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Evaluating the early impact of Medicaid expansion on trends in diagnosis and treatment of benign gallbladder disease in Kentucky

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ABSTRACT

Background: In January 2014, Kentucky expanded Medicaid coverage in an effort to improve access to healthcare. This study evaluated the early impact of Medicaid expansion on diagnosis and treatment of benign gallbladder disease in Kentucky.

Methods: Administrative claims data were queried for patients undergoing cholecystectomy for benign gallbladder disease between 2011 and 2015. Demographic, procedure, and outcome variables from 2011 to 2013 (PRE) and 2014–2015 (POST) were compared.

Results: After Medicaid expansion, patients were more likely to have their operation performed as an outpatient (80.0% vs. 78.2%, $p < 0.001$). A significant trend was noted toward a shorter hospital stay ($p < 0.001$) among inpatients. For both inpatients and outpatients, a significant shift was noted toward increased hospital charges ($p < 0.001$).

Conclusions: The expansion of Kentucky Medicaid in 2014 has been associated with an increase in outpatient cholecystectomy, shorter hospital stays for inpatients, and increased hospital charges for both inpatients and outpatients. Increased charges for all procedures may represent a mechanism for hospitals to offset the cost of providing global care for more patients.

Introduction

In 2010, the United States federal government passed the Patient Protection and Affordable Care Act (ACA) in an effort to provide access to healthcare for many Americans, particularly those lower or lower-middle income families for whom private insurance had been unaffordable and who did not qualify for Medicaid programs.[1] Subsequently, in January 2014, the commonwealth of Kentucky expanded Medicaid coverage to include all individuals and families with incomes up to 33% above the federal poverty line.[2] This expansion aimed to improve access to healthcare for many of the commonwealth's citizens.

Indeed, Medicaid expansion significant reduced the proportion of uninsured patients in Kentucky, resulting in a reduction of uninsured from 19% to 7%.[2] Many hoped that this drop, the largest of any state in the United States, would translate into patients seeking care earlier for medical conditions, thereby avoiding the morbidity and cost associated with delays in treatment.[3–7] However, with an increase in healthcare utilization and a larger proportion of insured patients, it remained unclear how hospitals and physicians would adjust both practice and billing patterns to account for changes in volume, case mix, and payor mix.[8–10]

Previous studies have evaluated trends access to and quality of treatment for malignancy and care for surgical conditions (cholecystitis, appendicitis, peripheral artery disease, aortic aneurysm) and demonstrated improvements in access to and quality of care in association with Medicaid expansion.[11,12] However, none have specifically looked at the influence of Medicaid expansion on patterns of management and operative intervention for benign gallbladder disease as well as hospital charges for such care. Indeed, these represent elements of equal importance to access to and quality of care for surgical conditions in evaluating the overall impact of Medicaid expansion on healthcare. This study evaluated the early impact of Medicaid expansion on trends in diagnosis and treatment of benign gallbladder disease in Kentucky. We hypothesized that Medicaid expansion would be associated with an increase in diagnosis of benign gallbladder disease, a lower proportion of uninsured patients, and a higher proportion of outpatient procedures.

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Methods

Patient cohort and data acquisition

Administrative claims data from the Kentucky Cabinet for Health and Family Services, Office of Health Policy was queried for all patients age 18–64 undergoing cholecystectomy for benign gallbladder disease between 2011 and 2016. These data are provided to the cabinet by all hospitals in Kentucky. To be included in the dataset, patients were required to have at least one ICD9 or ICD10 diagnosis code consistent with benign gallbladder disease (cholecystitis, cholelithiasis, and/or biliary dyskinesia) and at least one ICD9 or ICD10 procedure code or CPT code consistent with cholecystectomy (laparoscopic or open). Data were compiled by the Office of Health Policy and provided in aggregate to the investigators for analysis. Missing data were removed prior to data compilation.

Variable selection

Total number of cholecystectomies performed, age, insurance status, hospital setting, indication for surgical intervention, type of procedure performed (laparoscopic vs. open), length of stay (for patients undergoing cholecystectomy as an inpatient), and total hospital charges associated with the procedure were assessed for each year during the study period. To evaluate for an association between Medicaid expansion and changes in these parameters, the above variables from prior to Medicaid expansion and after Medicaid expansion (POST) were compared.

