



The Trends in the Costs of Nonalcoholic Fatty Liver Disease-Related Admissions Stratified by Comorbidities: An Analysis of US Hospitals

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Background and Aims

Nonalcoholic fatty liver disease (NAFLD) is one of the leading contributors to the increasing US cirrhosis cases. We analyze the cost burden of NAFLD using a national hospital database.

Methods

The 2016-2019 National Inpatient Sample was utilized to calculate inflation-adjusted total and per-hospitalization mean costs of NAFLD. The study cohort was stratified according to obesity-related medical comorbidities and liver complications. Linear regression was performed and corresponding R² and p-values are reported.

Results

Total cost data are described in millions of dollars. From 2016 to 2019, total costs of NAFLD-related hospitalizations increased every year: 5206.2, 5881.4, 6626.3, 7737.1 (R²=0.99, p=0.007). Total costs with diabetes: 474.3, 567.0, 666.0, 754.3, (1.00, <0.001); hypertension: 705.1, 696.97, 750.87, 863.51 (0.79, 0.11); hypopituitarism 2.49. 3.64, 2.39. 5.76 (0.50, 0.29); dyslipidemia: 260.8, 344.4, 381.3, 464.7 (0.98, 0.01); obesity hypoventilation syndrome (OHS): 12.35, 16.57, 20.80, 28.50 (0.97, 0.01); obstructive sleep apnea (OSA): 123.5, 140.6, 162.7. 185.7 (1.00, 0.002); polycystic ovarian syndrome (PCOS): 9.9, 11.0, 18.0, 18.0 (0.97, 0.02); without comorbidities: 1266.8, 1519.0, 1705.3, 1974.3 (1.00, 0.002). In terms of liver complications, total costs in patients with ascites: 169.5, 187.3, 190.1, 241.6 (0.93, 0.09); compensated cirrhosis (CC): 341.9, 406.5, 512.4, 625.9 (0.99, 0.007); hepatic encephalopathy (HE): 47.0, 58.9, 63.2, 67.1 (0.92, 0.04); hepatorenal syndrome (HRS): 7.6, 17.4, 12.9, 12.8 (0.13, 0.64); varices: 35.6, 32.9, 33.4, 33.2 (0.48, 0.31); without any liver complications: 3920.7, 4374.8, 4893.3, 5651.8 (0.99, 0.008). Corresponding mean costs (in dollars) were calculated. Mean costs with diabetes: 15320.0, 15147.2, 15252.1, 16430.3 (0.55, 0.26); hypertension 13291.8, 12986.2, 12798.2, 13257.2 (0.03, 0.84); hypopituitarism: 17796.9, 18193.2, 15411.9, 26806.3 (0.39, 0.37); dyslipidemia: 15126.0, 14921.2, 14315.2, 15205.3 (0.01, 0.88); OHS: 34788.5, 22238.4, 22613.2, 22095.1 (0.61, 0.22); OSA: 16517.2, 15662.1, 15704.0, 16229.5 (0.06, 0.75); PCOS: 10578.7, 10227.5, 12876.4, 11677.1 (0.41, 0.36); without comorbidities: 14198.6, 14740.0, 14428.1, 14934.5 (0.56, 0.25). In terms of liver complications, mean hospitalization costs in patients with ascites: 21755.1, 21701.5, 20514.4, 21826.6 (0.04, 0.80); CC: 13803.4, 14012.1, 13830.7, 14502.7 (0.58, 0.24); HE: 14351.2, 15348.1, 16009.1, 16160.9 (0.91, 0.05); HRS: 30225.8, 53589.0, 36417.3, 31513.7 (0.03, 0.84); varices: 16070.4, 13940.3, 14162.1, 14383.6 (0.41, 0.36); without any liver complications: 13372.6, 13494.2, 13451.9, 14004.8 (0.70, 0.17).

Conclusion

Total US cost burden of NAFLD increased from 2016 to 2019. Diabetes, dyslipidemia, OHS, OSA, CC, and HE were associated with increasing total costs.

