

Trends in the Costs Associated with Liver Transplantations Performed in the US, Stratified by Liver Etiologies and Complications: An Analysis Of U.S. Hospitals

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Background and Aims

Liver transplant (LT) use has grown alongside increasing United States cirrhosis burden. We analyze LT costs using a national database, stratified by liver complication and disease.

Methods

The National Inpatient Sample was queried for LT patients between 2016 and 2019. Total and per-hospitalization mean costs were deduced via cost-to-charge ratios. The study cohort was described according to liver complications and transplant indication. Conditions included ascites, encephalopathy, hepatorenal syndrome (HRS), or varices, and diseases consisted of alcoholic liver disease (ALD), autoimmune liver disease (AILD), hepatocellular carcinoma (HCC), hepatitis B and C (HBV or HCV), metabolic liver disease (MLD), non-alcoholic fatty liver disease (NAFLD), or other. Linear regression was conducted with corresponding R² and p-values.

Results

Total cost data are described in millions of dollars with R² and p-values listed as (R², p-value). From 2016 until 2019, total costs of LT-related hospitalizations increased every year: 946.65, 1,014.62, 1,055.72, 1,150.43 (0.98, 0.01). Results in patients with encephalopathy were as follows: 82.00, 95.04, 122.31, 125.07 (0.92, 0.04). Ascites: 106.60, 102.33, 111.29, 90.02 (0.33, 0.42). HRS: 72.65, 88.66, 104.27, 80.81 (0.15, 0.62). Varices: 85.99, 81.60, 92.89, 117.99 (0.73, 0.15). Liver disease strata were analyzed, and patients with ALD showed: 191.78, 205.33, 220.14, 282.89 (0.85, 0.08). AILD: 41.74, 61.16, 55.76, 92.21 (0.78, 0.11). HCC: 29.70, 33.38, 34.83, 33.19 (0.50, 0.29). HBV: 12.90, 18.80, 21.62, 19.63 (0.63, 0.21). HCV: 69.29, 51.63, 50.16, 35.78 (0.92, 0.04). MLD: 7.78, 11.99, 9.35, 13.36 (0.52, 0.28). NAFLD: 87.19, 125.30, 122.06, 142.37 (0.82, 0.10). Other disease: 243.18, 255.83, 258.09, 244.15 (0.01, 0.91). Mean per-hospitalization costs were also calculated. In patients with encephalopathy: 99,392.87, 101,646.94, 104,095.00, 102,100.12 (0.50, 0.29). Ascites: 148,060.84, 151,596.14, 155,655.23, 151,288.54 (0.32, 0.43). HRS: 254,896.42, 239,616.67, 254,321.79, 202,025.83 (0.56, 0.25). Varices: 121,972.87, 120,004.05, 123,027.35, 142,152.99 (0.63, 0.20). ALD: 153,245.59, 154,381.49, 151,296.98, 146,576.64 (0.77, 0.12). AILD: 109,851.20, 139,003.96, 121,206.68, 123,766.36 (0.07, 0.74). HCC: 174,690.85, 151,727.99, 148,201.81, 179,408.49 (0.01, 0.91). HBV: 184,309.99, 163,487.29, 205,939.27, 178,439.29 (0.03, 0.82). HCV: 135,871.31, 122,917.21, 135,571.83, 135,010.85 (0.04, 0.79). MLD: 111,194.89, 114,182.06, 155,884.16, 166,963.45 (0.89, 0.05). NAFLD: 131,116.06, 139,999.57, 135,624.58, 125,434.48 (0.20, 0.56). Other disease: 187,060.39, 201,441.98, 204,835.45, 220,954.50 (0.95, 0.03).

Conclusion

LT expenses grew between 2016 to 2019, but specific trends varied based on complication and disease strata. Patients with encephalopathy experienced increasing total hospitalization costs, and patients with MLD had increasing mean per-hospitalization costs, while patients with HCV had decreasing total costs. Further studies are needed to determine the exact drivers of these phenomena.