Statistical analysis

Pearson correlation was used to assess for significance in trends in cholecystectomy rate over time. Descriptive analysis was performed for demographic, procedural, and outcome variables. Chi-squared tests with Yates correction and student's t-tests were used to evaluate the association between pre/post Medicaid expansion status and the aforementioned variables. All analyses were performed using GraphPad Prism 7 (GraphPad Software, La Jolla, CA, USA). All analyses were two-sided, and $p < 0.05$ was considered statistically significant.

Results

Of a total of 103,838 patients undergoing operative intervention for benign gallbladder disease, 53,282 (51.3%) were treated from 2011 to 2013 and 50,556 (48.7%) were treated from 2014 to 2016. The number of patients undergoing operative intervention for benign gallbladder pathology (cholecystitis, cholelithiasis, or biliary dyskinesia) ranged from 16,024 to 19,229 between 2011 and 2016 (Fig. 1). On the whole, the number of cholecystectomies performed annually over the study period remained relatively stable ($r^2 = 0.37$, $p = 0.20$). However, from 2011 to 2013, a trend toward a significant linear decrease was noted in the number of cholecystectomies performed per year ($r^2 = 0.98$, $p = 0.09$). However, from 2014 to 2016, the number of cholecystectomies performed annually remained relatively stable ($r^2 = 0.56$, $p = 0.46$).

After Medicaid expansion, patients tended to be slightly younger (45.2% age <40 POST vs. 44.3% age <40 PRE, $p = 0.002$), were more likely to have Medicaid (33.9% POST vs. 15.0% PRE), and were less likely to be uninsured (0.3% POST vs. 2.7% PRE) or self payors (2.0% POST vs. 8.7% PRE) ($p < 0.001$) (Table 1). Interestingly, patients were also less likely to have commercial insurance (53.5% POST vs. 62.6% PRE). This pattern persisted when stratifying by diagnosis. Among patients with a diagnosis of cholecystitis, the proportion of patients with Medicaid increased (31.4% POST vs. 13.0% PRE), while those who were uninsured (0.1% POST vs. 2.4% PRE), self payors (1.6% POST vs. 6.3% PRE), or had commercial insurance (56.6% POST vs. 67.8% PRE) decreased ($p < 0.001$). Among those with a diagnosis of cholelithiasis or biliary dyskinesia, the proportion of patients with Medicaid increased (35.0% POST vs. 16.1% PRE), while those who were uninsured (0.4% POST vs. 2.9% PRE), self payors (2.2% POST vs. 10.1% PRE), or had commercial insurance (52.0% POST vs. 59.6% PRE) decreased ($p < 0.001$). Of note, a greater decrease in commercial insurance before and after Medicaid expansion was noted among patients with a diagnosis of cholecystitis than cholelithiasis or biliary dyskinesia (−11.2% cholecystitis vs. −7.6 cholelithiasis or biliary dyskinesia), while a greater decrease in self payors was noted among patients with cholelithiasis or biliary dyskinesia (−7.9% cholelithiasis or biliary dyskinesia vs. −4.7% cholecystitis).

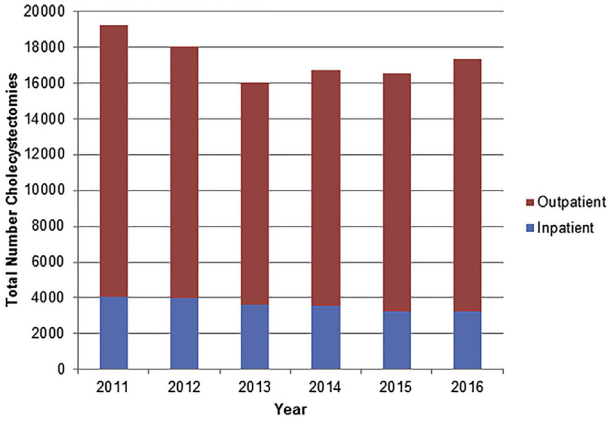

Fig. 1. Cholecystectomies performed in Kentucky, 2011–2016.

