	3.5	5.6	1.4
Flint	175,318	132,327	68,485	42,991	51,834	2.5	26.7	4.1	8.3	9.1	4.5	8.6	3.1
Frankfort	1,392	1,028	541	364	878								
Fremont	6,995	4,922	2,489	2,073	3,663			4.3	(12.8)	(13.4)	(4.3)	(11.7)	(3.5)
Garden City	16,375	12,426	6,379	3,948	11,642	2.7	22.6	5.0	9.0	11.6	4.4	7.4	1.8
Gaylord	12,901	9,264	4,742	3,637	4,705		24.5	5.2	8.5	7.4	4.9	7.0	(1.5)
Gladwin	5,256	3,923	2,026	1,333	2,883			(4.3)		(9.4)	(4.4)	(6.4)	(2.8)
Grand Haven	11,130	8,141	4,175	2,989	5,732	(2.8)	25.7	4.3	(13.9)	12.4	5.0	10.6	(3.1)
Grand Rapids	163,990	117,284	59,343	46,706	74,069	2.3	19.7	4.3	7.8	11.0	3.4	7.0	2.7
Grayling	13,133	9,790	5,066	3,343	6,748	(2.3)	19.3	4.3	(13.0)	15.3	5.0	9.1	(2.1)
Greenville	4,337	3,096	1,570	1,241	2,105			(6.2)		(10.8)	(5.3)	(13.1)	(4.3)
Grosse Pointe	20,120	14,906	7,790	5,214	8,407	(2.5)	19.7	3.7	6.6	8.8	2.8	3.8	1.1

HSA City	BCBSM Members (All Ages Included in Data Analysis) (1997)	Adult BCBSM Members Included in Data Analysis (1997)	Adult Female BCBSM Members Included in Data Analysis (1997)	Child BCBSM Members Included in Data Analysis (1997)	Medicare Enrollees (1996)	Colexymed Per 1,000 Medicare Enrollees (1998)	Proportion of Births That Were Cesarean Sections (1997)	Arthroscopic Knee Procedures per 1,000 BCBSM Members (All Ages) (1997)	Tonsillectomy per 1,000 Child BCBSM Members (1997)	Myringotomy and Tympanostomy per 1,000 Child BCBSM Members (1997)	Cholecystectomy per 1,000 Adult BCBSM Members (1997)	Hysterectomy for Benign Conditions of the Uterus per 1,000 Adult Female BCBSM Members (1997)	Back Surgery per 1,000 Adult BCBSM Members (1997)
Hancock	5,701	4,066	2,094	1,635	3,125	27.6	(3.6)			(6.7)	(7.9)		
Harbor Beach	2,422	1,698	882	724	1,248		(7.3)						
Hastings	11,624	8,327	4,199	3,296	5,015	15.7	4.6	(6.4)	8.1	4.7	9.8	(3.3)	
Hillsdale	10,945	7,830	4,002	3,115	4,700	32.0	4.5	(10.3)	8.3	6.6	7.1	(2.9)	
Holland	16,021	11,661	5,964	4,360	10,907	3.2	21.0	3.0	9.7	10.4	3.8	6.3	(3.6)
Howell	17,599	12,797	6,493	4,802	4,430	(2.7)	21.3	3.9	11.3	10.6	3.1	7.0	1.6
Ionia	6,558	4,702	2,385	1,856	2,059	30.5	5.6		(8.7)	(6.3)	(10.4)	(2.3)	
Iron Mountain	7,932	5,823	2,961	2,109	7,163	(1.8)	27.7	7.4	(15.4)	(7.0)	(4.2)	(12.1)	
Iron River	2,438	1,779	938	659	2,287			(5.8)					
Ironwood	4,394	3,316	1,738	1,077	4,996	(2.8)		(2.9)	(12.2)		(4.7)	(6.8)	
Ishpeming	4,061	2,893	1,508	1,168	2,070			(4.9)					
Jackson	35,444	26,112	13,316	9,332	20,290	2.3	20.5	5.2	8.6	10.7	4.2	9.3	2.1
Kalamazoo	72,800	52,957	27,374	19,843	32,194	2.4	25.2	3.4	7.5	8.1	4.3	8.0	2.6
