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State Differences in the Diagnosis and Treatment of Joint Injuries

An important objective in delivering workers compensation medical benefits is ensuring an appropriate level of care to injured workers. Either excessive or inadequate care may result in poor outcomes. Jurisdictions employ various tools for utilization management such as independent medical exams, utilization review, and treatment guidelines to help ensure the appropriate level of care to achieve the best outcomes for injured workers. Various studies have identified differences in the treatment of workers compensation (WC) injuries by state, especially back injuries. This study takes a look at state differences in the treatment of joint cases by looking at differences in mix and quantity of services for relatively objective injuries—those involving knee, shoulder, elbow, and ankle.

Joint injuries are among the more common WC claims. While some can be catastrophic, most are straightforward to treat and require less time to heal than, for example, many back injuries. Differences between states in the diagnosis and treatment of joint cases can be observed earlier in the course of treatment than for more complicated cases. This study looks at medical services provided within the first two years after the date of injury. Although the nature of a joint injury is often better understood and the care more standardized than for more complex injuries, the care provided for a joint injury can run the full gamut of specialized medical services—from physical therapy to diagnostic imaging to surgery.

KEY FINDINGS

- There is a wide variation among states in the utilization of services to treat joint cases
- Surgery and physical medicine show the greatest variation
- Utilization of diagnostics is fairly consistent across states
- Comparing high- and low-utilization states, differences in utilization are driven more by the treatments for given diagnoses than by the mix of diagnoses

BACKGROUND/METHODOLOGY

The cost for the medical care on a WC claim can be separated into two components—price and utilization—defined as:¹

- **Cost**—the total dollars paid per claim
- **Price**—what is paid for individual services
- **Utilization**—the nature and extent of services provided per claim
 - Mix of services (e.g., X-ray vs. MRI)
 - Number of services
- $\text{Cost} = \text{Price} \times \text{Utilization}$

State differences in price are related to WC medical fee schedules and have been extensively studied.² This study focuses on utilization. Studies have identified differences among the states in the services utilized to treat back injuries, particularly in the use of surgery.³ Here we look at differences between states in the utilization of services to treat joint injuries.

¹ An early paper promoting this perspective is Durbin, Corro, and Helvacian, “Workers’ Compensation Medical Expenditures: Price vs. Quantity,” *The Journal of Risk and Insurance*, Vol. 63, No. 1, March 1996.

² For example, see B. Lipton, D. Corro, N. Moore, J. Robertson, “Effectiveness of WC Fee Schedules—A Closer Look,” NCCI, February 2009. See also the WCRI series on designing and benchmarking fee schedules.

³ For example, see Christine A. Yee, Steve Pizer, and Olesya Fomenko, “Why Surgery Rates Vary,” WCRI, June 2015. That study found more variation in surgery rates for back cases than for knee cases.

The study uses NCCI's Medical Data Call (MDC). The MDC captures transaction-level detail on medical bills processed on or after July 1, 2010, including dates of service, charges, payments, procedure codes, and diagnosis codes. NCCI collects the Call for the 35 jurisdictions where NCCI provides ratemaking services and for a number of additional states.⁴

We select joint injury claims based on a selection of diagnoses specific to each joint:⁵

- Shoulder—selected diagnoses include sprain/strain and rotator cuff injuries
- Elbow—diagnoses include tennis elbow (lateral epicondylitis)
- Knee—diagnoses include sprain/strain and torn ligament
- Ankle—diagnoses include sprain/strain and broken ankle

We include cases where 85% or more of the cost during the first 90 days post injury goes to treat one or more conditions in exactly one of four groups of diagnoses. This results in a cohort of cases for each joint.⁶ A state must have at least 50 cases to be included in a cohort.

Cohorts are *not* meant to include all cases for a given joint or even a representative sample of injuries to the given joint.⁷ Cases are selected so as to be reasonably comparable across claims, and across states. For example, the ankle injuries studied here are those for which at least 85% of the medical costs in the first 90 days following the injury are for treatments for diagnosis codes related to ankle injuries. As such, cases where there are significant injuries to the foot or to the lower leg, in addition to the ankle, are largely excluded, because of the difficulty in ensuring the selection of reasonably comparable injuries. The case selection is highly dependent on the specific lists of diagnosis codes. Because the diagnosis codes are widely used, it is reasonable to use them to select cases for comparisons of utilization patterns among the states.⁸

Utilization is measured by the Cost at Common Fees (CCF) for treatments provided during the first 24 months after the injury. This index controls for price differences between states⁹ and is computed as follows:

- For each medical service, a common countrywide fee is determined by taking the median amount paid for that service within each state, and then averaging these state medians¹⁰
- The CCF is what the cost of treatment would have been had all services been reimbursed at this common fee

Although the CCF is expressed in dollars, it measures only the *utilization* of medical services, and is not affected by price differences between states. As such, it is not directly comparable with other cost measures, such as the average cost per case, which reflect both price and utilization. The CCF does respond to both:

- The number of services provided
- The price of services, as measured by the common fee (e.g., MRIs have a higher value in the CCF than X-rays)

⁴ Jurisdictions included in this study are AK, AL, AR, AZ, CO, CT, DC, FL, GA, HI, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MN, MO, MS, MT, NC, NE, NH, NJ, NM, NV, OK, OR, RI, SC, SD, TN, UT, VA, VT, WI, and WV.

⁵ Appendix A lists the groups of ICD-9 diagnosis codes used to select joint injury cases.

⁶ We considered other percentage thresholds and selection periods and determined that the findings were not very sensitive to the choice of an 85% threshold or to the choice of a 90 day selection period.

⁷ In this study, the number of ankle cases among the four joints is small compared to what one would expect among all the joint injuries. Consider the use of a generic code for "difficulty walking" (e.g., ICD9 code 719.7). When applied to a sprained ankle, this would not assign that case into the ankle cohort, as that code is not specific to the ankle and is not on the selection list.

Conversely, the focus on a three-month selection period does not guarantee that all treatment is confined to the one joint. The elbow case cohort, for instance, includes cases treated for wrist problems like carpal tunnel syndrome (CTS).

⁸ There are differences in the precision of diagnosis coding among medical providers which may have some regional component, such as the level of network penetration or use of bill review services, diagnosis codes subject or not to treatment guidelines, or even local conventions. It must be understood that the diagnosis code a physician uses is related to reimbursement which in turn is related to state WC medical cost containment strategies. This is a potential source of differences in utilization among states in addition to epidemiologic differences in injury mix.

⁹ The need to control for price differences by state is highlighted in the study Olesya Fomenko and Rui Yang, "Hospital Outpatient Cost Index for Workers' Compensation, 4th Edition," WCRI, February 2015, which notes large differences among the states in the reimbursement for knee and shoulder surgeries.

¹⁰ Appendix B provides additional details on how the common fee for a medical service is determined.

Because treatment for many of the injuries considered can extend beyond the two-year window used in this study, we often refer to the CCF as the CCF for initial care.¹¹ Our findings are based on claims with dates of injury occurring between July 1, 2010, and December 31, 2011, reported in the MDC, which allows for a full two-year window of initial care for each claim to be included in the calculation of the CCF.

For each state within a joint cohort, we adjust the claimant mix by age (over/under age 45 when injured) and gender to match that for all states combined. We refer to this as the age/gender-adjusted cohort. Tabulating the CCF by claim enables us to compare the average utilization per claim among the states for each of the four injury age/gender-adjusted cohorts. Other utilization comparisons are made by tabulating the CCF by diagnosis and type of service.

¹¹ We also considered time windows of 90, 180, and 360 days post injury and found differences in utilization among the states similar to those found with the 720-day window used in the study. With the exception of the ankle cohort, the relative variance of state average CCFs was greater for the shorter time windows.

Findings

We developed Table 1 to see if states had similar utilization variation for different joint injuries. The table shows the average CCF per case for the four age/gender-adjusted cohorts. Within each column, the color changes from green to yellow to red as the state CCF changes from lowest to medium to highest values. The states are sorted by the average CCF for the shoulder cohort. States with both red and green boxes show the greatest disparity in utilization ranking across the different joint cases.

Average CCF per Case by Age/Gender-Adjusted Cohort				
State	Knee	Shoulder	Elbow	Ankle
DC	\$3,265	\$2,397		
ME	\$1,742	\$2,720	\$1,707	
UT	\$2,732	\$2,818	\$1,039	\$4,720
NV	\$1,975	\$3,092	\$1,981	
AZ	\$2,095	\$3,129	\$1,468	\$9,608
IN	\$1,719	\$3,370	\$1,201	\$6,210
TN	\$2,016	\$3,413	\$1,237	\$5,999
MN	\$1,900	\$3,436	\$1,202	\$11,827
MD	\$1,623	\$3,503	\$1,271	\$6,272
FL	\$2,121	\$3,567	\$1,291	\$8,622
WI	\$2,094	\$3,595	\$1,207	\$8,576
MS	\$2,991	\$3,595	\$627	
NE	\$2,252	\$3,690	\$1,001	
MA	\$2,011	\$3,759	\$1,455	\$5,546
HI	\$1,981	\$3,832	\$2,667	
RI	\$2,179	\$3,874	\$1,847	
KY	\$2,775	\$3,897	\$1,075	\$5,978
VA	\$2,312	\$3,897	\$989	\$8,700
NC	\$2,385	\$4,032	\$1,016	\$7,241
SD	\$2,609	\$4,044	\$992	
AR	\$1,708	\$4,103	\$986	
CO	\$2,779	\$4,108	\$1,894	\$10,891
ID	\$2,763	\$4,138	\$1,268	
KS	\$2,445	\$4,193	\$1,172	\$8,515
OR	\$2,087	\$4,203	\$1,270	
NJ	\$2,702	\$4,263	\$1,369	\$7,096
AK	\$1,818	\$4,284	\$1,026	
IA	\$1,785	\$4,359	\$1,176	\$5,166
GA	\$2,194	\$4,400	\$1,724	\$6,103
NM	\$4,144	\$4,452	\$1,373	
NH	\$2,069	\$4,498	\$1,882	
WV	\$1,772	\$4,540	\$992	\$8,822
CT	\$2,492	\$4,892	\$1,591	\$8,087
OK	\$2,191	\$4,986	\$1,621	\$5,521
MO	\$1,898	\$5,061	\$1,911	\$7,697
SC	\$1,754	\$5,413	\$1,305	
VT	\$2,341	\$5,498	\$2,077	
AL	\$2,496	\$5,726	\$870	
MT	\$4,624	\$5,806	\$1,522	
LA	\$2,445	\$6,390	\$764	\$7,920
IL	\$2,782	\$6,841	\$2,157	\$8,171

Table 1

For the knee and elbow columns there is a semblance of the coloring going from green on top to red on bottom, revealing some tendency for a low (high) utilization state within one joint cohort to also be low (high) for the shoulder. For all but a few states, the average CCF is greatest for ankle, followed by shoulder, knee, and elbow.

Each of the following four sections focuses on a single cohort. For each joint we have selected three of the larger volume states with a comparatively low average CCF per case and three states with a comparatively high average CCF. While the findings depend on the selection of the six states, they are generally indicative of the differences between the high- and low-utilization states in the cohort. Restricting to a few states simplifies the comparisons, while still including enough state-specific detail to show how utilization can vary by state. Combining the states into two groups, we break down the difference in utilization between the selected low and high states according to the diagnoses made and the services delivered. Charts that include all the states in the cohort are in Appendices C and D.

Knee

Chart 1 shows that the average CCF per case for knee injuries varies considerably between the six selected states. For example, the CCF for Illinois is in excess of 70% above the CCF for Maryland ($2782 / 1623 = 1.71$). We will use these six states to illustrate utilization differences between the high- and low-utilization states (Appendix C shows how the average CCFs for these six states are positioned among those of the other states). We will look at utilization differences attributable to the mix of the diagnoses and to the mix of the types of services used to care for the knee cohort cases.

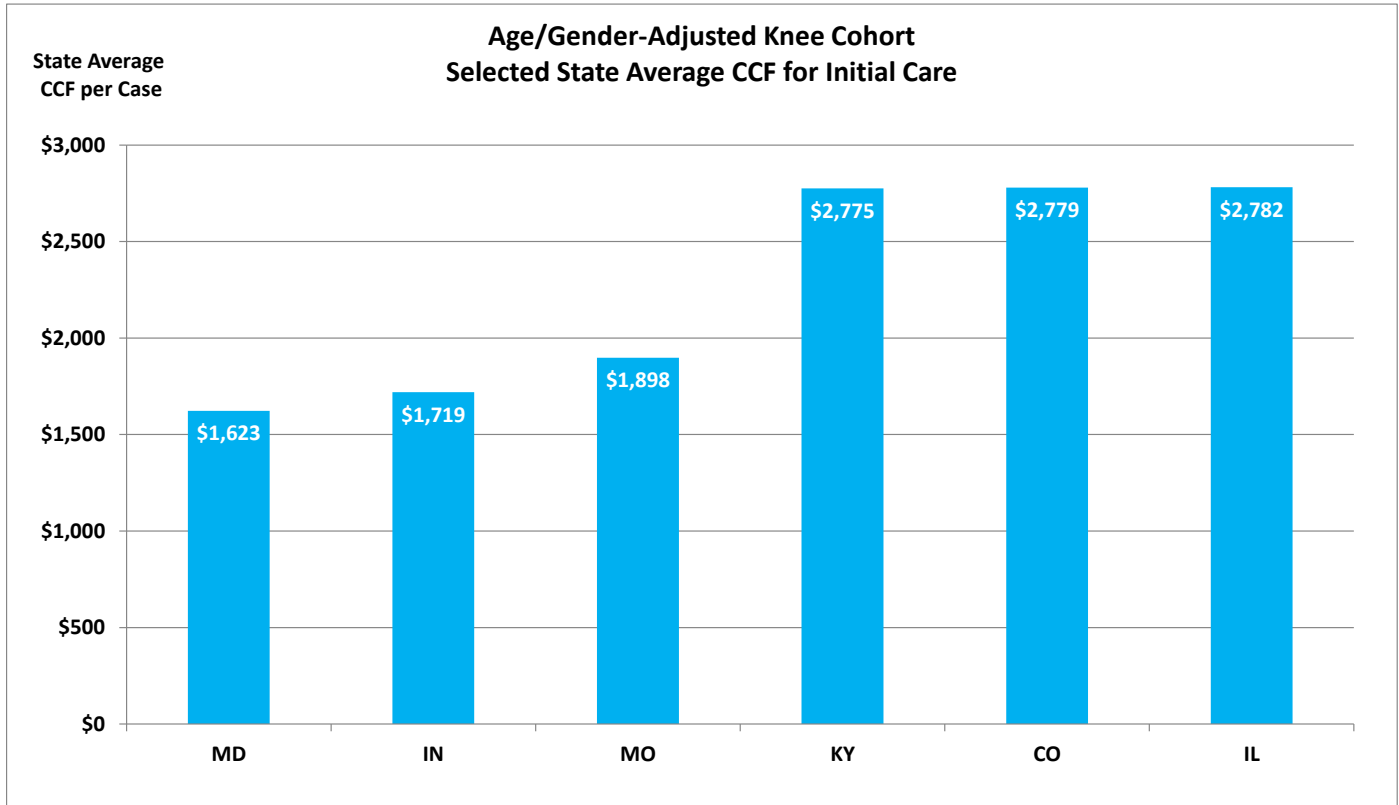


Chart 1

Medical bills for a claim may be reported with more than one diagnosis code. However, to evaluate the impact of utilization due to mix of diagnosis, we assign one diagnosis code to each claim, namely the diagnosis code resulting in the greatest CCF over the two-year initial care period. After assigning each claim to the one diagnosis code with the highest CCF, we look at the five diagnosis codes with the greatest total CCFs over all claims in the cohort.