Regarding operative setting, patients were more likely to have their operation performed as an outpatient after Medicaid expansion (80.0% POST vs. 78.1% PRE, $p < 0.001$). When stratifying by indication, patients with a diagnosis of cholecystitis were more likely to have their operations performed as an outpatient after Medicaid expansion (85.9% POST vs. 84.2% PRE, $p < 0.001$), as were patients with a diagnosis of cholelithiasis or biliary dyskinesia (77.2% POST vs. 74.2% PRE, $p < 0.001$).

Regarding diagnosis and type of operation, after Medicaid expansion, a greater proportion of patients underwent cholecystectomy for a diagnosis of cholelithiasis or biliary dyskinesia (67.0% POST vs. 66.1% PRE, $p < 0.001$) (Table 2). Patients were also more likely to have their operation performed laparoscopically (97.4% POST vs. 97.1% PRE, $p = 0.001$). Again, when stratifying by indication, patients with a diagnosis of cholecystitis were more likely to have their operations performed laparoscopically after Medicaid expansion (98.1% POST vs. 97.7% PRE, $p = 0.003$), as were patients with a diagnosis of cholelithiasis or biliary dyskinesia (97.0% POST vs. 96.6% PRE, $p = 0.003$).

Among inpatients, a slight but significant trend was noted toward a shorter hospital stay ($p = 0.002$) (Table 3a). This trend derived largely from hospital stays in patients with cholelithiasis or biliary dyskinesia (13.0% 1 day, 25.0% 2 days, 21.0% 3 days, 14.0% 4 days, 8.0% 5 days, 5.0% 6 days, 14.0% 7 + days POST vs. 14.0% 1 day, 24.0% 2 days, 20.0% 3 days, 14.0% 4 days, 9.0% 5 days, 6.0% 6 days, 14.0% 7 + days PRE, $p = 0.01$). No difference in hospital stay before and after Medicaid expansion was noted among inpatients undergoing cholecystectomy for a diagnosis of cholecystitis (13.0% 1 day, 23.0% 2 days, 19.0% 3 days, 14.0% 4 days, 8.0% 5 days, 5.0% 6 days, 18.0% 7 + days POST vs. 13.0% 1 day, 22.0% 2 days, 19.0% 3 days,

Table 1
Demographics and insurance status among patients undergoing cholecystectomy for benign gallbladder disease in Kentucky before and after Medicaid expansion.

	2011–2013 (PRE) (n = 53,282)	2014–2016 (POST) (n = 50,556)	p-value
Age			
18–19	1361 (2.6%)	1306 (2.6%)	**0.02**
20–29	10238 (19.2%)	10114 (20.1%)	
30–39	11997 (22.6%)	11450 (22.7%)	
40–49	12349 (23.2%)	11476 (22.7%)	
50–59	12175 (22.9%)	11367 (22.5%)	
60–64	5162 (9.7%)	4813 (9.5%)	
Hospital Setting			
Inpatient	11655 (21.9%)	10100 (20.0%)	**<0.001**
Outpatient	41627 (78.1%)	40456 (80.0%)	
Insurance Status			
Uninsured	1434 (2.7%)	160 (0.3%)	**<0.001**
Medicaid	7989 (15.0%)	17126 (33.9%)	
Early Medicare	5132 (9.6%)	4468 (8.8%)	
Commercial	33375 (62.6%)	27024 (53.5%)	
Self Pay	4619 (8.7%)	1032 (2.0%)	
Other	733 (1.4%)	746 (1.5%)	

*Variables expressed as n (%).

13.0% 4 days, 9.0% 5 days, 6.0% 6 days, 18.0% 7 + days PRE, $p = 0.48$).