Cost Analyses Tables

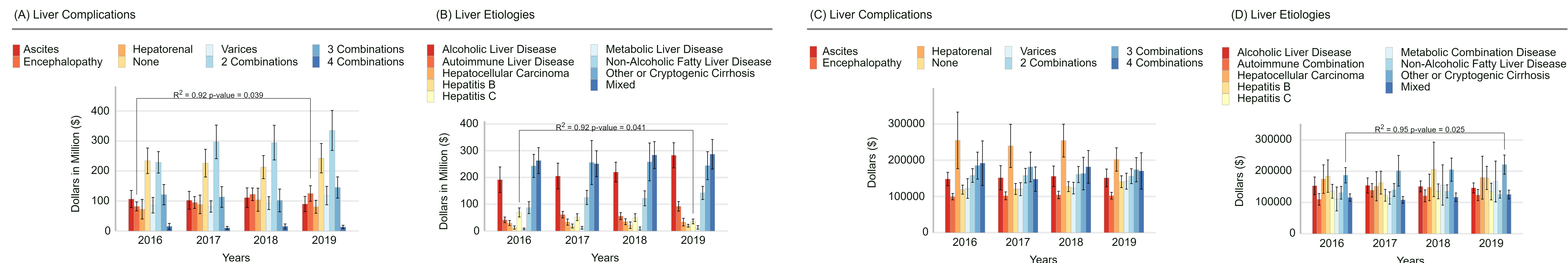
Year	2016			2017			2018			2019			R ²	p-value
Total Annual Cost (in millions)	946.65			1,014.62			1,055.72			1,150.43			0.98	0.01 *
Total Cost (95% CI)														
Liver Etiologies														
Alcoholic Liver Disease	191.78	(144.27 – 239.30)		205.33	(157.10 – 253.55)		220.14	(183.07 – 257.20)		282.89	(235.96 – 329.82)		0.85	0.08
Autoimmune Disease Comorbidity	41.74	(31.34 – 52.14)		61.16	(49.18 – 73.15)		55.76	(42.83 – 68.68)		92.21	(74.32 – 110.09)		0.78	0.11
Hepatocellular Carcinoma	29.70	(20.50 – 38.89)		33.38	(21.82 – 44.94)		34.83	(23.95 – 45.70)		33.19	(18.86 – 47.52)		0.50	0.29
Hepatitis B	12.90	(6.88 – 18.92)		18.80	(11.43 – 26.18)		21.62	(9.48 – 33.77)		19.63	(14.47 – 24.79)		0.63	0.21
Hepatitis C	69.29	(52.38 – 86.21)		51.63	(38.84 – 64.41)		50.16	(35.68 – 64.64)		35.78	(26.86 – 44.70)		0.92	0.04 *
Metabolic Comorbidity	7.78	(4.50 – 11.07)		11.99	(6.73 – 17.25)		9.35	(3.60 – 15.10)		13.36	(6.77 – 19.94)		0.52	0.28
Non-alcoholic Fatty Liver Disease	87.19	(64.90 – 109.48)		125.30	(98.97 – 151.63)		122.06	(94.16 – 149.97)		142.37	(117.77 – 166.97)		0.82	0.10
Other or Cryptogenic	243.18	(200.03 – 286.32)		255.83	(173.57 – 338.09)		258.09	(187.46 – 328.73)		244.15	(192.02 – 296.29)		0.01	0.91
Liver Complications														
Ascites	106.60	(78.13 – 135.08)		102.33	(72.49 – 132.17)		111.29	(78.88 – 143.71)		90.02	(64.77 – 115.26)		0.33	0.42
Encephalopathy	82.00	(67.24 – 96.76)		95.04	(75.25 – 114.83)		122.31	(101.30 – 143.32)		125.07	(99.13 – 151.02)		0.92	0.04 *
Hepatorenal Syndrome	72.65	(39.99 – 105.30)		88.66	(57.70 – 119.61)		104.27	(65.81 – 142.74)		80.81	(59.24 – 102.38)		0.15	0.62
Varices	85.99	(60.02 – 111.96)		81.60	(62.64 – 100.56)		92.89	(71.51 – 114.26)		117.99	(87.29 – 148.69)		0.73	0.15