For six selected states, Chart 2 shows the state shares of the CCF for the top five diagnosis codes of the entire multistate knee cohort. This chart shows significant differences among the selected states in the diagnosis of knee injuries, especially for those diagnosed as strain/sprain of cruciate ligament or meniscus tear cases. There is a smaller share of CCF for contusions in the three high-utilization states than in the three low-utilization states. Kentucky has particularly small shares of CCF for contusions and anterior cruciate ligament (ACL) injuries. Conversely, Kentucky has higher shares than the other selected states for several knee diagnoses (e.g., loose body [717.6] and plica syndrome [727.83]) that are not among the top five for the entire knee cohort. The strain/sprain of cruciate ligament (844.2) and ACL injuries (717.83) are examples of diagnoses that may refer to very similar injuries.

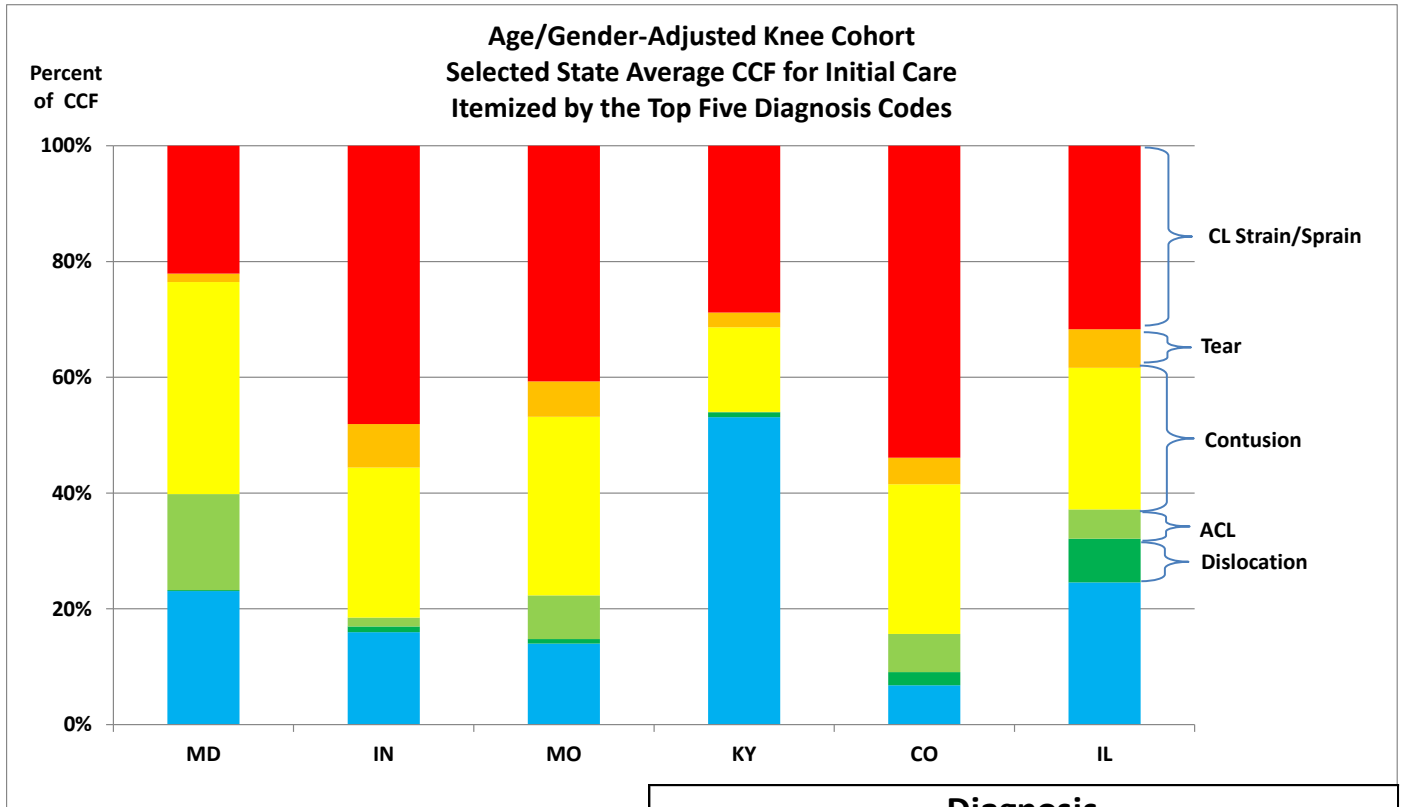
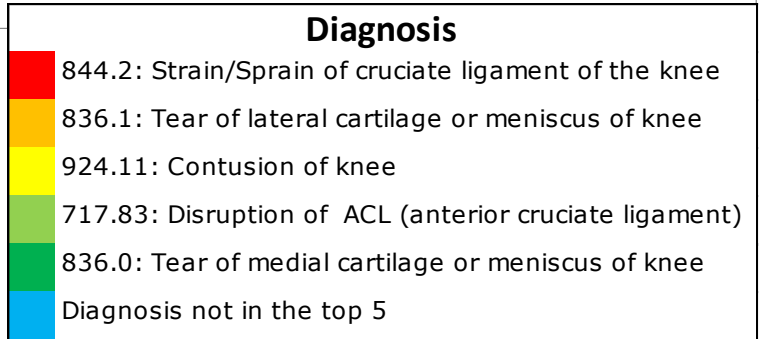


Chart 2



We move from looking at diagnoses of joint injuries to examining the types of services used to treat the injuries. Chart 3 itemizes the average CCF per case from Chart 1 into several broad service categories. For the selected states, higher expenditures on surgery and physical medicine distinguish the high-utilization states. The higher CCFs for surgery and physical medicine reflect some combination of a greater average number of services per claim and a shift toward more costly treatments, as measured by the common countrywide fee for each service used in the CCF. Although these states showed differences in their diagnosis mix (Chart 2), their CCFs per case for diagnostics are quite similar. The difference in the itemized average CCF per case between the low and high states for surgery and physical medicine is about \$2,400; this is more than five times the difference for drugs and diagnostics, which is about \$460.

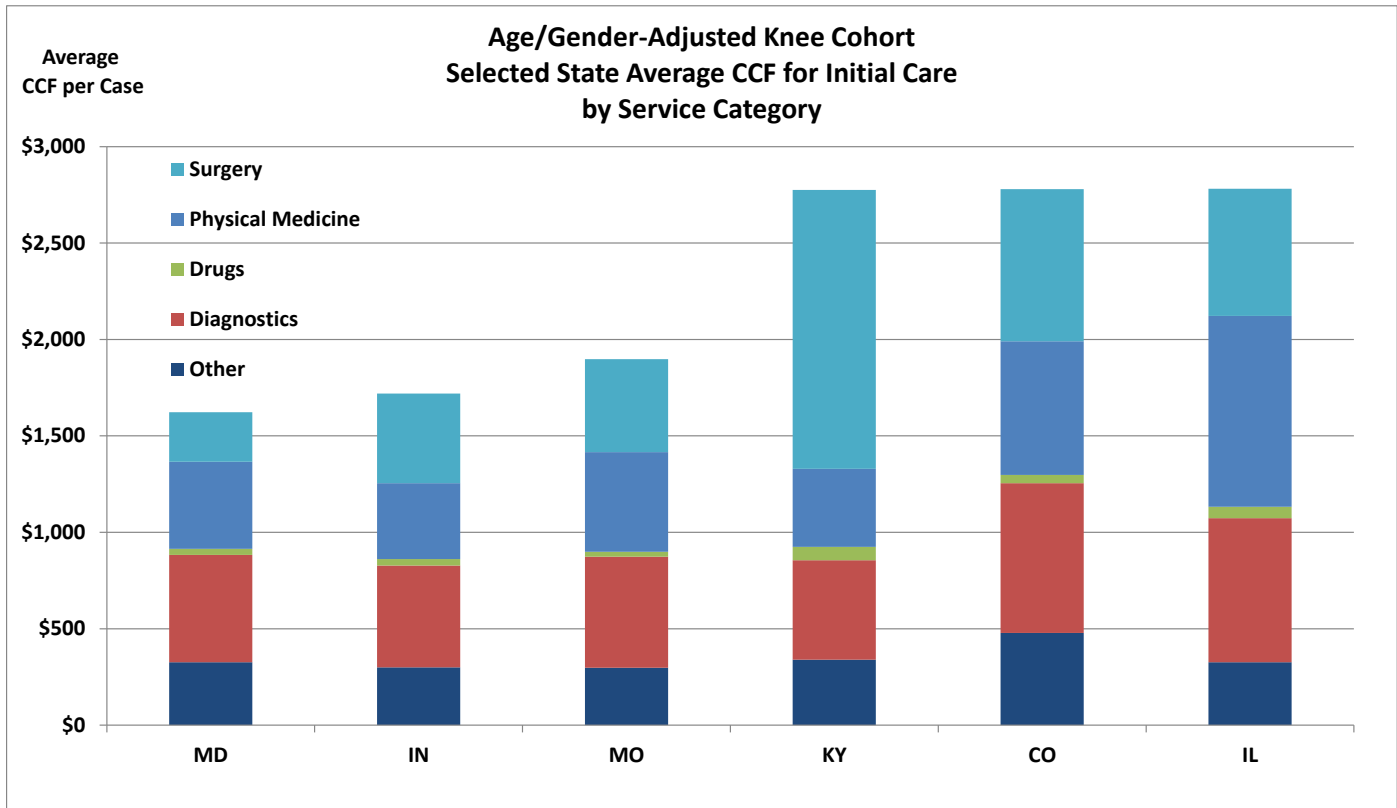
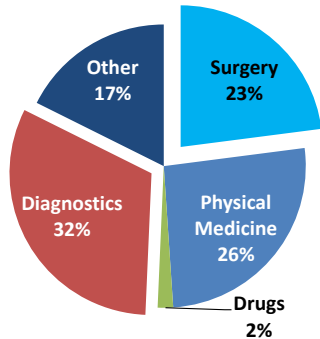


Chart 3

The CCF dollar amount for diagnostics is fairly close among the six states. Therefore the share of CCF for diagnostic services must decline as overall utilization increases. As utilization increases from the lower three states to the higher three, the shrinking share to diagnostics is offset by an increasing share to surgery.

This is illustrated in Chart 4 in which the itemized shares of CCF from the three low states are depicted on the left, and those for the high states on the right. For knee cases, higher utilization is characterized by a much greater share of resources devoted to surgery (35% versus 23%) and a considerably smaller share to diagnostics (24% versus 32%).

Age/Gender-Adjusted Knee Cohort
Three Low CCF States
Maryland - Indiana - Missouri



Age/Gender-Adjusted Knee Cohort
Three High CCF States
Kentucky - Colorado - Illinois

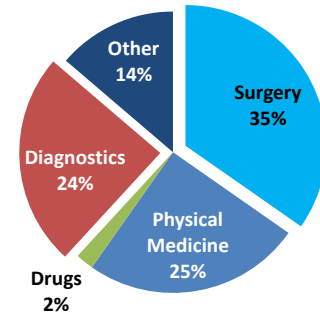


Chart 4

Chart 5 illustrates how diagnosis and treatment combine to drive utilization differences on knee cases:

- Diagnosis—Adjusting the CCF for the three low states to the diagnosis mix of the three high states (e.g., to reflect a smaller share of contusion and ACL cases) explains 23% of the difference in CCF between the two groups of states
- Treatment—Higher utilization to treat the same medical conditions accounts for the remaining 77% of the difference

This greater role for treatment makes sense from earlier charts. Compare the clear difference in average CCF between the two groups of states in Chart 1 with Chart 2 that shows no consistent difference in diagnosis shares between the two groups. It would require a greater difference between the two groups in their shares by diagnosis for the impact of adjusting for diagnosis mix to account for a larger proportion of the difference in the average CCF.

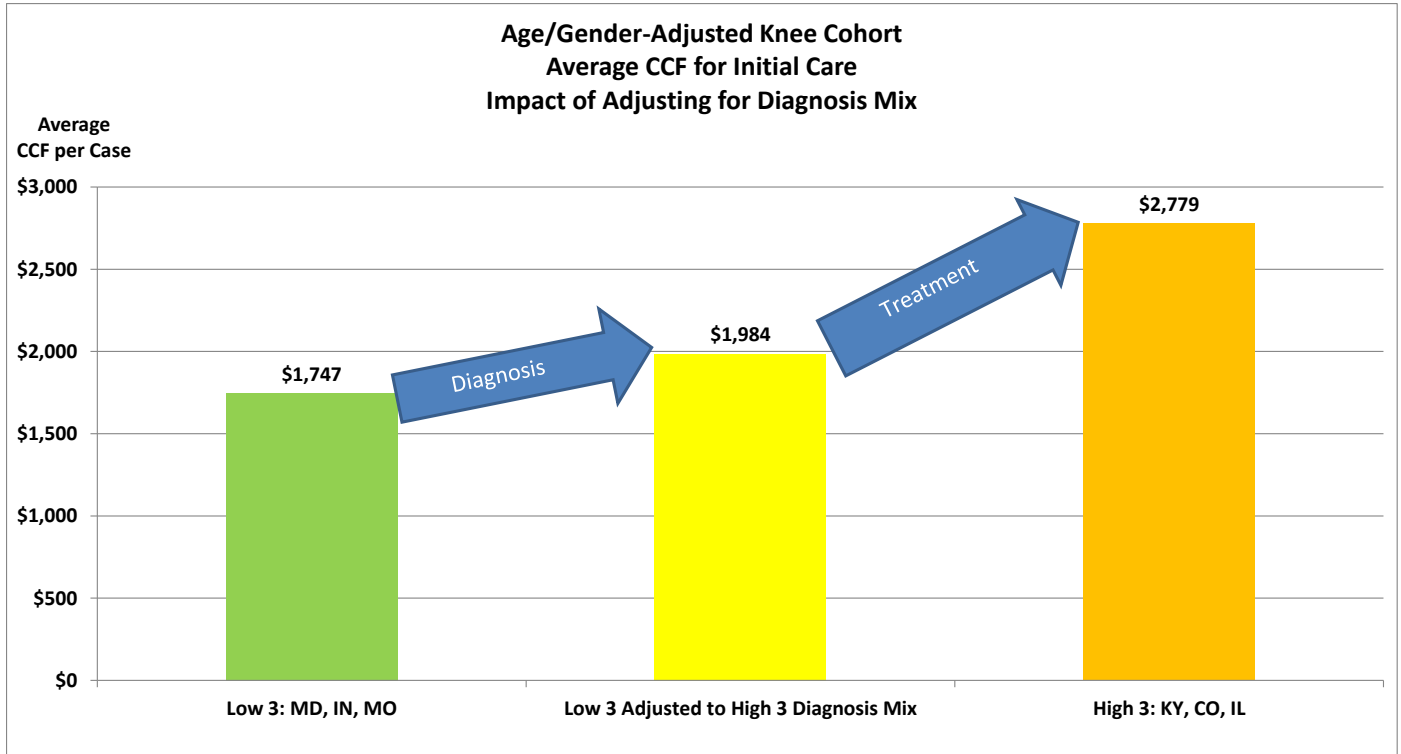


Chart 5

Shoulder

Chart 6 shows that the average CCF per case for shoulder injuries varies considerably over the six selected states, more than doubling from \$3,370 in Indiana to \$6,841 in Illinois. As was done with the knee cohort, we select six states to illustrate utilization differences attributable to the mix of diagnosis and to the mix of the types of services used to care for the shoulder cohort cases.