L'Anse	4,152	2,973	1,501	1,179	1,953	36.7	(3.2)				(6.6)	(11.7)	
Lakeview	1,527	1,079	554	448	612			(8.2)					
Lansing	102,233	77,185	39,545	25,048	34,659	2.0	24.6	5.2	5.8	8.9	3.5	6.7	2.2
Lapeer	33,787	24,462	12,352	9,326	7,576	(2.7)	18.4	5.6	9.3	7.7	6.1	12.4	3.0
Laurium	4,021	2,863	1,475	1,158	2,910				(9.9)			(11.2)	
Livonia	48,970	37,379	19,442	11,591	25,993	2.4	23.5	4.4	7.0	11.3	3.4	4.8	1.9
Ludington	9,381	6,835	3,540	2,547	5,244	(2.8)	34.8	6.5	(12.9)	(13.8)	3.6	8.2	(2.5)
Madison Heights	13,483	10,126	5,099	3,357	6,356	(2.3)	23.2	2.9	10.8	8.8	3.5	8.7	(2.2)
Manistee	6,122	4,572	2,338	1,550	3,860	(3.6)	34.2	(3.4)	(8.0)	(8.6)	(4.5)	(8.5)	(2.3)
Manistique	4,007	2,954	1,530	1,053	1,989			(5.3)	(12.8)		(4.4)	(13.5)	
Marlette	3,068	2,181	1,104	887	985			(5.3)			(8.8)	(14.3)	
Marquette	22,805	16,690	8,611	6,114	7,210	19.3	6.5	7.4	4.7	3.1	10.7	1.1	
Marshall	8,057	6,061	2,769	1,995	2,885	(4.9)	24.6	2.7	(7.6)	(9.5)	(7.9)	(6.4)	
Midland	21,456	15,794	7,956	5,662	10,426	(3.1)	28.7	4.3	6.8	7.8	3.9	11.2	2.7
Milford	34,890	25,860	13,111	9,030	7,983	(2.3)	21.9	3.9	9.3	14.9	4.1	5.3	2.7
Monroe	21,048	15,307	7,886	5,741	9,937	(3.0)	33.3	5.7	13.2	15.5	5.0	13.7	3.1
Mount Clemens	122,418	91,067	46,295	31,351	37,401	2.7	21.7	4.0	6.8	8.3	4.7	8.1	2.3
Mount Pleasant	17,996	12,984	6,711	5,012	4,159	20.5	3.4	6.2	8.4	4.6	6.4	2.2	
Munising	2,023	1,474	772	548	1,033							(17.9)	
Muskegon	44,203	31,566	16,211	12,637	23,941	2.8	22.9	5.1	13.4	13.1	5.2	10.3	2.3
Newberry	3,768	2,748	1,408	1,020	1,665	42.9	(4.6)	(14.2)	(12.9)	(4.3)	(8.5)		
Niles	8,565	6,393	3,331	2,173	8,315	(2.8)		2.7	(8.4)	(9.7)	3.9	(4.0)	
Northport	792	600	320	191	453								
Ontonagon	1,977	1,497	766	480	867								
Owosso	23,409	17,052	8,665	6,357	7,650	(2.5)	29.0	5.2	13.0	11.2	4.9	10.6	2.4
Paw Paw	6,950	5,017	2,584	1,933	3,479	(4.0)	18.1	2.2	(10.1)		(5.4)	(7.9)	
Petoskey	31,551	22,880	11,750	8,671	10,932	3.0	29.0	3.8	4.4	7.6	4.1	9.4	2.8
Pigeon	2,538	1,900	979	638	1,752			(5.0)	(19.7)		(7.6)		
Pontiac	123,548	94,047	47,474	29,501	29,644	2.9	24.1	3.7	7.3	10.8	3.9	7.8	2.8
Port Huron	52,106	37,385	19,105	14,721	17,847	2.7	22.4	4.2	9.9	12.2	4.7	8.4	1.8
Reed City	8,194	5,858	3,000	2,336	3,573	(3.7)	22.4	4.1	(9.0)	(14.0)	(4.1)	(8.7)	(4.3)
Rochester	42,419	32,223	16,575	10,197	10,227	(3.2)	24.8	5.0	8.8	10.5	4.8	8.5	2.0