* p < 0.05, ** p < 0.01, *** p < 0.001

Year	2016			2017			2018			2019			R ²	p-value
Mean Cost (95% CI)														
Liver Etiologies														
Alcoholic Liver Disease	153,425.59	(125356.54 – 181494.64)		154,381.49	(130349.82 – 178413.16)		151,296.98	(133828.63 – 168765.34)		146,576.41	(130711.12 – 162441.70)		0.77	0.12
Autoimmune Disease Comorbidity	109,851.20	(91311.97 – 128390.43)		139,003.96	(117544.08 – 160463.83)		121,206.68	(102149.37 – 140264.00)		123,766.36	(105999.36 – 141533.36)		0.07	0.74
Hepatocellular Carcinoma	174,690.85	(129005.24 – 220376.45)		151,727.99	(105124.19 – 198331.78)		148,201.81	(105713.58 – 190690.04)		179,408.49	(110746.85 – 248070.13)		0.01	0.91
Hepatitis B	184,309.99	(132467.05 – 236152.93)		163,487.29	(126909.19 – 200065.39)		205,939.27	(118809.13 – 293069.40)		178,439.29	(141264.19 – 215614.40)		0.03	0.82
Hepatitis C	135,871.31	(113706.67 – 158035.95)		122,917.21	(103966.07 – 141868.35)		135,571.83	(111863.64 – 159280.01)		135,010.85	(108257.40 – 161764.31)		0.04	0.79
Metabolic Comorbidity	111,194.89	(73060.34 – 149329.44)		114,182.06	(94481.10 – 133883.02)		155,884.16	(91448.26 – 220320.06)		166,963.45	(101541.43 – 232385.47)		0.89	0.05
Non-alcoholic Fatty Liver Disease	131,116.06	(110812.36 – 151419.76)		139,999.57	(119504.75 – 160494.39)		135,624.58	(114705.55 – 156543.62)		125,434.48	(114046.27 – 136822.70)		0.20	0.56
Liver Complications														
Ascites	148,060.84	(129517.80 – 166603.88)		151,596.14	(118253.31 – 184938.97)		155,655.23	(127400.60 – 183909.86)		151,288.54	(126924.46 – 175652.63)		0.32	0.43
Encephalopathy	99,392.87	(90504.33 – 108281.41)		101,646.94	(90773.63 – 112520.24)		104,095.00	(93826.74 – 114363.26)		102,100.12	(92886.27 – 111313.98)		0.50	0.29
Hepatorenal Syndrome	254,896.42	(176760.41 – 333032.43)		239,616.67	(179904.39 – 299328.95)		254,321.79	(208976.64 – 299666.94)		202,025.83	(169767.53 – 234284.14)		0.56	0.25
Varices	121,972.87	(94843.97 – 149101.76)		120,004.05	(102075.64 – 137932.47)		123,027.35	(107009.81 – 139044.90)		142,152.99	(120108.07 – 164197.92)		0.63	0.20

* p < 0.05, ** p < 0.01, *** p < 0.001

Figures of the Trends



(A) and (C) represent the total and mean costs of Liver Transplant stratified by liver complications including ascites, encephalopathy, hepatorenal syndrome, combination of 2 or more of the above mentioned complications, absence of liver complications and varices. (B) and (D) represent the total and mean costs of Liver Transplant stratified by liver etiologies including alcoholic liver disease, autoimmune combination, hepatocellular carcinoma, hepatitis B, hepatitis C, metabolic combination disease, non-alcoholic fatty liver disease, other or cryptogenic cirrhosis, and mixed.

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