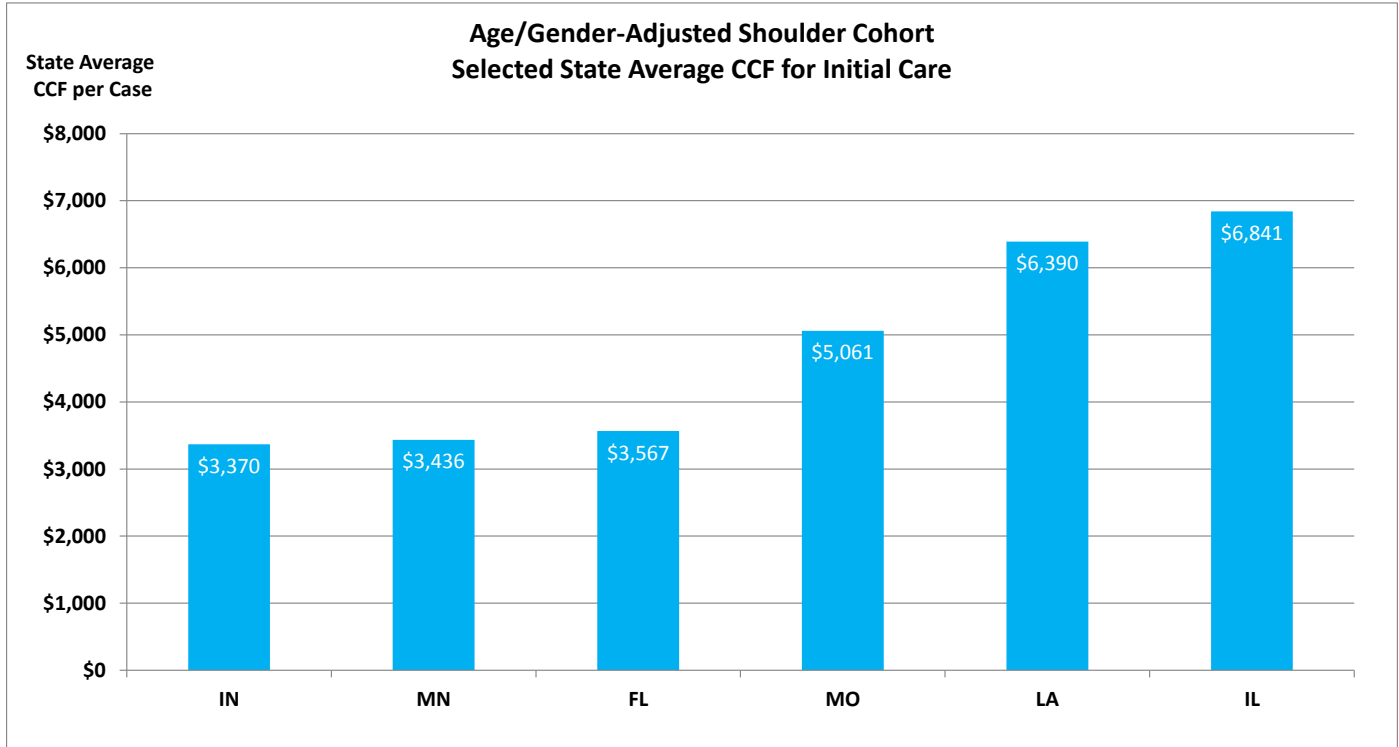
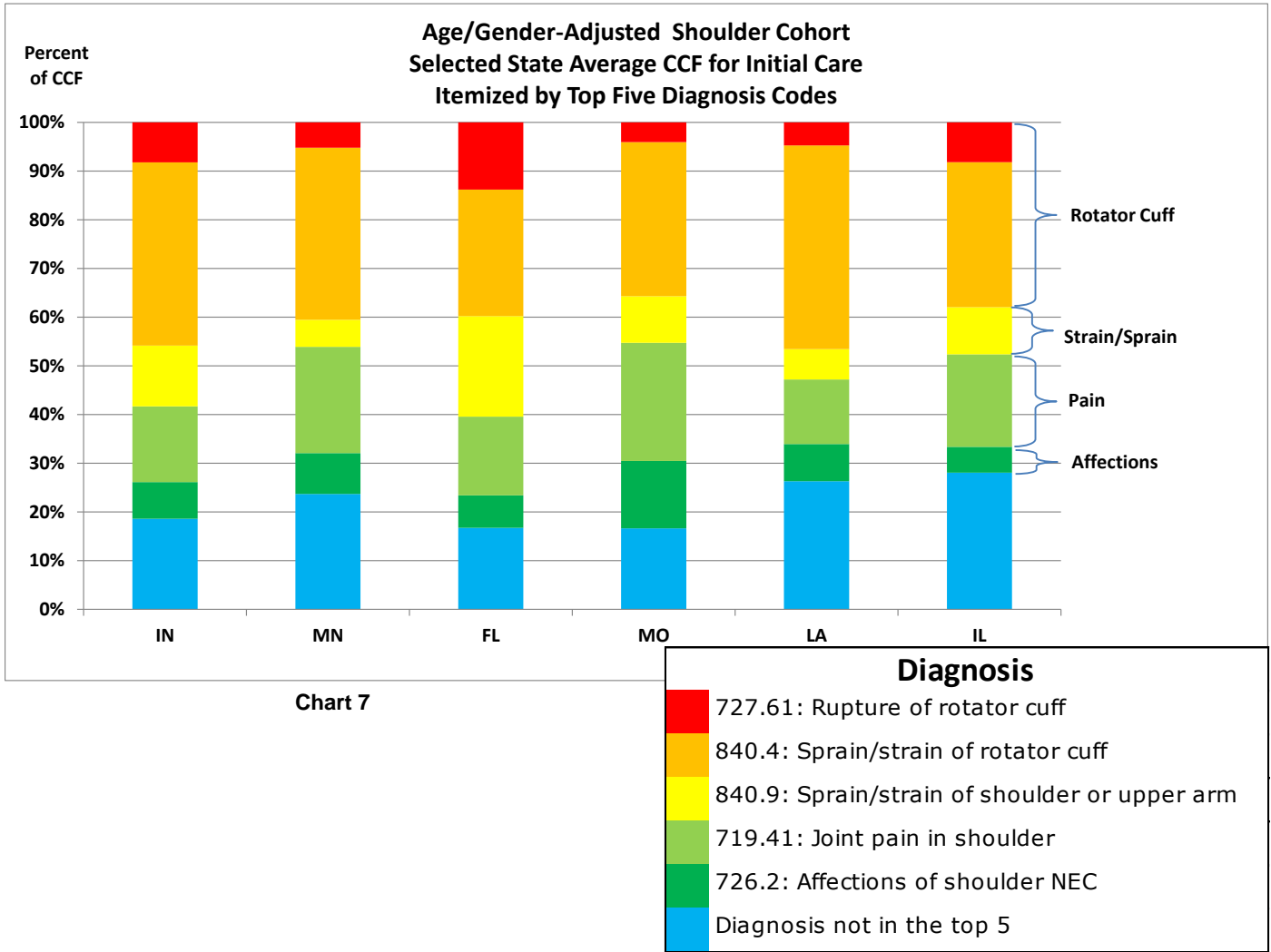


Chart 6

Assigning each shoulder case to a diagnosis code, Chart 7 shows the shares of the CCF for the top five diagnoses. There is greater similarity among the states in the diagnosis of shoulder injuries than was seen for the six states selected from the knee cohort.



For the selected state shoulder cases, Chart 8 shows that a greater use of surgery and physical medicine distinguishes the high-utilization states, while expenditures per case for diagnostics are quite similar. The difference in the CCF between the low and high states for surgery and physical medicine is \$5,916; this is almost eight times the difference for drugs and diagnostics, which is \$757.

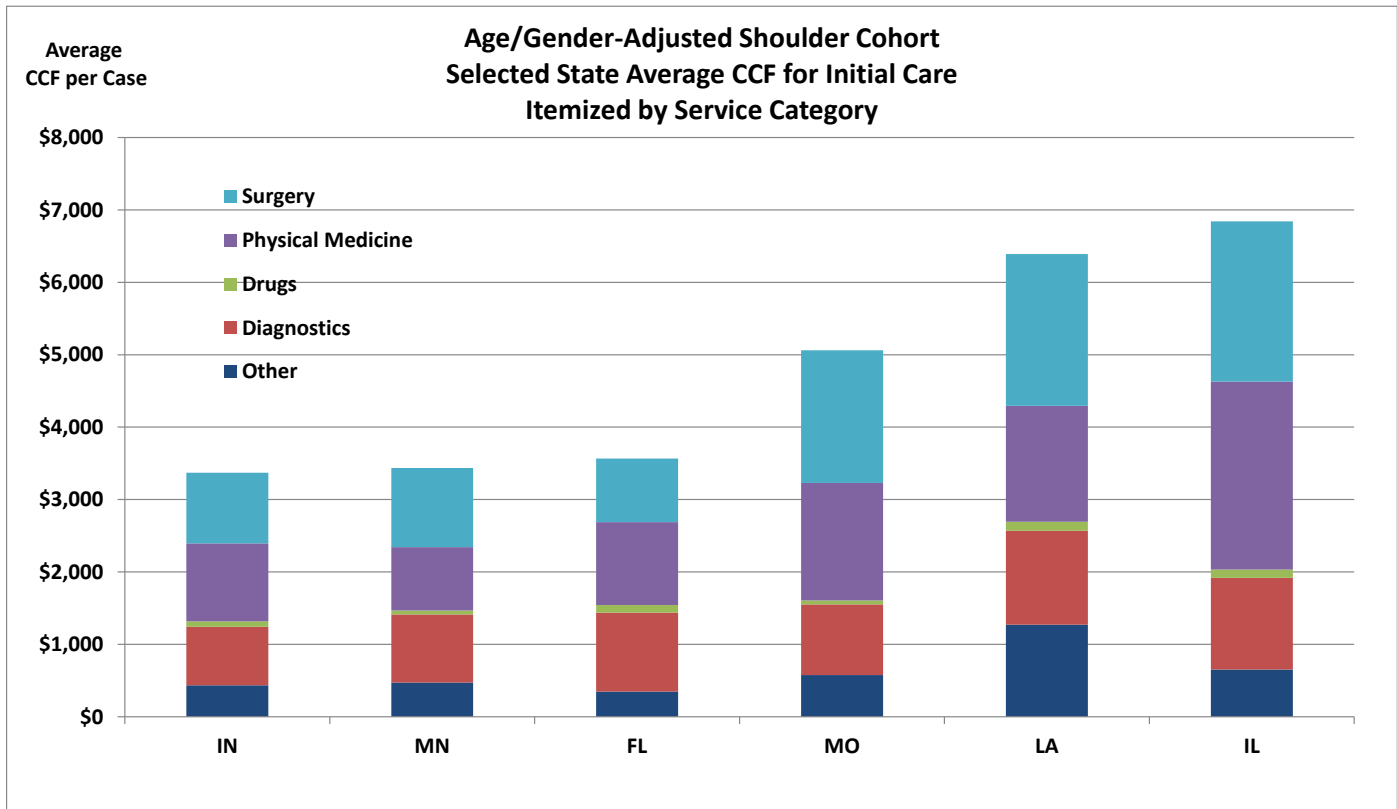
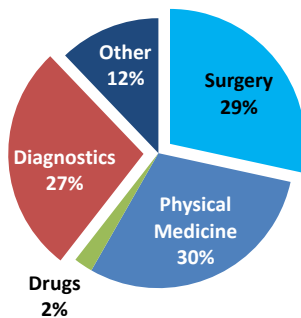


Chart 8

Being fairly consistent in dollar terms among the six states, the share of the CCF for diagnostics must decline as the CCF increases. As utilization increases from the lower three states to the higher, that shrinking percentage is offset by a growing percentage to surgery. This is illustrated in the two pie charts in Chart 9. Similar to what was observed for the knee cohort, higher utilization in shoulder cases is characterized by a somewhat greater share of medical resources to surgery (33% versus 29%) coupled with a considerably smaller share to diagnostics (19% versus 27%).

Age/Gender-Adjusted Shoulder Cohort
Three Low CCF States
Indiana - Minnesota - Florida



Age/Gender-Adjusted Shoulder Cohort
Three High CCF States
Missouri - Louisiana - Illinois

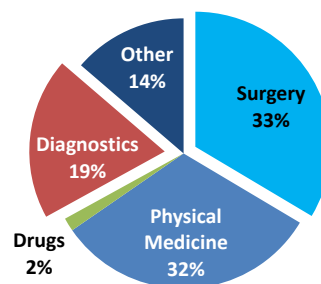


Chart 9

Chart 10 illustrates how diagnosis and treatment combine to drive utilization differences in shoulder cases:

- **Diagnosis**—Adjusting the low three states to the diagnosis mix of the high three states explains 12% of the difference in CCF between the two groups of states, which is about half of the percentage found for knee cases
- **Treatment**—Higher utilization of services being used to treat similar medical conditions accounts for the remaining 88% of the increase

One reason why differences in diagnosis play a greater role for knee than for shoulder cases may be that the treatment of knee cases, especially ACL tears, is somewhat more standardized than treatment of shoulder injuries.

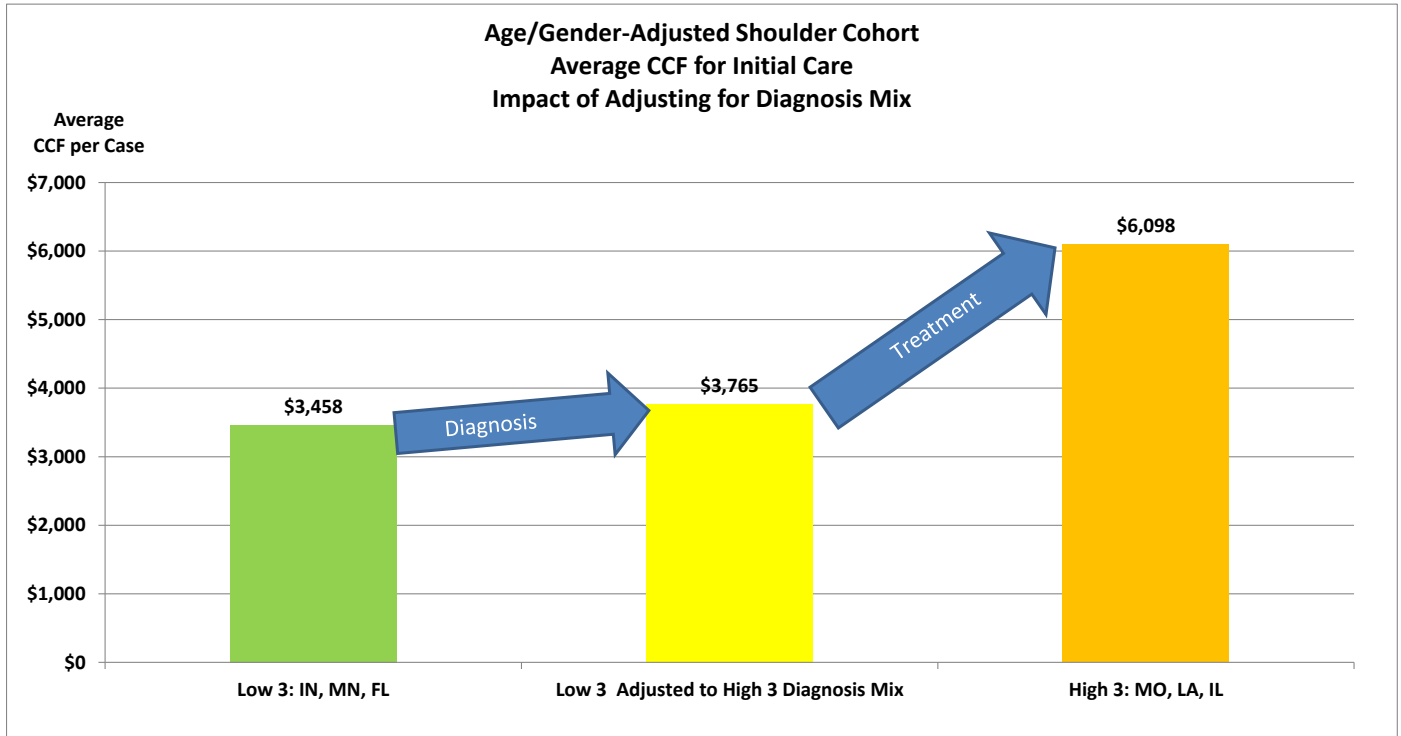


Chart 10

Elbow

For the six selected states from the elbow cohort, Chart 11 shows that the state average CCF per case varies greatly, nearly tripling from \$764 in Louisiana to \$2,157 in Illinois. We will use these six states to illustrate utilization differences attributable to the mix of diagnosis and mix of the types of services used to care for the elbow cohort cases.