With respect to hospital charges, an upward trend was noted after Medicaid expansion for both inpatients ($p < 0.001$) and outpatients ($p < 0.001$) (Tables 3a and 3b, respectively). This increase in hospital charges associated with Medicaid expansion persisted among inpatients when stratified by indication for operative intervention (inpatients with cholecystitis: 3.5% <$15,000, 28.0% $15,000-$24,999, 47.7% $25,000-$49,999, 13.7% $50,000-%99,999, 7.1% $100,0000 + POST vs. 9.4% <$15,000, 35.0% $15,000-$24,999, 41.1% $25,000-$49,999, 10.5% $50,000-%99,999, 6.9% $100,0000 + PRE, $p < 0.001$; inpatients with cholelithiasis or biliary dyskinesia: 2.5% <$15,000, 24.7% $15,000-$24,999, 51.5% $25,000-$49,999, 16.6% $50,000-%99,999, 4.6% $100,0000 + POST vs. 10.5% <$15,000, 35.6% $15,000-$24,999, 41.5% $25,000-$49,999, 10.0% $50,000-%99,999, 2.3% $100,0000 + PRE, $p < 0.001$). A similar associated was noted in the outpatient setting (outpatients with cholecystitis: 2.0% <$5,000, 17.9% $5000-$9,999, 72.2% $10,000-$24,999, 6.1% $25,000-%49,999, 1.8% $50,0000 + POST vs. 3.3% <$5,000, 34.8% $5000-$9,999, 57.5% $10,000-$24,999, 3.4% $25,000-%49,999, 1.0% $50,0000 + PRE, $p < 0.001$; outpatients with cholelithiasis or biliary dyskinesia: 1.3% <$5,000, 14.6% $5000-$9,999, 73.3% $10,000-$24,999, 10.1% $25,000-%49,999, 0.7% $50,0000 + POST vs. 2.6% <$5,000, 33.6% $5000-$9,999, 59.7% $10,000-$24,999, 4.0% $25,000-%49,999, 0.1% $50,0000 + PRE, $p < 0.001$).

On subgroup analysis of patients with Medicaid and those with commercial insurance, Medicaid patients were more likely to have their procedures performed as an outpatient (78.1% POST vs. 73.7% PRE, $p < 0.001$), have an indication of cholelithiasis or biliary dyskinesia (69.4% POST vs. 67.0% PRE, $p < 0.001$), and have their procedure performed laparoscopically (97.6% POST vs. 97.1% PRE, $p = 0.04$) (Table 4a). Patients with commercial insurance were more likely to have their procedures performed for cholelithiasis or biliary dyskinesia after Medicaid expansion (65.0% POST vs. 61.9% PRE, $p < 0.001$) but did not exhibit any difference in hospital setting or surgical approach (Table 4b). With respect to hospital charges, both sets of patients exhibited a significant increase in hospital charges in both the inpatient and outpatient settings (Tables 5a and 5b).

Discussion

Herein, we demonstrate that Medicaid expansion has been associated with an increase in outpatient surgery and surgery for non-acute benign gallbladder pathology (i.e. cholecystitis). However, hospital charges for surgery for benign gallbladder disease have increased during this period, suggesting that, while Medicaid expansion may have resulted in improved access to surgical care in Kentucky, hospital systems may be using higher charges for surgery to offset the costs providing medical care in general to a larger number of individuals.

As previously mentioned, through Medicaid expansion, Kentucky (and many other states) sought to improve access to and timely receipt of healthcare. The results of the present study, in line with others published over the last several years, indicate that said expansion has moved toward achieving this goal in the short-term.[11–15] Indeed, fewer patients underwent an operation for a diagnosis of cholecystitis and a greater proportion of patients received surgery as an outpatient. Even among inpatients, length of stay was shorter in the post-Medicaid expansion era. Together, these data suggest that patients both presented earlier in the course of their disease and were more likely to undergo appropriate operative intervention after Medicaid expansion. As has previously been demonstrated, timely access to healthcare can result in significant improvement in outcomes for patients regardless of their disease.[4,11,16,17] In the present case, Medicaid expansion and the

Table 2
Diagnosis and operation type among patients undergoing cholecystectomy for benign gallbladder disease in Kentucky before and after Medicaid expansion.