HSA City	BCBSM Members (All Ages Included in Data Analysis (1997))	Adult BCBSM Members Included in Data Analysis (1997)	Adult Female BCBSM Members Included in Data Analysis (1997)	Child BCBSM Members Included in Data Analysis (1997)	Medicare Enrollees (1996)	Collectively per 1,000 Medicare Enrollees (1996)	Proportion of Births That Were Cesarean Sections (1997)	Arthroscopic Knee Procedures per 1,000 BCBSM Members (All Ages) (1997)	Tonsillectomy per 1,000 Child BCBSM Members (1997)	Mylingotomy and Tympanostomy per 1,000 Child BCBSM Members (1997)	Chelecystectomy per 1,000 Adult BCBSM Members (1997)	Hysterectomy for Benign Conditions of the Uterus per 1,000 Adult Female BCBSM Members (1997)	Back Surgery per 1,000 Adult BCBSM Members (1997)
Royal Oak	110,930	84,577	44,613	26,353	47,091	2.1	21.5	3.4	7.0	9.5	2.7	4.6	1.9
Saginaw	81,077	60,296	30,671	20,781	29,186	3.1	22.4	4.0	7.6	10.1	4.4	7.8	2.2
Saline	3,735	2,748	1,401	987	1,207			(5.8)				(7.6)	
Sandusky	3,664	2,599	1,343	1,065	1,196			(4.0)	(11.7)	(10.7)	(6.8)	(10.1)	
Sault Ste Marie	16,409	11,653	6,000	4,756	4,427	(2.5)	23.1	6.3	5.6	8.4	4.6	8.9	(2.6)
South Haven	5,698	4,129	2,106	1,569	3,308			(4.8)	(12.4)	(8.8)	(6.5)	(6.2)	
Southfield	14,813	11,749	6,473	3,064	8,163	(3.3)	31.6	2.2		4.0	2.3	6.4	0.9
St. Clair	10,749	7,999	3,988	2,751	3,973	(3.3)	24.0	3.0	(6.8)	(6.2)	4.8	7.2	(2.1)
St. Johns	5,318	3,920	1,964	1,398	1,820			(4.0)	(8.8)	(9.4)	(3.4)	(8.3)	
St. Joseph	22,375	16,634	8,634	5,741	14,533	2.1	N/A	4.9	8.8	9.2	3.7	7.5	1.1
Standish	5,120	3,627	1,834	1,493	1,660			(3.0)	(13.3)	(17.4)	(3.7)		
Sturgis	5,598	4,030	2,059	1,568	3,574	(4.7)	26.0	(4.6)	(7.8)	(7.0)	(7.5)	(8.0)	
Tawas City	14,427	10,569	5,541	3,858	7,496	(2.3)	15.1	3.2	7.0	11.5	4.1	7.2	(3.4)
Taylor	14,713	10,976	5,557	3,737	6,206	(2.4)	16.9	3.8	7.1	10.5	7.4	8.4	(3.0)
Tecumseh	7,725	5,594	2,854	2,131	2,708	(4.1)	20.5	5.0	(11.7)	(11.3)	(5.1)	(9.9)	(2.7)
Three Rivers	7,598	5,470	2,796	2,128	3,932	(3.1)	21.1	3.8	(13.8)	(6.2)	(5.7)	(8.3)	(2.4)
Traverse City	53,037	38,548	19,328	14,489	20,499	2.7	21.5	4.9	7.6	9.7	4.1	8.3	1.7
Trenton	24,330	18,266	9,292	6,064	8,766	(3.3)	25.1	4.5	8.8	10.2	6.2	6.9	3.1
Troy	42,020	32,064	16,413	9,956	10,876	2.3	23.2	3.6	8.4	10.4	3.7	5.4	1.8
Warren	66,416	51,075	26,031	15,341	37,292	2.6	19.6	3.5	7.2	8.3	4.2	6.5	2.0
Watervliet	3,135	2,256	1,135	879	1,849			(7.2)			(9.2)		
Wayne	34,567	25,963	13,434	8,604	17,844	2.3	18.0	3.8	8.2	7.9	5.1	9.5	2.8
West Branch	12,821	9,337	4,854	3,484	6,388	(2.9)	16.5	3.5	10.3	14.2	6.1	12.3	(2.6)
Wyandotte	29,723	22,263	11,394	7,460	20,123	3.0	21.8	4.4	8.1	9.9	4.8	6.5	2.6
Zeeland	3,229	2,177	1,120	1,052	1,961		29.3			(14.1)			
Michigan	2,666,214	1,978,316	1,014,408	687,898	1,146,313	2.6	22.9	4.0	7.9	9.4	4.1	7.7	2.2