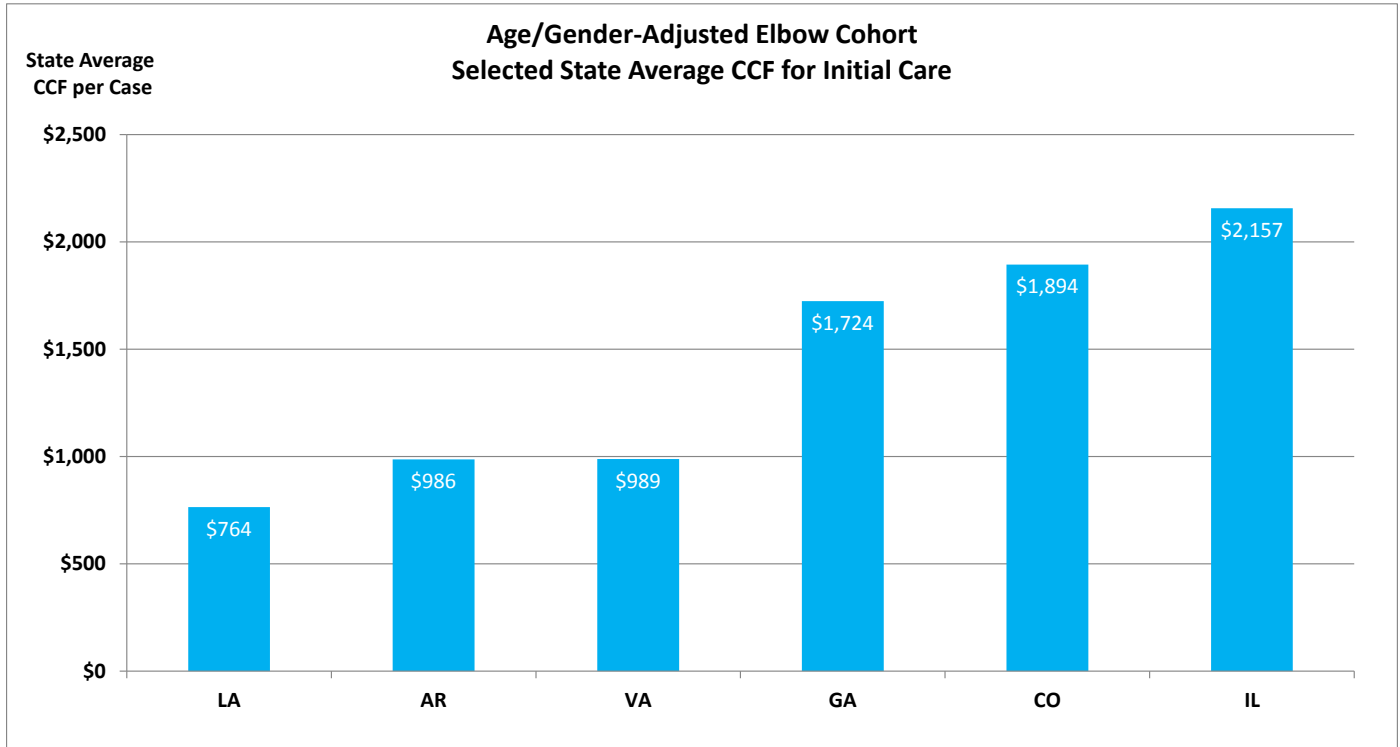


Chart 11

Again using the CCF to assign a diagnosis code to each elbow case, Chart 12 shows the shares of the CCF for the top five diagnoses. Contusions, strains, and sprain cases account for a greater proportion of the care in the lower utilization states. In the higher utilization states of Colorado and Illinois, tennis elbow (lateral epicondylitis) cases account for over half of the CCF for initial care.

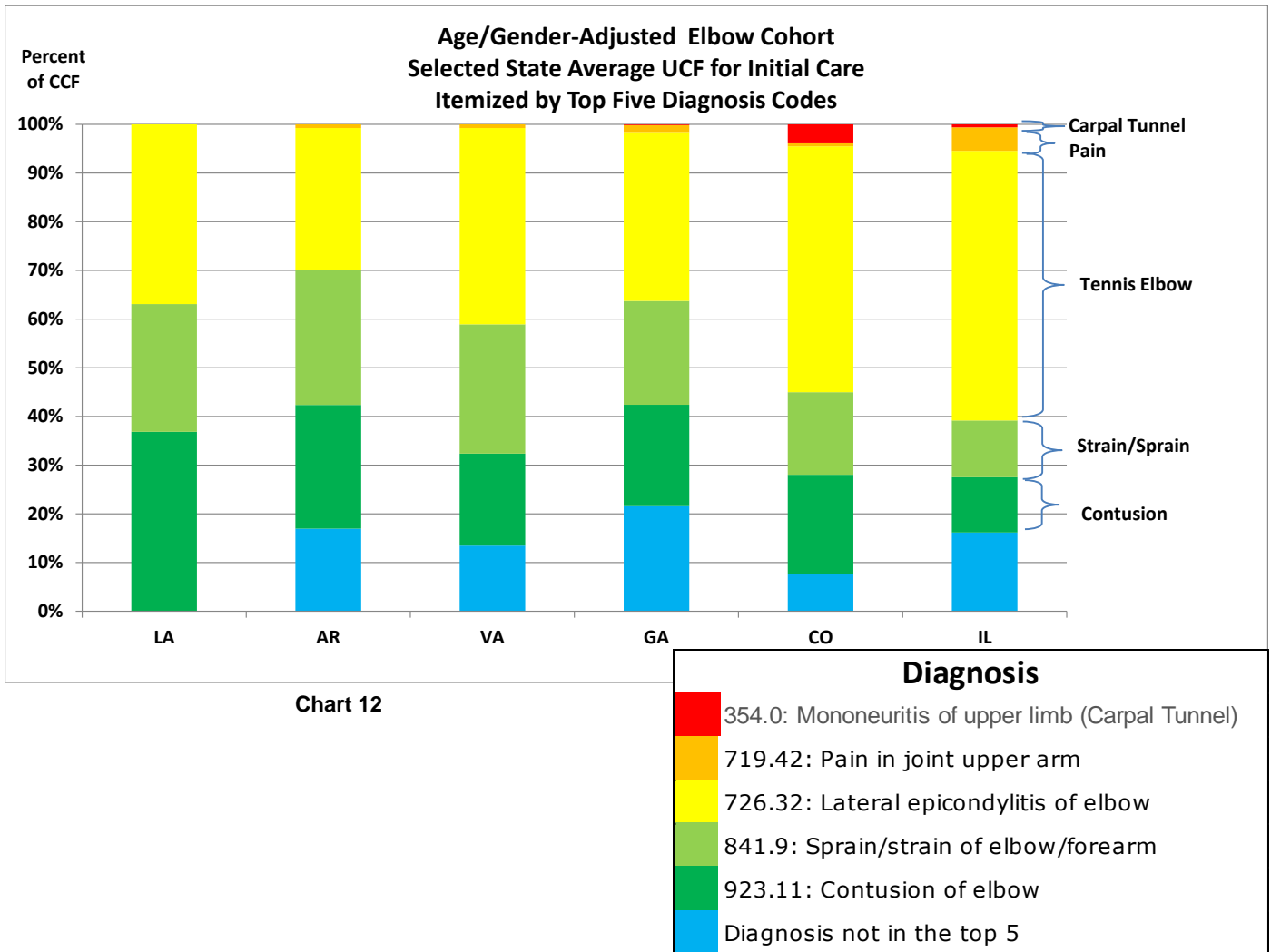


Chart 13 repeats the pattern in which expenditures on surgery and physical medicine distinguish the high-utilization states with closer expenditures per case for diagnostics and drugs. The difference in the CCF between the low and high states for surgery and physical medicine is \$1,795; this is more than twice the difference for drugs and diagnostics, which is \$786.

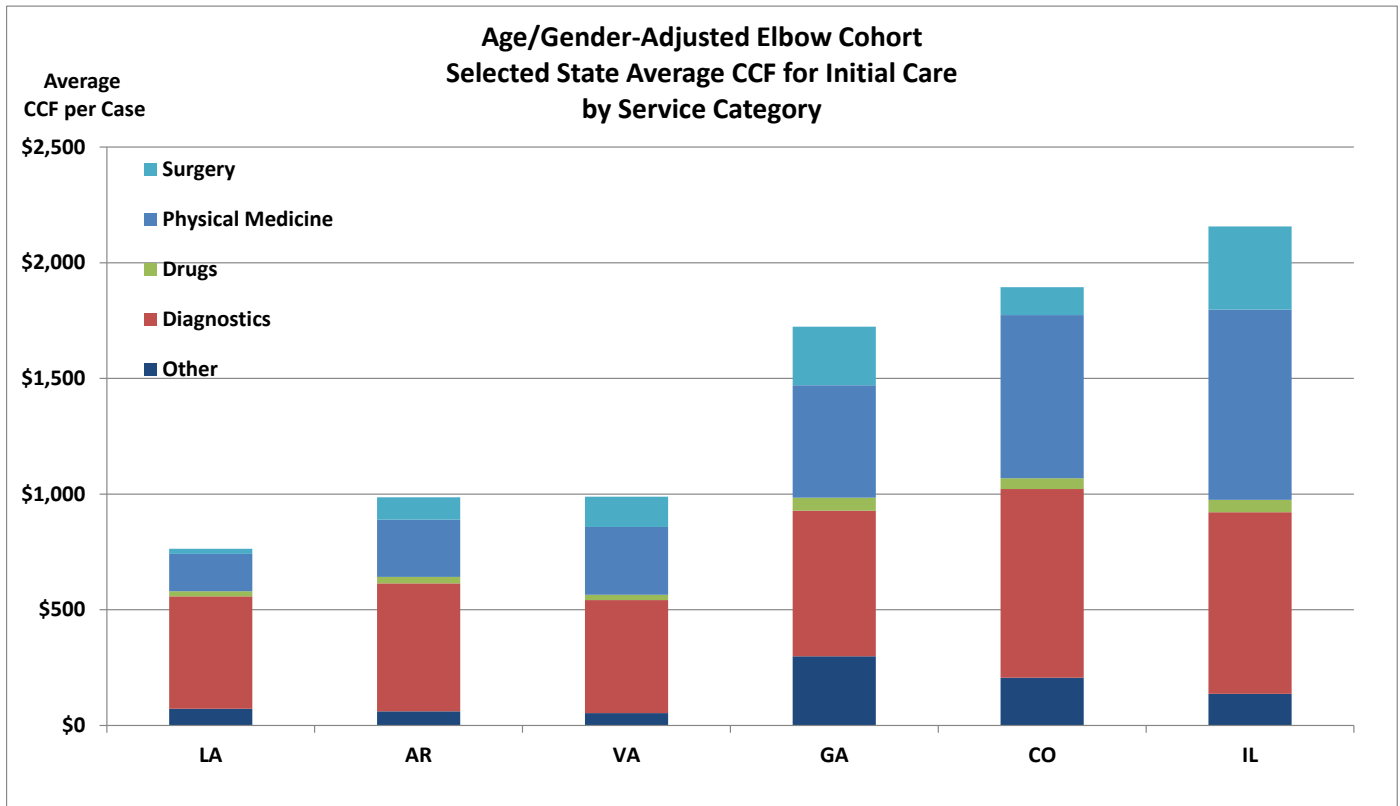


Chart 13

As illustrated in Chart 14, comparing utilization from the lower to the higher three states, a shrinking share to diagnostics (56% versus 38%) is largely offset by higher shares for surgery (9% versus 13%) and physical medicine (25% versus 35%).

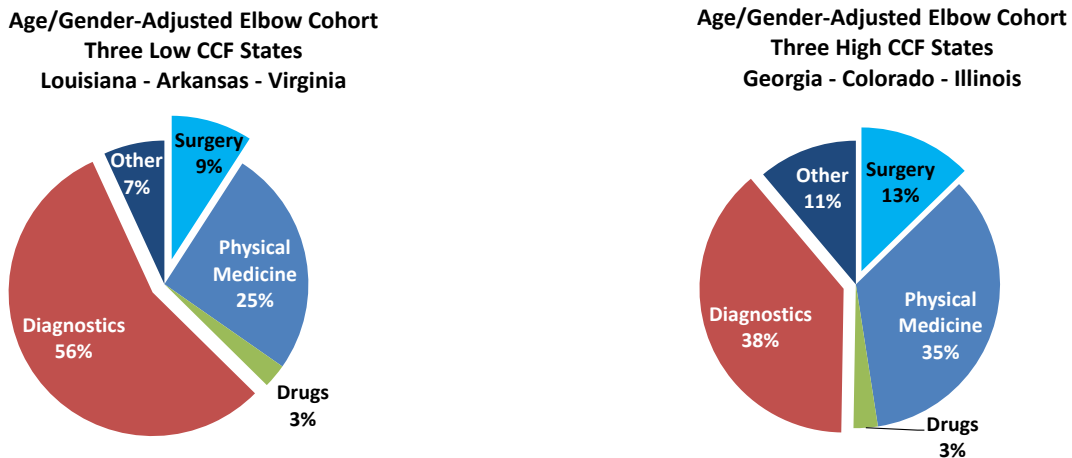


Chart 14

Chart 15 illustrates how diagnosis and treatment combine to drive utilization differences for elbow cases:

- Diagnosis—Adjusting the low three states to the diagnosis mix of the high three states (more tennis elbows, fewer sprains) explains 16% of the difference in CCF between the two groups of states
- Treatment—Higher utilization for the treatment of specific medical conditions in the three high states accounts for the remaining 84% of the difference

The pattern is similar to what was observed for shoulder cases. Again a reason why differences in diagnosis play a greater role for knee than for elbow cases may be that the treatment of knee cases is somewhat more standardized than treatment of elbow injuries. Some elbow cases may prove difficult to resolve, resulting in a variety of approaches to treatment.