	2011–2013 (PRE) (n = 53,282)	2014–2016 (POST) (n = 50,556)	p-value
Indication			
Cholecystitis	18083 (33.9%)	16706 (33.0%)	**0.002**
Cholelithiasis or Biliary Dyskinesia	35199 (66.1%)	33850 (67.0%)	
Type of Operative Intervention			
Laparoscopic	51724 (97.1%)	49246 (97.4%)	**0.001**
Open	1558 (2.9%)	1310 (2.6%)	

*Variables expressed as n (%).

Table 3a
Length of stay and hospital charges among inpatients undergoing cholecystectomy for benign gallbladder disease in Kentucky before and after Medicaid expansion.

	2011–2013 (PRE) (n = 11,655)	2014–2016 (POST) (n = 10,100)	p-value
Length of Stay (Inpatient) (days)			
1	1564 (13.0%)	1344 (13.0%)	**0.002**
2	2678 (23.0%)	2437 (24.0%)	
3	2263 (19.0%)	2085 (21.0%)	
4	1616 (14.0%)	1401 (14.0%)	
5	1058 (9.0%)	846 (8.0%)	
6	717 (6.0%)	523 (5.0%)	
7+	1759 (15.0%)	1464 (14.0%)	
Hospital Charges (Inpatient) (USD)			
<$15000	1202 (10.3%)	276 (2.7%)	**<0.001**
$15000-$24999	4107 (35.2%)	2524 (25.0%)	
$25000-$49999	4798 (41.2%)	5109 (50.6%)	
$50000-$99999	1185 (10.2%)	1659 (16.4%)	
$100000+	363 (3.1%)	532 (5.3%)	

*Variables expressed as n (%).

associated access to healthcare may have resulted in more timely intervention for benign gallbladder pathology may have contributed to smaller number of admissions and inpatient procedures and fewer (likely urgent) procedures for cholecystitis.

Interestingly, in this study, Medicaid expansion appeared to be associated with a reversal in the decline of cholecystectomies performed annually. While the reasons for a decrease prior to Medicaid expansion remain unclear and are beyond the scope of the present study, the stable number of procedures performed since January 1, 2014 along with the significant reduction in the number of uninsured individuals in the state (and the number of uninsured patients undergoing cholecystectomy) during the post-Medicaid expansion era suggests that at least some of that pre-expansion decrease in cholecystectomies may have been related to lack of access to healthcare. Though the data available in the present study do not identify patient motivations for seeking medical attention, one can speculate that, without adequate access to healthcare, individuals may have simply waited until developing more acute pathology (i.e. cholecystitis) before presenting for evaluation. Alternatively, they may have managed symptoms as needed without seeking medical attention and/or been lost to follow-up by their primary care physicians for those individuals who had established primary care providers.

The above postulates are indirectly supported by the relationship between patterns of emergency department admissions and insurance status.[3,8,9] General surgery patients lacking insurance are more likely to present to the emergency department with complex surgical issues, again suggesting a delay in presentation associated with lack of insurance.[3] Additionally, Medicaid expansion has been associated with an increase in emergency department utilization, particularly among patients insured by Medicaid.[9] The concomitant decrease in admissions of uninsured patients points to a change in payor mix for the hospital. Particularly for hospitals serving underprivileged areas, such a change has resulted in increased revenue, as it has provided at least some compensation for care of many patients who were previously uninsured.

Indeed, from a hospital standpoint, increased revenue resulting from providing emergency and surgical care for a lower proportion of uninsured patients can represent a significant financial windfall. Moreover, earlier presentation and more timely care translate into lower costs for the hospital given a greater proportion of outpatient procedures and shorter length of stay for inpatients.[18] However, broadly speaking, increased access to healthcare also requires hospitals providing care to patients with medical conditions that do not require surgery or procedures. Hospitals frequently use charges for procedures to offset these costs, which nearly half of hospital revenue deriving from procedures.[19] Using cholecystectomy as a surrogate for procedures in general, the results of the present study suggest that hospitals may be further increasing procedure charges to offset the cost of providing global care to a larger number of individuals. Alternatively, the increase in charges may simply reflect standard annual increases in hospital billing for surgical services from year to year. A further case-matched analysis with individual patient level data accounting for a given hospital's annual charge increase rate could better define the relationship between Medicaid expansion and hospital charges for surgical services.