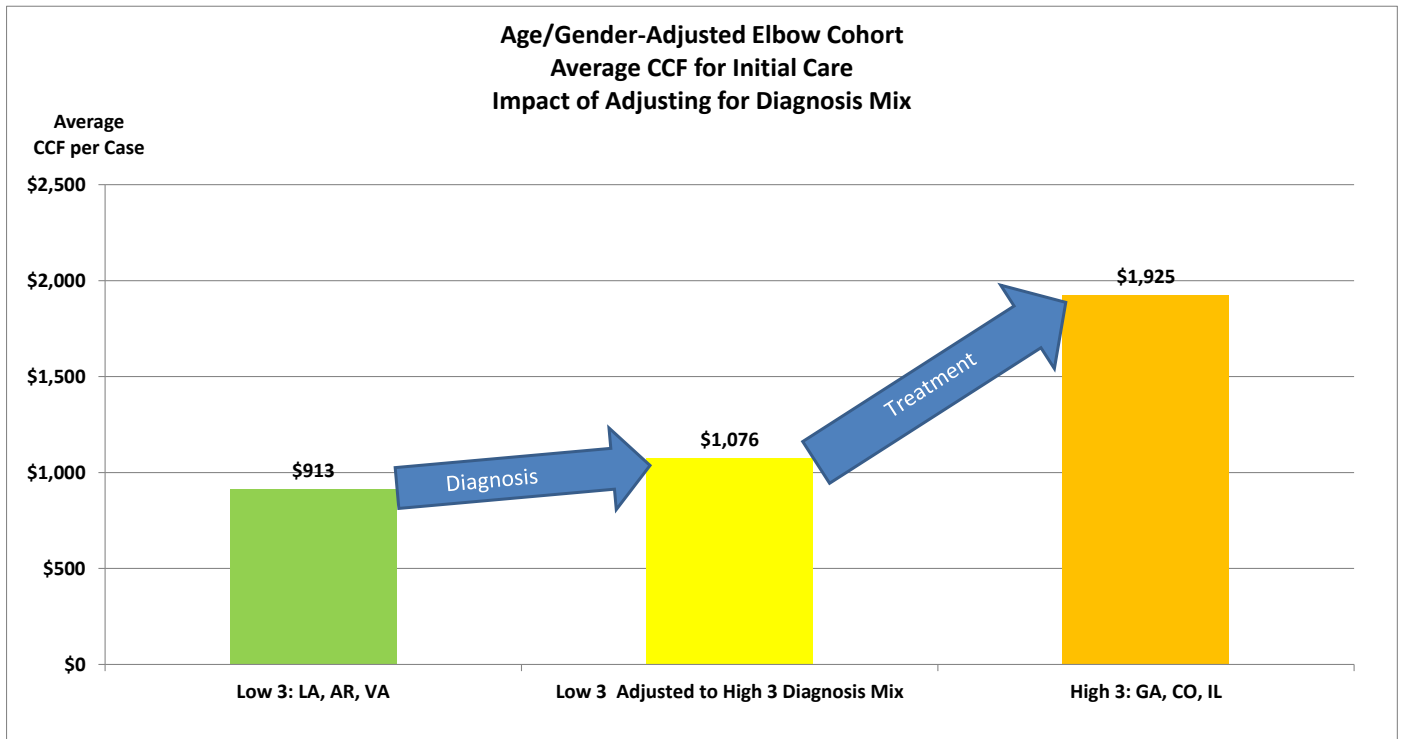


Chart 15

Ankle

The criteria to include a case in the ankle cohort selects cases that are more likely to involve a fracture and on average entail more intense treatment than joint injuries in the other three cohorts. From Table 1, among the four cohorts, the average CCF is greatest for the ankle cohort for every state for which there are sufficient cases for comparison. This suggests that, while the ankle cohort case selection criteria need not yield a representative sample of all ankle injuries, there is reason to believe it applies consistently by state. That differential in average CCF per case is typically significant, with the average for the ankle only rivaled by the shoulder cohort for a few states. For the six selected states, Chart 16 shows that the average CCF per case for ankle injuries varies considerably by state, more than doubling from \$5,521 in Oklahoma to \$11,827 in Minnesota.

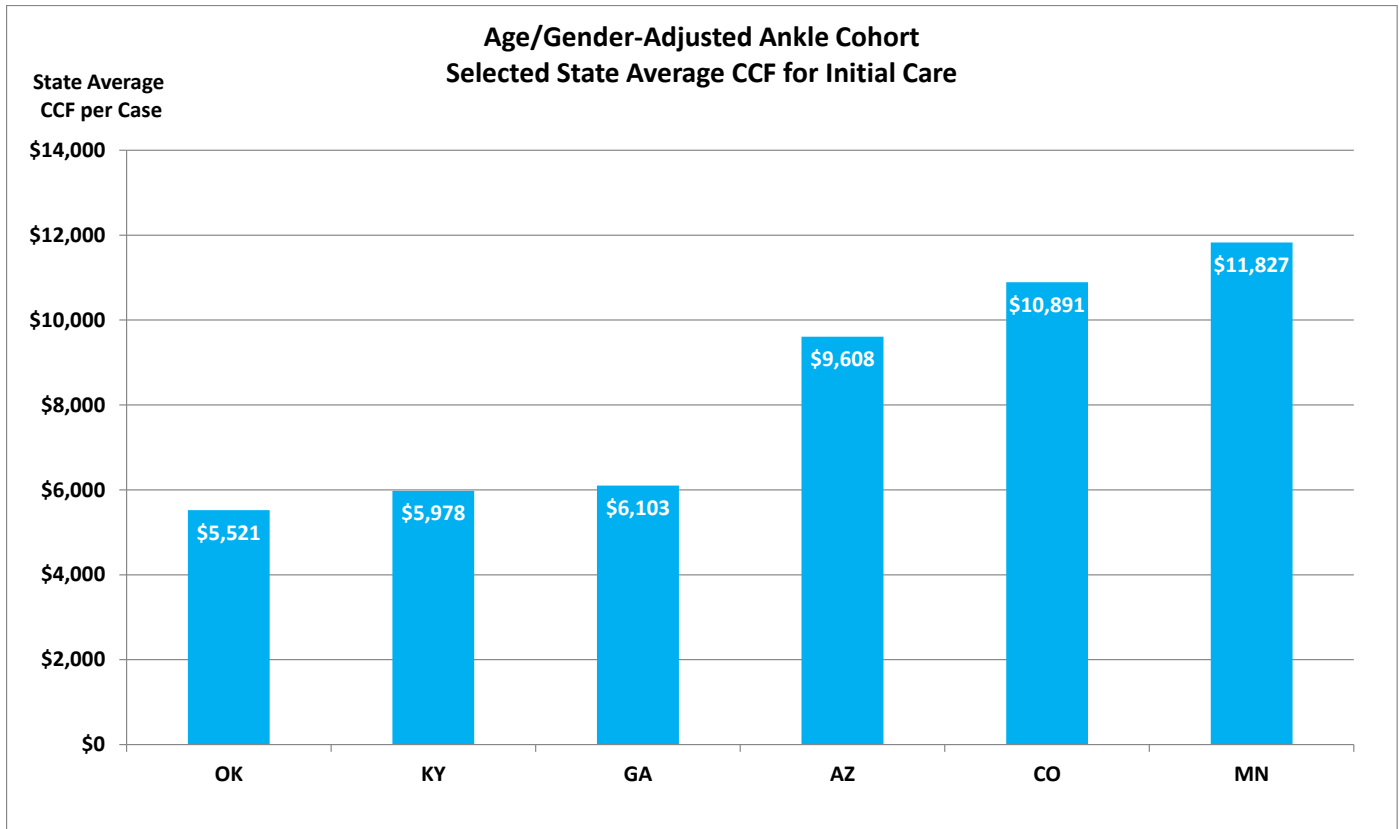


Chart 16

Chart 17 shows the shares of the CCF for the top five diagnoses of ankle cases. While there are differences in the specific broken bones, all the states show more than three-fourths of the CCF going to treat fractures. The higher-utilization states—Colorado and Minnesota—do show somewhat higher percentages of CCF going to treat fracture cases than Oklahoma and Georgia.

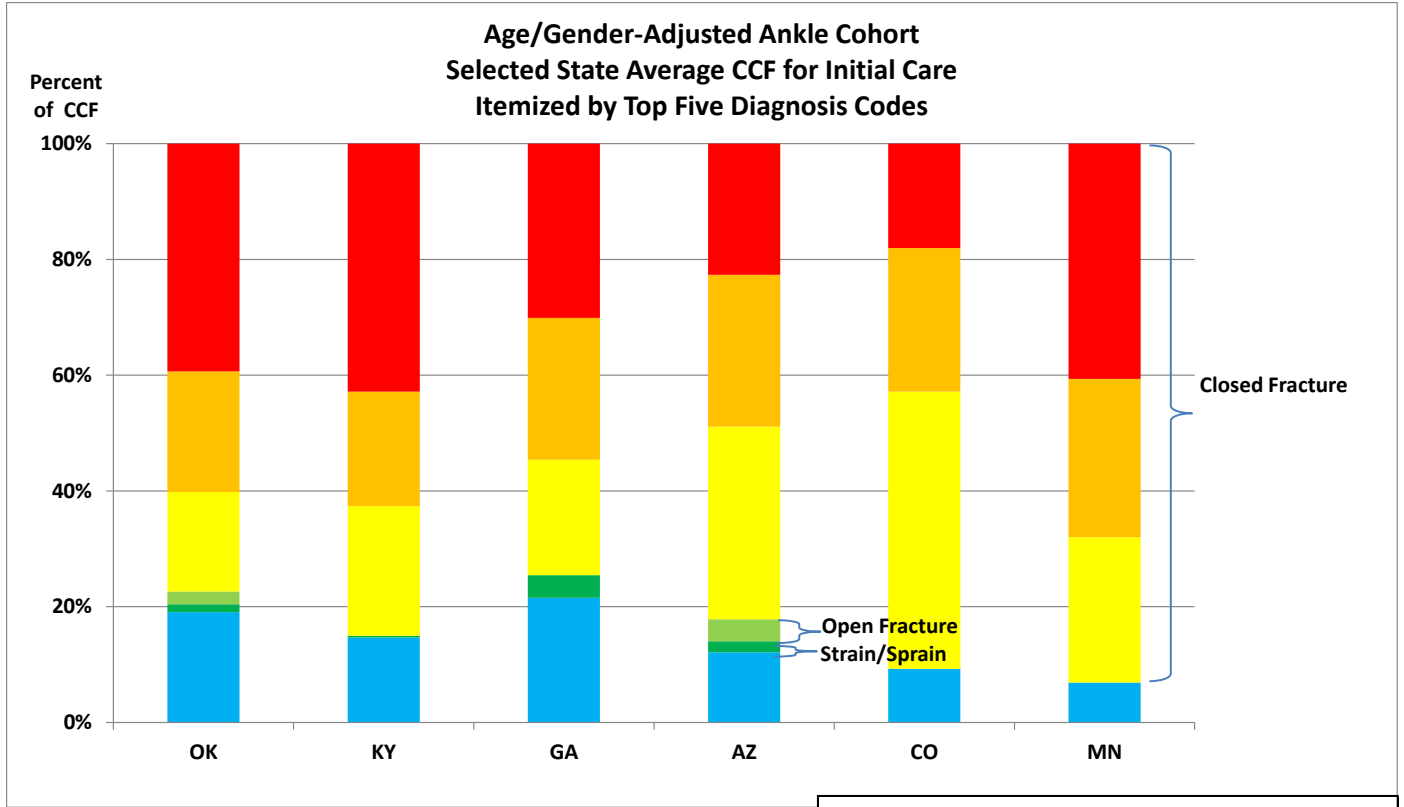


Chart 17

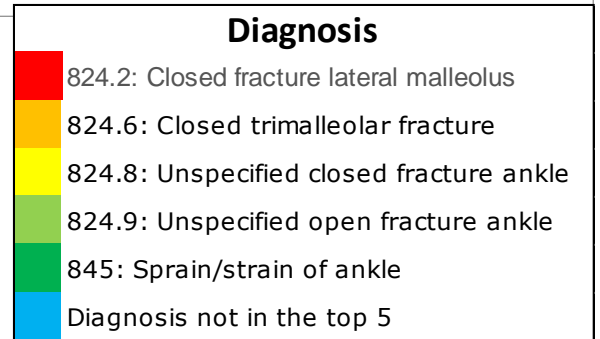


Chart 18 itemizes the CCF into several broad service categories. For the selected states, higher expenditures on surgery and other services (e.g., supplies and equipment, like air boots) distinguish the high-utilization states. Again, the utilization of diagnostics and drugs among the six states is more consistent than their use of physical medicine or surgery. The difference in the CCF between the low and high states for surgery and physical medicine is \$6,872, which is almost four times the difference for drugs and diagnostics, which is still considerable at \$1,791.

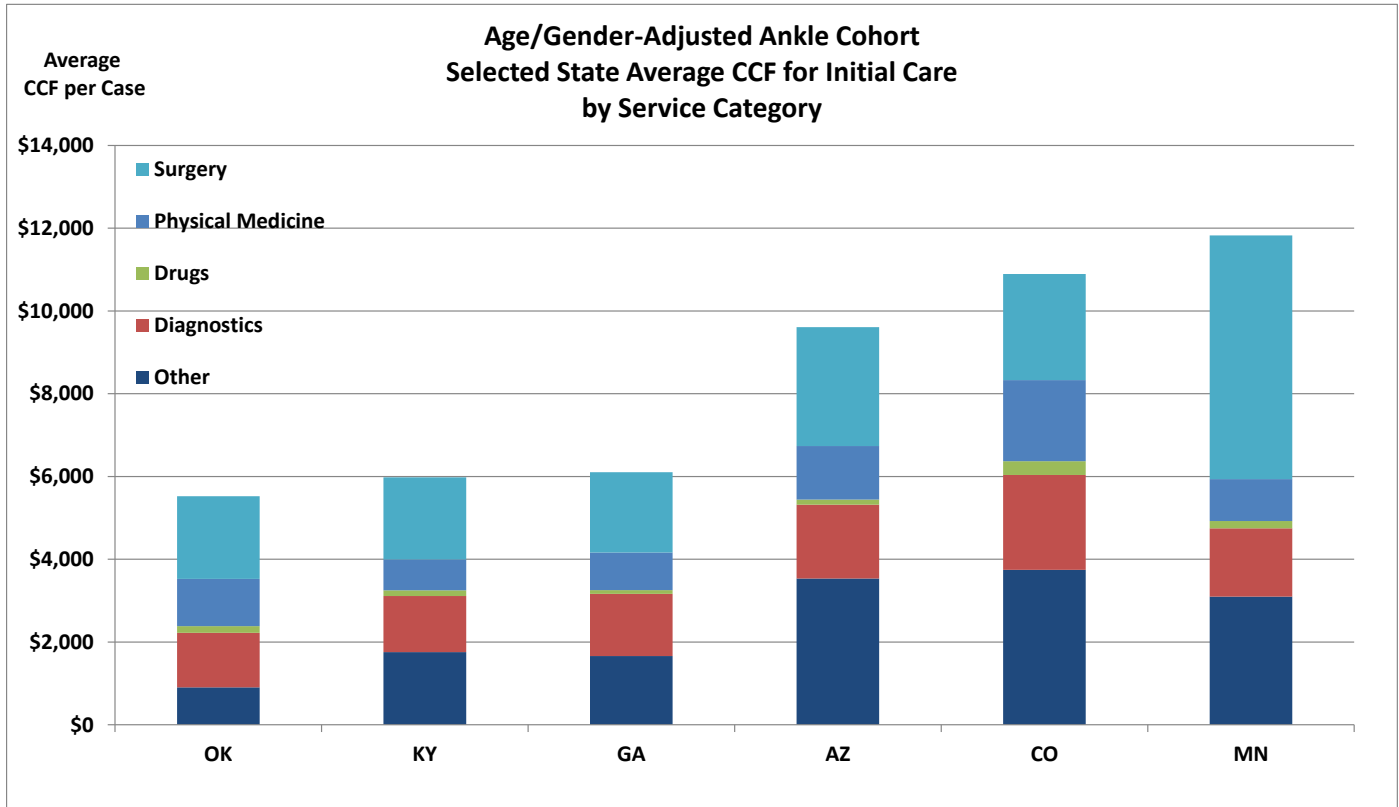


Chart 18

As utilization increases from the lower to the higher three states, Chart 19 shows that the shrinking percentage to diagnostics (24% versus 18%) is more than offset by an increasing percentage to other services (24% versus 32%).

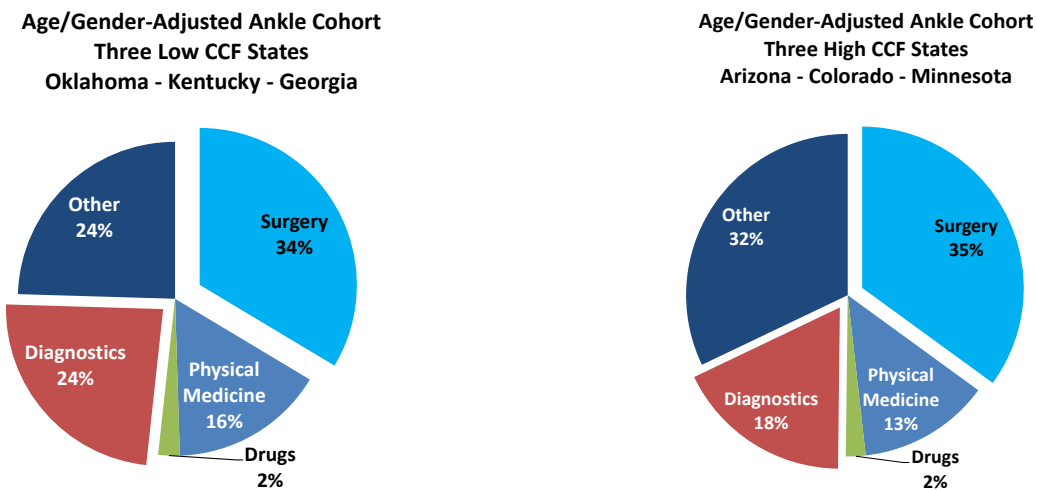


Chart 19

Chart 20 illustrates how treatment dominates diagnosis when combining to drive utilization differences on ankle cases:

- **Diagnosis**—Adjusting the low three states to the diagnosis mix of the high three states (a somewhat higher share of fractures) explains only 6% of the difference in CCF between the two groups of states
- **Treatment**—Higher utilization for the treatment of similar medical conditions (mostly fractures) in the three high states accounts for nearly all (94%) of the difference

Chart 17 suggests a possible reason why differences in diagnosis play a smaller role in the interstate variation for ankle injuries than for the other joints. The high percentage of fractures in the ankle cohort might result in a routine test like an X-ray being more likely to provide a definitive diagnosis in ankle cohort cases.

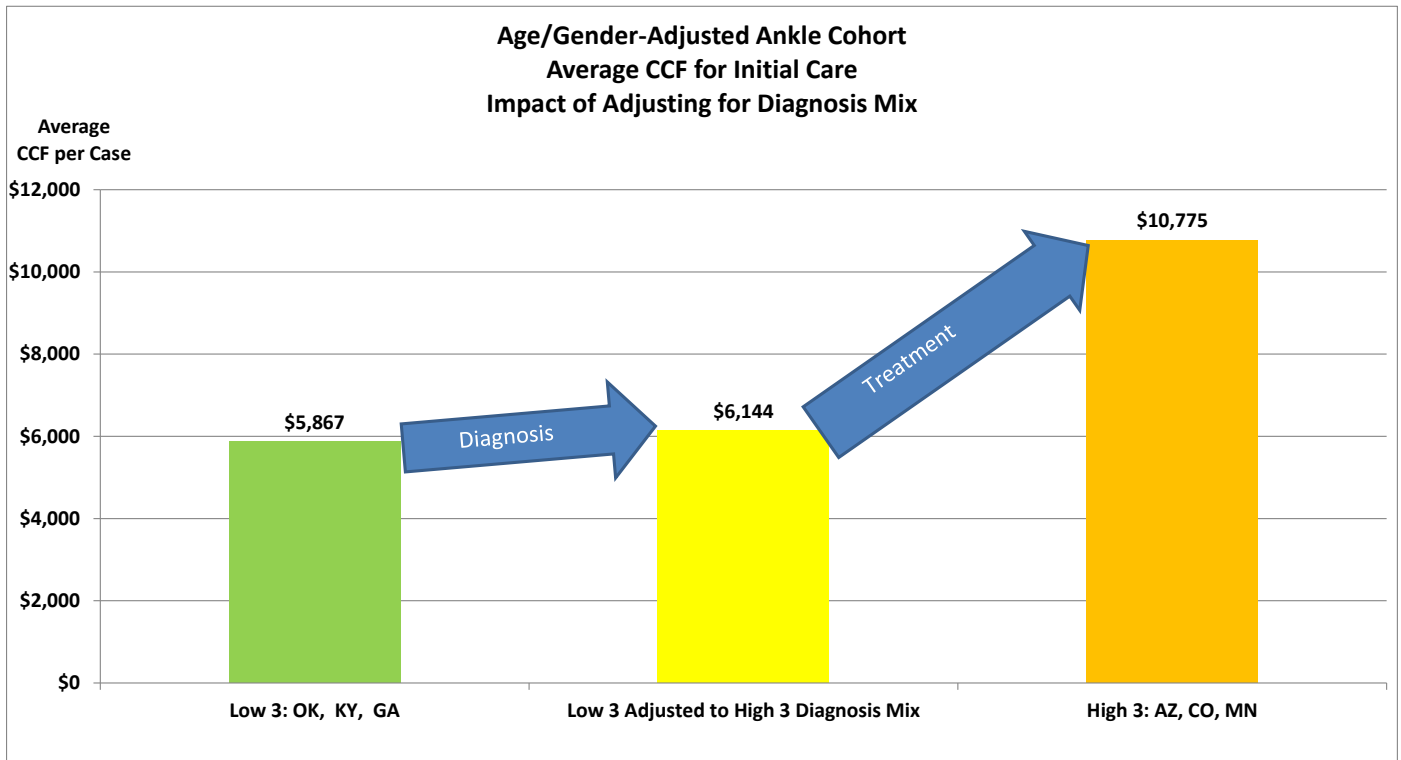


Chart 20

CONCLUSION

Stakeholders are interested in differences in treatment patterns by state and how to ensure the best outcomes for injured workers. This study quantifies differences in treatment patterns by state for joint injuries. Some key findings are:

- There is a wide variation among states in the utilization of services to treat joint cases as measured by the average CCF per case.
- For each cohort, we selected three lower and three higher utilization states from among the larger volume states. The average CCF per case is much higher for the higher-utilization states than the lower-utilization states, with elbow cases showing the greatest spread. The percentage differences in the average CCF among all states is at least as great as that between the highest and lowest of the six selected states:
 - Knee: 71%
 - Shoulder: 103%
 - Elbow: 182%
 - Ankle: 114%
- For each joint cohort:
 - Surgery and physical medicine show the greatest variation in CCF across states
 - The CCF for diagnostics is comparatively consistent across states
 - Utilization differences across our selected states are driven more by differences in the treatment for given diagnoses than to the mix of diagnoses; this finding is strongest for shoulder and elbow cases

Future research is needed to better understand the drivers of the differences in diagnosis and treatment among states and to evaluate the effectiveness of approaches for regulating utilization. This study assumes that diagnosis coding is done consistently by state. The question is, are there differences between states in diagnosis coding of otherwise comparable injuries, and, if so, are these differences related to state WC physician fee schedules or treatment guidelines? Finding a relationship between utilization and treatment guidelines is challenging due to the lack of data on the claimant's comorbidities and prior medical history.

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Appendix A: List of Diagnoses Used to Identify Cohort Cases:

Injured Joint	ICD9 Code	Description
Ankle	845	Strains and sprains of ankle and foot
	824.8	Unspecified closed fracture ankle
	824.2	Closed fracture lateral malleolus
	825	Fracture of one or more tarsal and metatarsal bones
	824.6	Closed trimalleolar fracture
	824.9	Unspecified open fracture of ankle
	727.67	Nontraumatic rupture of achilles tendon
Elbow	726.32	Lateral epicondylitis of elbow
	841.9	Sprain & strain unspecified site elbow & forearm
	923.11	Contusion of elbow
Knee	836.0	Tear medial cartilage/meniscus of knee current
	836.1	Tear lateral cartilage/meniscus of knee current
	717.9	Unspecified internal derangement knee
	924.11	Contusion of knee
	717.83	Old disruption of ACL
	717.2	Derangement of posterior horn medial meniscus
	844.2	Sprain & strain cruciate ligament knee
	822	Closed fracture of patella
	836.2	Other tear cartilage/meniscus knee current
	717.3	Other & unspecified derangement medial meniscus
Shoulder	717.6	Loose body in knee
	840.4	Rotator cuff sprain and strain
	726.1	Rotator cuff syndrome of shoulder and allied disorders
	840.9	Sprain & strain unspecified site shoulder & upper arm
	719.41	Pain in joint, shoulder region
	727.61	Complete rupture of rotator cuff
	726	Peripheral enthesopathies and allied syndromes
	726.12	Bicipital tenosynovitis
	923	Contusion of shoulder region
	718.01	Articular cartilage disorder shoulder region
	726.2	Other affections shoulder region NEC
718.31	Recurrent dislocation of shoulder joint	

The top five CCF diagnoses for the shoulder and knee cohorts are included in the above lists. Conversely, the three elbow selection diagnoses are among the top five CCF knee diagnoses. The ankle cohort is exceptional, with no diagnosis code common to the ankle diagnosis selection list and the top 5 CCF ankle diagnoses. This reinforces what was noted before (footnote 7) that the case selection for the ankle cohort results in a small volume of comparatively costly cases. For making comparisons among states, however, the study assumes that for each joint, the selection rules will produce comparable—albeit not necessarily representative—claim samples by state.

Appendix B: Determining the Common Fee for a Medical Service

In order for the utilization measure to account for price differences by state, we use a common medical service fee for all states over the full initial care period. The common fee for a service is derived from median amounts paid as described in the following steps:

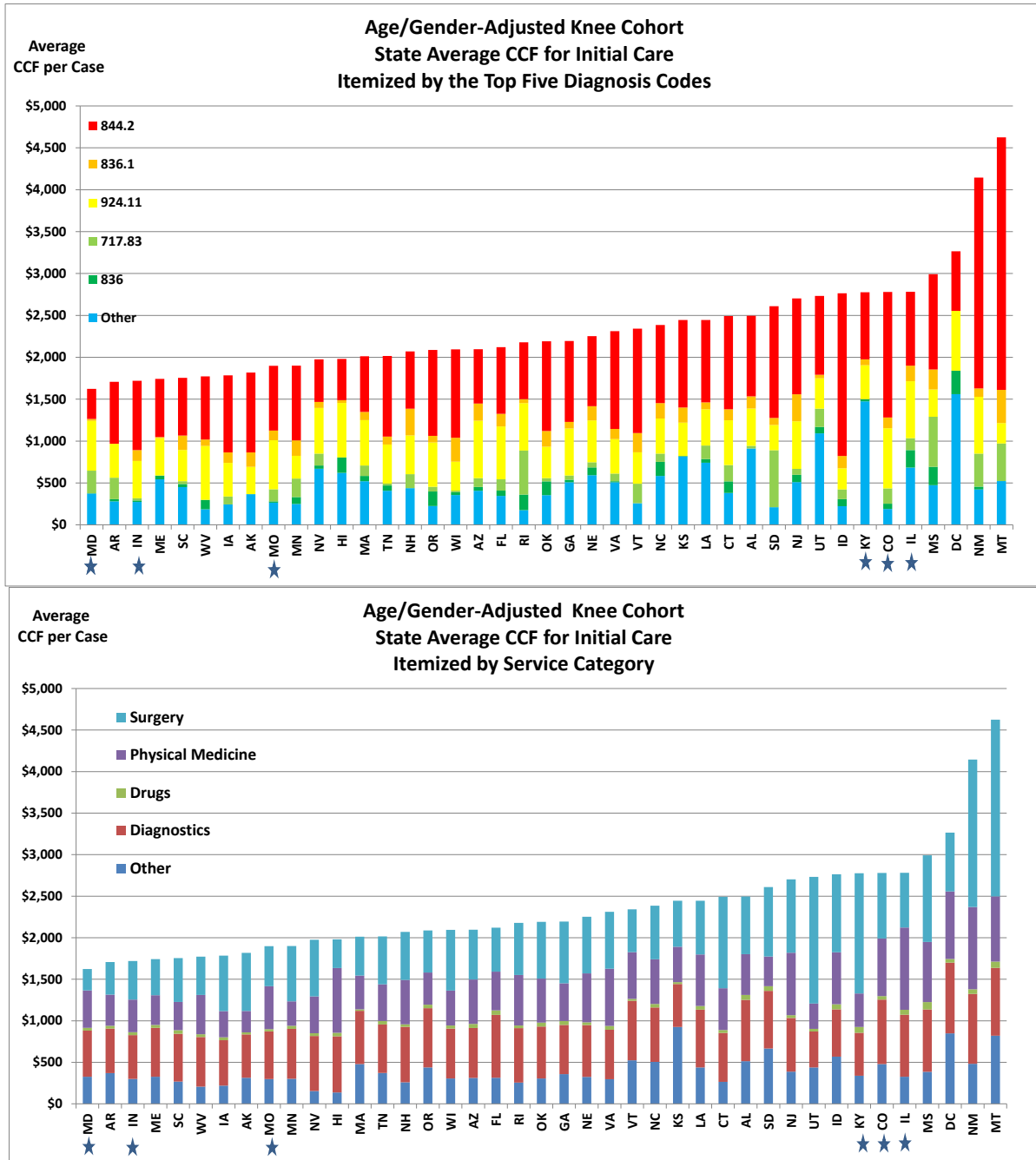
1. For each transaction, require that the paid amount be greater than \$0 and adjust, as needed, so that each observation corresponds to 1 “unit” of the medical procedure
2. For each procedure and state, determine the median fee paid
3. For each state, determine a base procedure as the most common procedure (= 15 minutes of physical therapy, CPT Code 97110)
4. For each state and procedure, calculate the ratio of the median fee for the procedure from step 2 to the state’s median fee for the one base procedure determined in step 3
5. For each procedure, calculate the simple geometric average over the states of the ratios from step 4
6. Determine a base fee as the median paid for the base procedure (97110) over all states
7. For each procedure, the common fee is determined as the product of the base price from step 6 times the relativity from step 5

This calculation does not allow large volume states to dominate the median price determination. In effect, each state has an equal “vote” (the ratio of step 4) when assessing the relative value of any specific medical procedure. That value is converted to a dollar amount, per unit of the medical procedure, and those amounts constitute the common fee.