On a larger scale, however, the data in this study demonstrate that the effects of increases in procedure costs may have broad and unintended consequences for both taxpayers and individuals with commercial insurance. Medicaid expansion appears to be associated with not only a decrease in uninsured patients but also in patients with commercial insurance. The reasons for this latter phenomenon remain unclear and may be due to changes in employer hiring practices to mitigate the cost of providing health insurance for full-time employees under the Employer Mandate of the Patient Protection and Affordable Care Act.[20] Additionally, it may be partially attributable to individuals who had previously been working simply to receive employer-sponsored health insurance working less or finding different jobs given the availability of

Table 3b
Hospital charges among outpatients undergoing cholecystectomy for benign gallbladder disease in Kentucky before and after Medicaid expansion.

	2011–2013 (PRE) (n = 41,627)	2014–2016 (POST) (n = 40,456)	p-value
Hospital Charges (Outpatient)			
<$5000	1200 (2.9%)	670 (1.7%)	**<0.001**
$5000-$9999	14146 (34.0%)	6080 (15.0%)	
$10000-$24999	24495 (58.8%)	29651 (73.3%)	
$25000-$49999	1570 (3.8%)	3619 (9.0%)	
$50000+	216 (0.5%)	436 (1.1%)	

*Variables expressed as n (%).

Table 4a
Demographics, disease, and surgical approach among Medicaid patients undergoing cholecystectomy for benign gallbladder disease in Kentucky before and after Medicaid expansion.

	Pre (2011–2013)	Post (2014–2016)	p-value
Hospital Setting			
Inpatient	2102 (26.3%)	3744 (21.9%)	**<0.001**
Outpatient	5887 (73.7%)	13382 (78.1%)	
Indication			
Cholecystitis	2686 (33.0%)	5490 (30.6%)	**<0.001**
Cholelithiasis or Biliary Dyskinesia	5445 (67.0%)	12422 (69.4%)	
Surgical Approach			
Laparoscopic	7758 (97.1%)	16708 (97.6%)	**0.04**
Open	231 (2.9%)	418 (2.4%)	

*Variables expressed as n (%).

Table 4b
Demographics, disease, and surgical approach among patients with commercial insurance undergoing cholecystectomy for benign gallbladder disease in Kentucky before and after Medicaid expansion.

	Pre (2011–2013)	Post (2014–2016)	p-value
Hospital Setting			
Inpatient	5317 (15.9%)	4331 (16.0%)	0.09
Outpatient	28058 (84.1%)	22693 (84.0%)	
Indication			
Cholecystitis	12571 (38.1%)	9916 (35.0%)	**<0.001**
Cholelithiasis or Biliary Dyskinesia	20418 (61.9%)	18423 (65.0%)	
Surgical Approach			
Laparoscopic	32640 (97.8%)	26456 (97.9%)	0.67
Open	735 (2.2%)	568 (2.1%)	

*Variables expressed as n (%).

Table 5a
Hospital charges among Medicaid patients undergoing cholecystectomy for benign gallbladder disease in Kentucky before and after Medicaid expansion.

	Pre (2011–2013)	Post (2014–2016)	p-value
Hospital Charges (USD) (Inpatient)			
<$15000	211 (10.0%)	100 (2.7%)	**<0.001**
$15000-$24999	714 (34.0%)	878 (23.5%)	
$25000-$49999	871 (41.4%)	1892 (50.5%)	
$50000-$99999	229 (10.9%)	666 (17.8%)	
$100000+	77 (3.7%)	208 (5.6%)	
Hospital Charges (Outpatient)			
<$5000	96 (1.6%)	195 (1.5%)	**<0.001**
$5000-$9999	1816 (30.8%)	1852 (13.8%)	
$10000-$24999	3615 (61.4%)	9818 (73.4%)	
$25000-$49999	305 (5.2%)	1284 (9.6%)	
$50000+	55 (0.9%)	233 (1.7%)	

*Variables expressed as n (%).