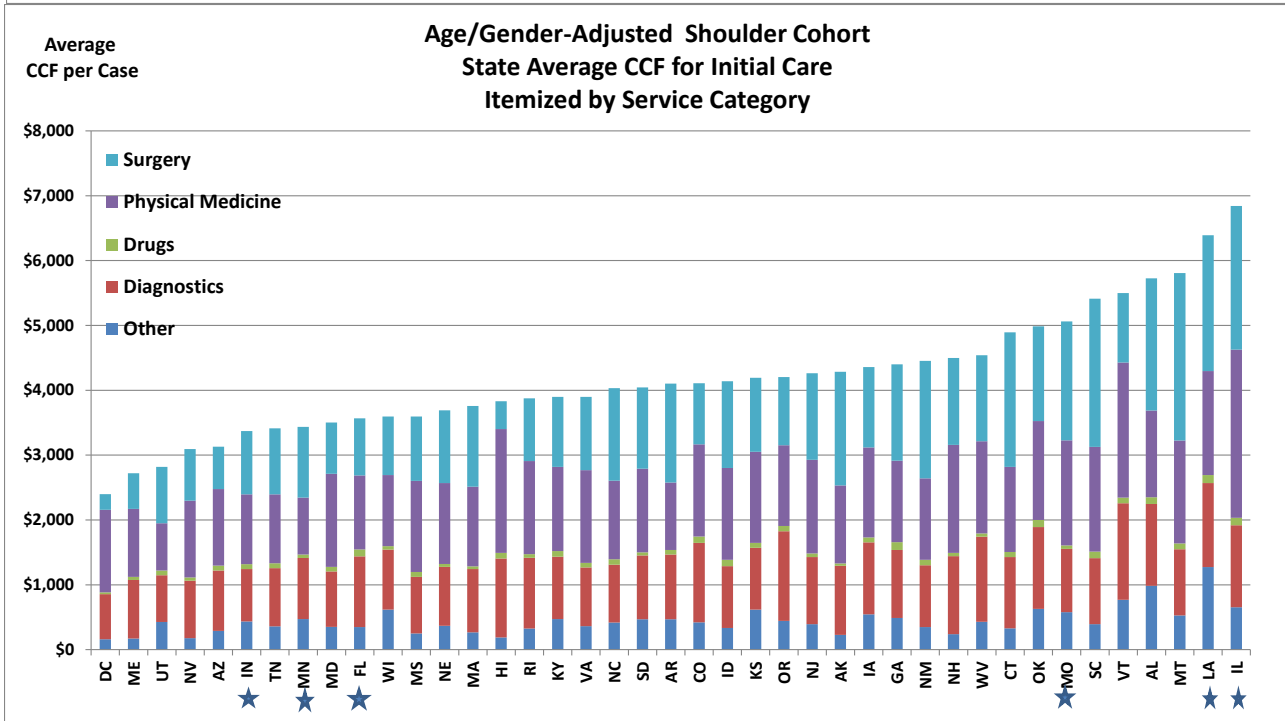
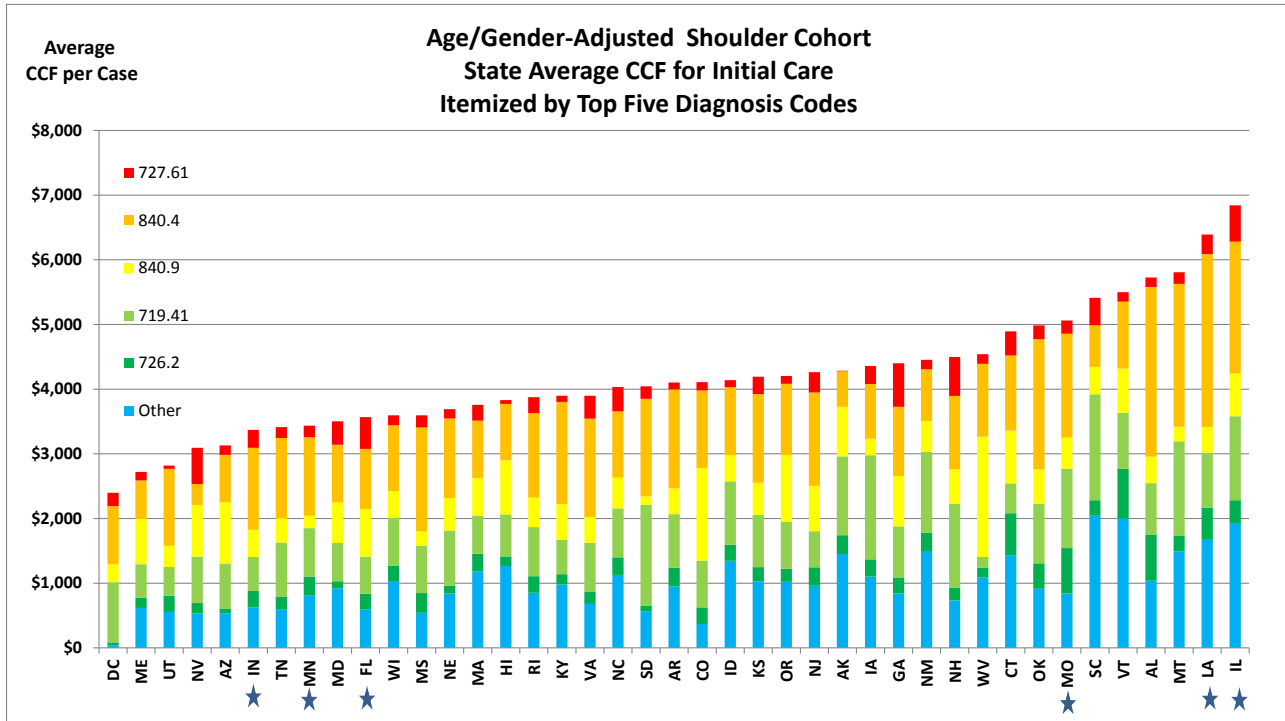
Appendix C: State Average CCF Itemized by Diagnosis and Service Category

For each joint type, this appendix includes two charts that itemize the average CCF by state—first by diagnosis code and then by service category. They extend analogous charts from the paper for six selected states (indicated with a star below) to show all the states in the cohort. While these charts further illustrate the variation in utilization by state, they also suggest the considerable “noise” that including many states—especially small volume states—would introduce into the discussion.

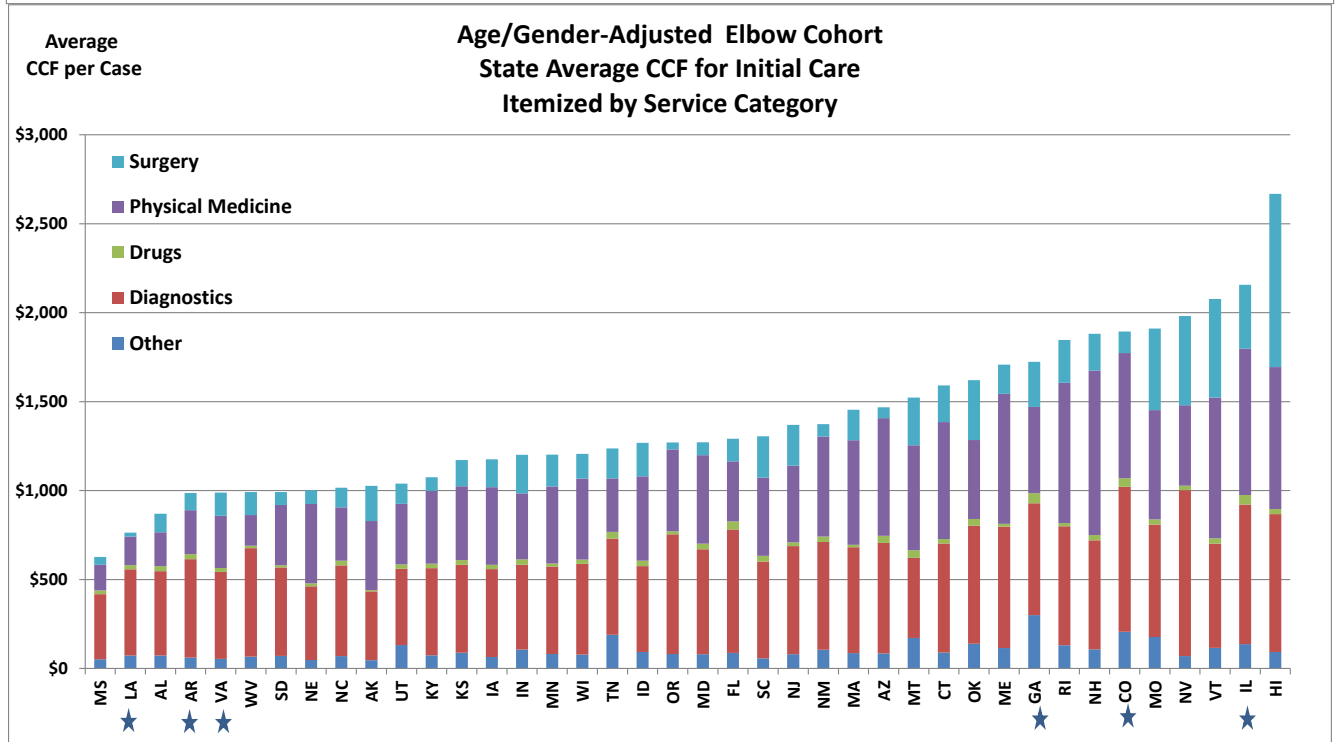
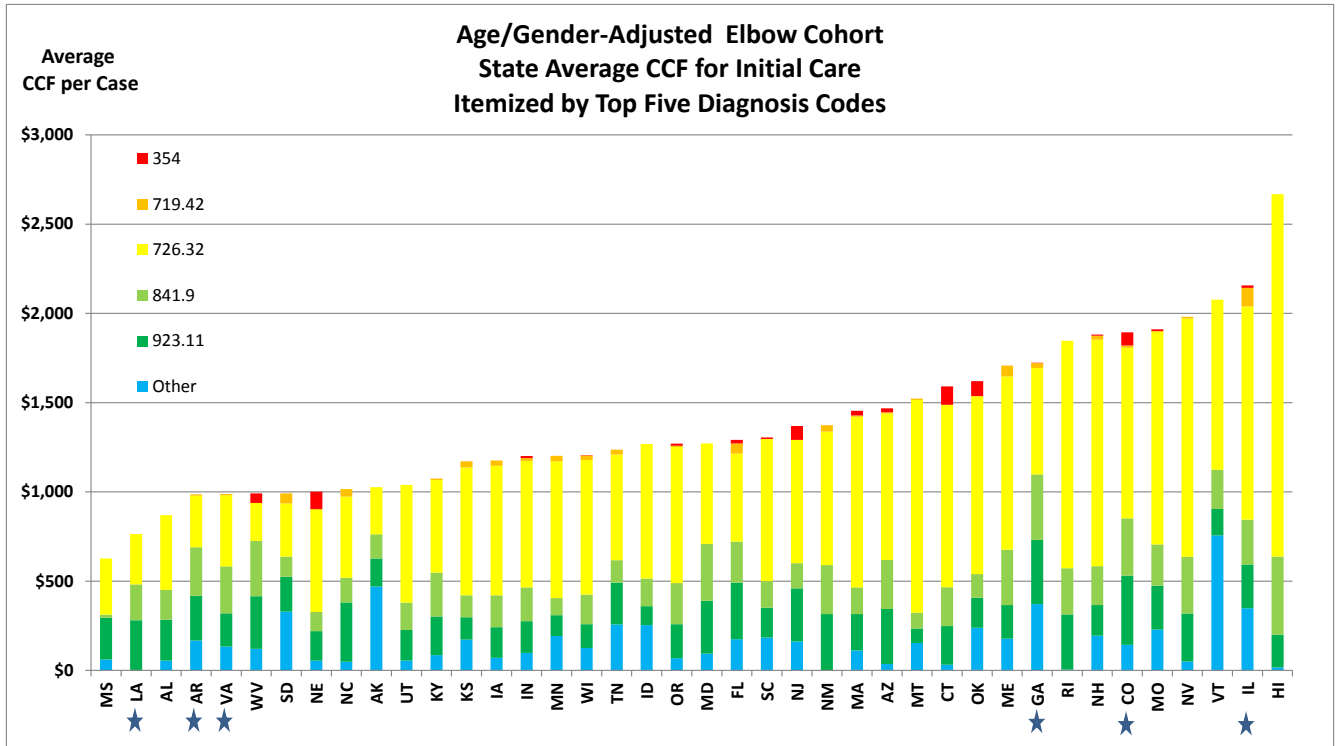
Knee



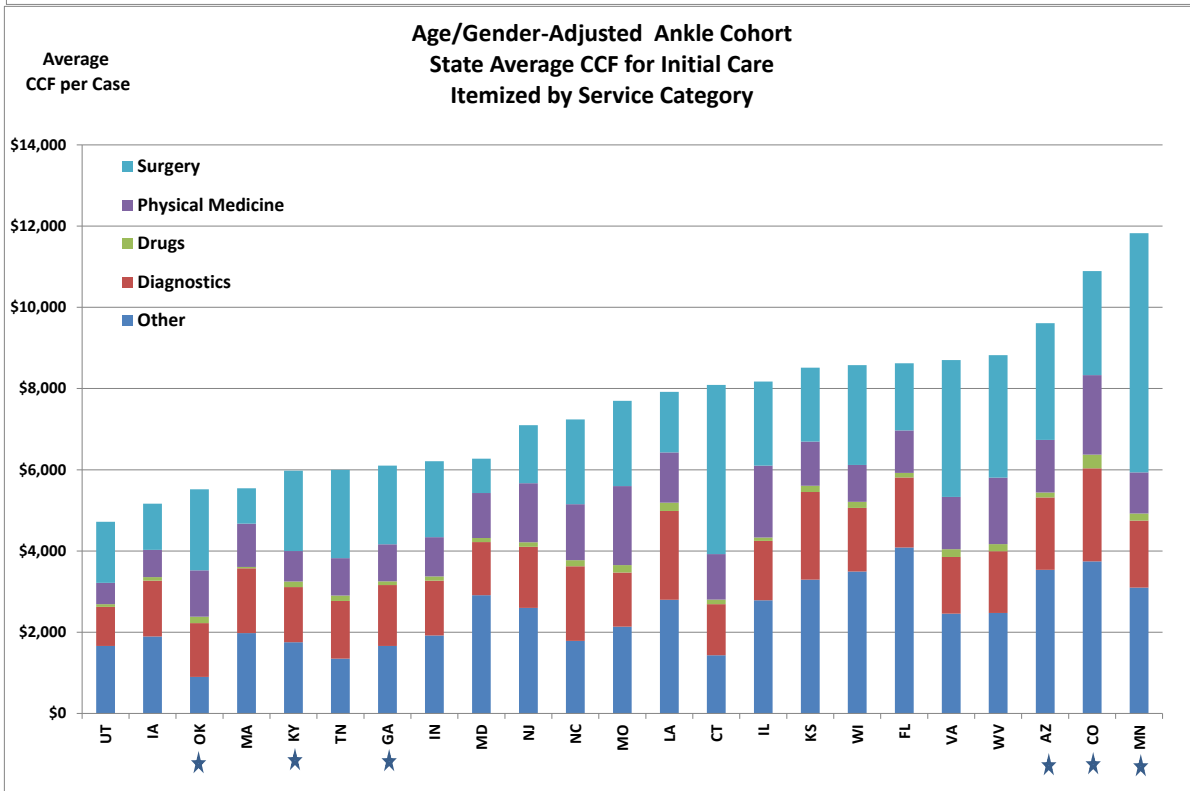
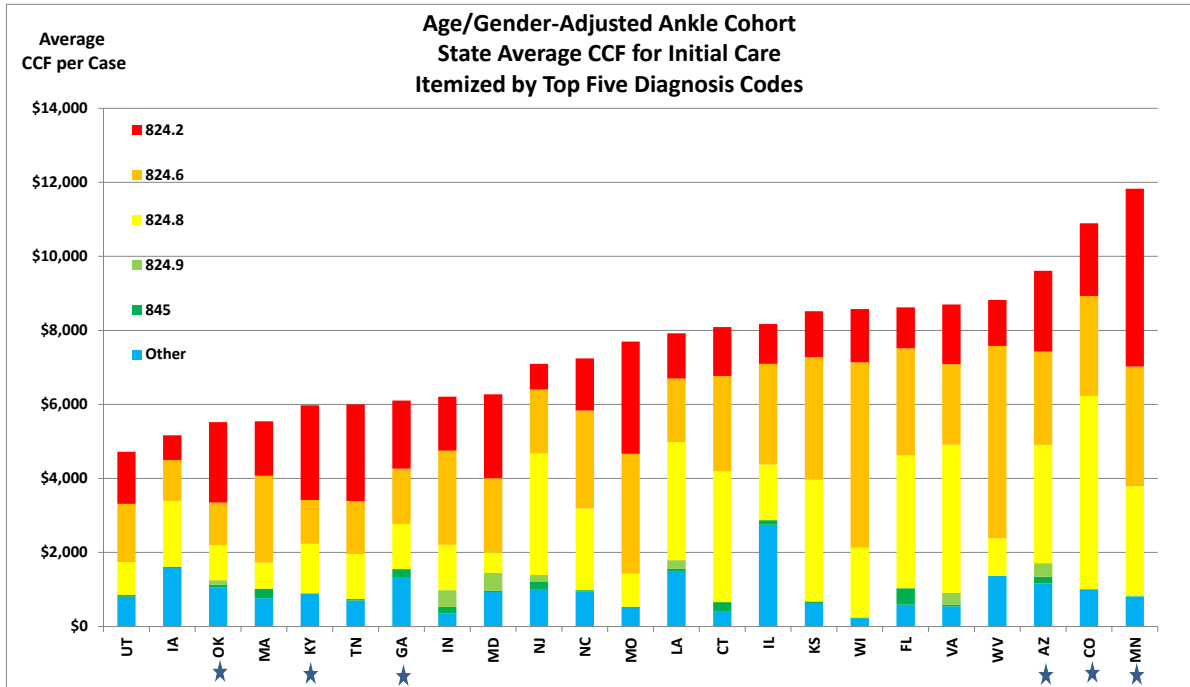
Shoulder



Elbow



Ankle



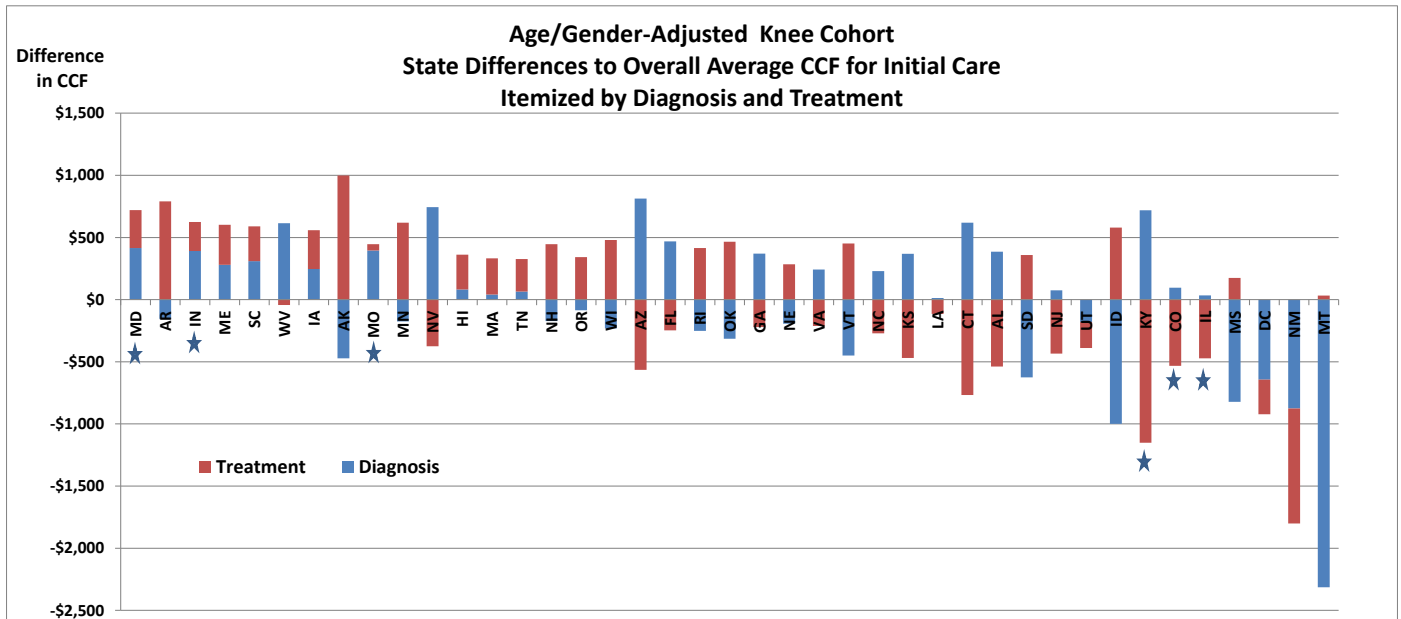
Appendix D: Impact of Diagnosis and Treatment by State

For each joint type, this appendix includes a chart that itemizes the difference between the state average CCF per case and the average CCF per case for the entire cohort. This helps us to see how sensitive the selection of the six states is in the break down of the difference in the average CCF per case between the selected high and low state groups.

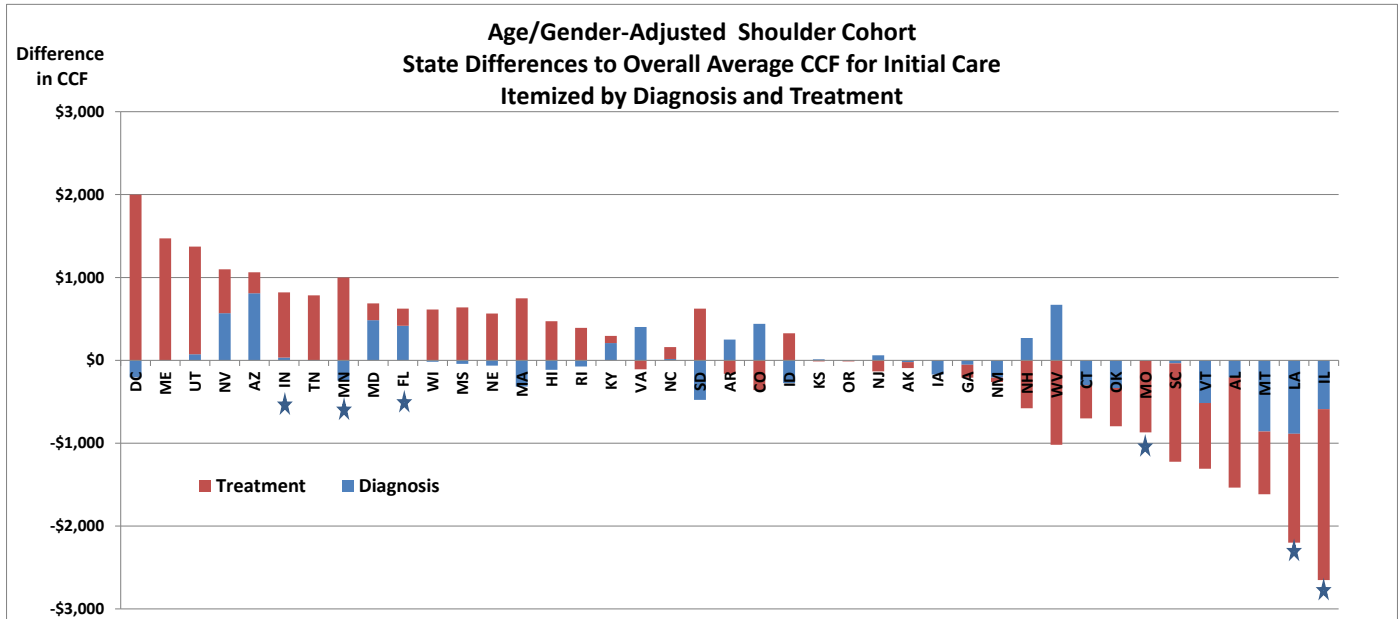
States are sorted as before in increasing average CCF per case. Since the impact of the mix in diagnosis and mix of treatment can be in different directions, the height of the columns is not decreasing smoothly from the lowest utilization state to the highest utilization state. The lower (higher) utilization states to the left (right) typically have positive differences as one would need to increase (decrease) their average CCF to get to the overall for the cohort.

The charts indicate that, except for the knee cohort, the treatment component is greater than the diagnosis component for most of both the higher and lower utilization states. Accordingly, except for the knee cohort, this suggests that our finding that utilization differences between high and low states are driven more by differences in the treatment for given diagnoses than to the mix of diagnoses holds more generally than for just the six selected states.

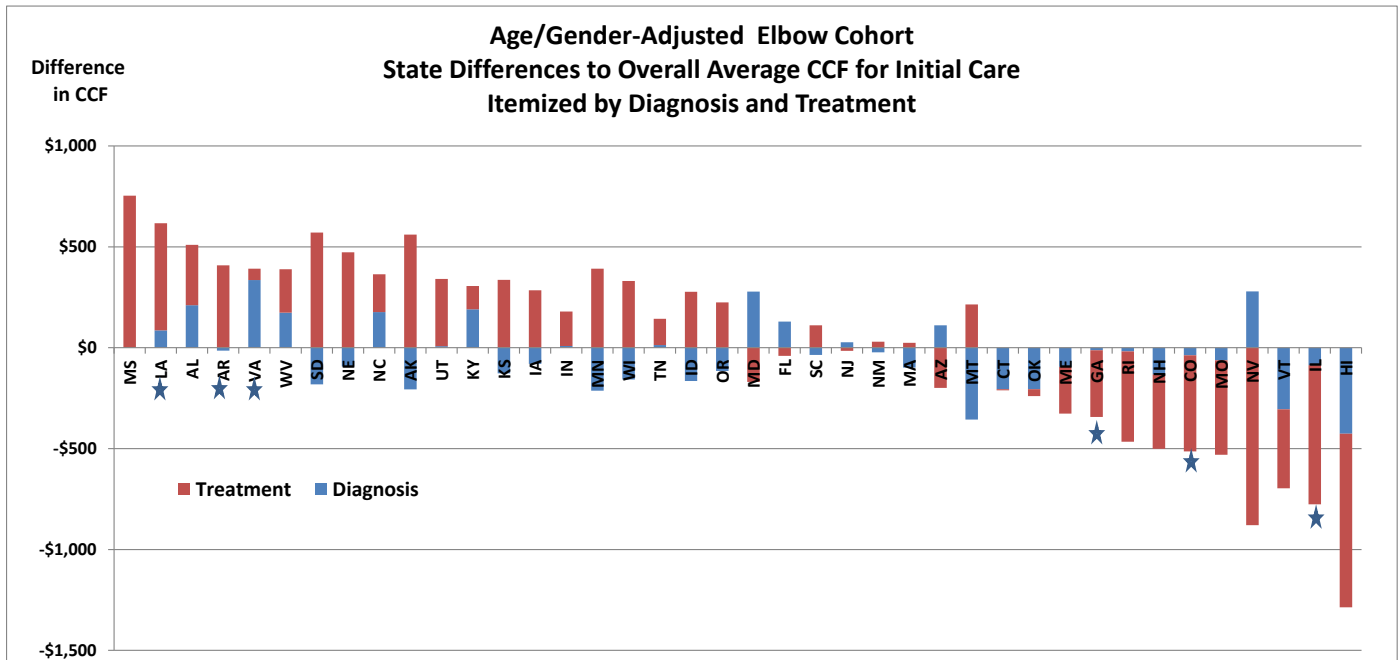
Knee



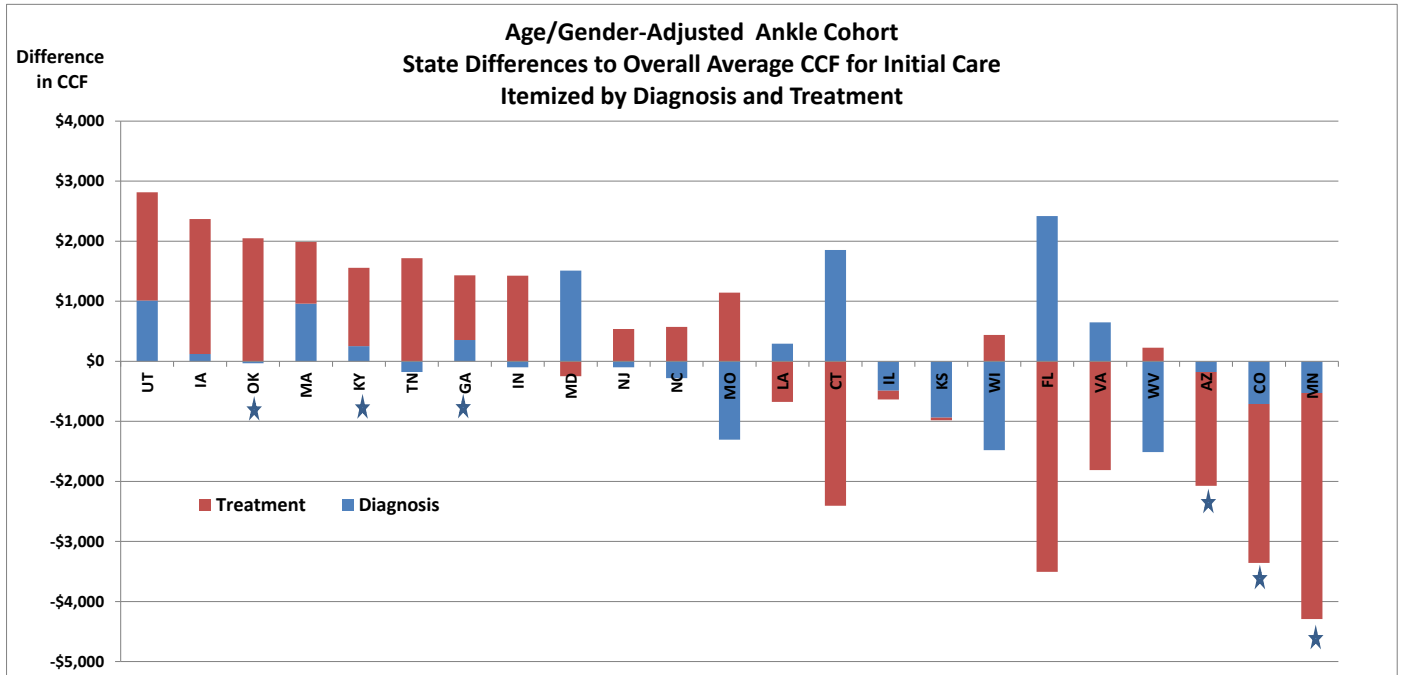
Shoulder



Elbow



Ankle



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