Table 5b
Hospital charges among patients with commercial insurance undergoing cholecystectomy for benign gallbladder disease in Kentucky before and after Medicaid expansion.

	Pre (2011–2013)	Post (2014–2016)	p-value
Hospital Charges (USD) (Inpatient)			
<$15000	602 (11.3%)	129 (3.0%)	**<0.001**
$15000-$24999	1990 (37.4%)	1201 (27.7%)	
$25000-$49999	2167 (40.8%)	2251 (52.0%)	
$50000-$99999	432 (8.1%)	568 (13.1%)	
$100000+	126 (2.4%)	182 (4.2%)	
Hospital Charges (USD) (Outpatient)			
<$5000	968 (3.5%)	428 (1.9%)	**<0.001**
$5000-$9999	10158 (36.2%)	3712 (16.4%)	
$10000-$24999	16005 (57.0%)	16535 (72.9%)	
$25000-$49999	808 (2.9%)	1860 (8.2%)	
$50000+	119 (0.4%)	158 (0.1%)	

*Variables expressed as n (%).

Medicaid.[21] We do believe that the low median household income in Kentucky ($46,535 compared to the U.S. national average of $61,372 in 2017) and the large proportion of Kentuckians employed by small businesses (44.3% of the population) contributed significantly to the patterns observed after implementation of the Affordable Care Act.[22,23] The system-level implications of these above points cannot be overstated. Current projections approximate a 3% increase in state spending on health insurance for previously uninsured individuals.[24] However, should hospital systems attempt to offset the cost of providing healthcare for a larger number of patients in general by increasing charges for procedures, states will be forced to increase Medicaid budgeting and spending (or decrease the services covered by Medicaid). Similarly, without augmenting their pool of healthy individuals without preexisting conditions, private insurance companies will inevitably raise premiums or decrease services offered for a given level of health insurance coverage. Unchecked, such a cycle could ultimately result in higher taxes and less affordable private insurance packages.

This study should be interpreted in light of several limitations. As with all retrospective, population registry-based studies, the data used for this analysis derives from hospital-based coding and reporting, which is inherently heterogeneous. For example, the fact that 14% of patients with cholelithiasis/biliary dyskinesia had hospital stay $\geq$7 days suggests either complications and multiple patient comorbidities or inaccurate coding. Additionally, the method of diagnosis (physical exam, laboratory studies, ultrasound, computed tomography, HIDA scan) cannot be accurately discerned from hospital level data, precluding the investigators' ability to verify the accuracy of coded. From a systems-level perspective, the method of referral for surgery (from a primary care physician or through the emergency department) was not captured in this dataset, precluding any analysis of such patterns before and after Medicaid expansion. Moreover, the present analysis focuses solely on Kentucky and does not provide a comparison to a non-Medicaid expansion state, thereby limiting the generalizability of the

findings presented herein. The fact that data was provided in aggregate rather than at an individual level, coupled with the lack of granularity of the dataset, limited our ability to account for multiple potential confounders. This, coupled with the limited timeframe of available post-Medicaid expansion data, mitigates the strength, generalizability, and sustainability of our findings with respect to surgical management of benign gallbladder disease. Finally, several differences reported in this study before and after Medicaid expansion, while statistically significant, represent quantitatively small changes. Nonetheless, given the prevalence of benign biliary tract disease and the absolute number of cases corresponding to even a small percentage change (1% difference corresponds to approximately 500–550 cases over a three year period in Kentucky), even small proportional changes likely have important impacts on the healthcare system.

Conclusions

The expansion of Kentucky Medicaid in 2014 has been associated with an increase in operative intervention on patients on Medicaid, outpatient procedures, and hospital charges. These data indicate a possible shift towards earlier intervention in benign gallbladder disease with improved access to healthcare. They also suggest hospital use of surgical procedures as a mechanism to offset costs associated with providing care in general for a larger contingent of patients with access to healthcare. Interstate comparative analyses can further help delineate the contribution of Medicaid expansion to these trends in operative care for benign gallbladder disease.

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