Cost Analyses Tables

Total Cost (95% CI)	2016		2017		2018		2019		r ²	pvalue
Year	5,206.20		5,881.42		6,626.30		7,737.10		0.99	0.007**
Comorbidities										
Diabetes	474.31 (443.40 - 505.22)	566.96 (532.68 - 601.24)	666.98 (627.98 - 703.98)	754.31 (709.24 - 799.38)	1.00 (1.00 - 1.00)	<0.001*** (<0.001*** - <0.001***)				
Hypertension	705.13 (672.04 - 738.21)	696.97 (663.55 - 730.39)	750.87 (717.13 - 784.61)	863.51 (821.73 - 905.28)	0.79 (0.80 - 0.79)	0.11 (0.11 - 0.11)				
Hypopituitarism	2.49 (1.28 - 3.70)	3.64 (2.52 - 4.76)	2.39 (0.94 - 3.84)	5.76 (3.73 - 7.80)	0.50 (0.34 - 0.59)	0.29 (0.41 - 0.23)				
Dyslipidemia	260.77 (241.75 - 279.78)	344.38 (321.33 - 367.43)	381.29 (358.12 - 404.45)	464.67 (440.22 - 489.12)	0.98 (0.98 - 0.98)	0.01* (0.010** - 0.01)				
Obesity Hypoventilation Syndrome	12.35 (5.77 - 17.93)	16.57 (13.07 - 20.07)	20.80 (16.99 - 24.62)	28.50 (22.39 - 34.62)	0.97 (0.99 - 0.95)	0.01* (0.004** - 0.05)				
Obstructive Sleep Apnea	123.47 (112.69 - 134.24)	140.57 (129.52 - 151.62)	162.69 (149.60 - 175.79)	185.67 (171.52 - 199.81)	1.00 (1.00 - 0.99)	0.002** (0.002** - 0.003)				
Polycystic Ovary Syndrome	9.94 (8.62 - 11.26)	10.89 (9.62 - 12.37)	18.03 (13.14 - 22.91)	17.98 (15.20 - 20.76)	0.85 (0.98 - 0.74)	0.08 (0.02** - 0.14)				
Mixed	2,260.91 (2,250.95 - 2,448.98)	2,562.38 (2,472.32 - 2,694.45)	2,919.90 (2,794.44 - 3,043.35)	3,442.91 (3,298.47 - 3,596.93)	0.97 (0.97 - 0.97)	0.02* (0.02** - 0.02)				
None	1,266.80 (1,200.87 - 1,332.74)	1,518.95 (1,435.38 - 1,602.53)	1,705.33 (1,619.02 - 1,791.64)	1,974.35 (1,879.78 - 2,068.91)	1.00 (1.00 - 1.00)	0.002** (0.002** - 0.003)				
Liver Complications										
Ascites	169.47 (150.89 - 188.05)	187.28 (169.34 - 205.03)	190.07 (172.95 - 207.10)	241.52 (222.14 - 261.10)	0.83 (0.85 - 0.81)	0.09 (0.08 - 0.10)				
Cirrhosis	341.91 (320.93 - 362.89)	406.49 (382.02 - 430.96)	512.36 (482.77 - 541.94)	625.86 (587.13 - 664.59)	0.99 (0.99 - 0.98)	0.007** (0.007** - 0.008)**				
Encephalopathy	47.00 (40.43 - 53.57)	58.86 (52.53 - 65.19)	63.24 (56.28 - 70.20)	67.07 (60.71 - 73.43)	0.92 (0.92 - 0.92)	0.04* (0.04** - 0.04)				
Hepatorenal Syndrome	7.56 (5.12 - 9.99)	17.42 (8.35 - 26.48)	12.83 (7.68 - 18.18)	12.76 (9.72 - 15.81)	0.13 (0.77 - 0.03)	0.64 (0.12 - 0.83)				
Varices	35.60 (29.81 - 41.39)	32.90 (29.04 - 36.76)	33.42 (29.71 - 37.13)	33.23 (29.53 - 37.92)	0.48 (0.48 - 0.31)	0.31 (0.32 - 0.36)				
Mixed	883.94 (822.94 - 944.94)	803.65 (723.89 - 883.41)	920.99 (833.23 - 1,008.76)	1,504.74 (1,007.57 - 1,201.90)	0.99 (0.98 - 0.99)	0.007** (0.009** - 0.005)**				
None	3,920.70 (3,770.94 - 4,070.45)	4,374.81 (4,205.37 - 4,544.26)	4,893.28 (4,712.98 - 5,073.59)	5,651.79 (5,442.79 - 5,860.79)	0.99 (0.99 - 0.98)	0.008** (0.007** - 0.008)**				

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

Mean Cost (95% CI)	2016		2017		2018		2019		r ²	pvalue
Comorbidities										
Diabetes	15,320.01 (14,567.72 - 16,073.30)	15,147.20 (14,486.81 - 15,798.98)	15,252.13 (14,855.67 - 15,848.59)	16,430.29 (15,714.94 - 17,145.64)	0.55 (0.65 - 0.45)	0.26 (0.19 - 0.33)				
Hypertension	13,291.76 (12,873.72 - 13,709.80)	12,986.23 (12,569.43 - 13,413.02)	12,798.16 (12,386.65 - 13,197.68)	13,257.17 (12,792.48 - 13,721.85)	0.03 (0.06 - 0.01)	0.84 (0.78 - 0.91)				
Hypopituitarism	17,796.94 (10,794.40 - 24,859.48)	18,193.22 (13,643.18 - 22,743.25)	15,411.86 (8,917.83 - 23,905.90)	26,806.28 (18,509.08 - 35,103.50)	0.39 (0.19 - 0.52)	0.37 (0.56 - 0.28)				
Dyslipidemia	15,126.99 (13,431.41 - 16,820.56)	14,921.17 (14,186.00 - 15,646.33)	14,916.24 (13,760.69 - 16,023.81)	15,205.29 (14,548.18 - 15,762.39)	0.01 (0.02 - 0.12)	0.88 (0.86 - 0.89)				
Obesity Hypoventilation Syndrome	34,788.48 (20,486.79 - 49,090.17)	22,238.40 (17,956.40 - 26,520.40)	22,613.21 (18,809.91 - 26,418.51)	22,095.13 (17,471.53 - 26,718.74)	0.61 (0.64 - 0.59)	0.22 (0.20 - 0.23)				
Obstructive Sleep Apnea	16,517.21 (15,359.77 - 17,674.65)	15,662.13 (14,734.39 - 16,589.86)	15,704.03 (14,790.16 - 16,627.91)	16,229.53 (15,333.84 - 17,125.22)	0.06 (0.01 - 0.17)	0.75 (0.99 - 0.59)				
Polycystic Ovary Syndrome	10,578.68 (9,506.29 - 11,648.07)	10,227.50 (9,244.24 - 11,213.95)	12,876.37 (9,526.10 - 16,227.63)	11,677.13 (10,282.24 - 13,272.02)	0.41 (0.54 - 0.32)	0.38 (0.27 - 0.44)				
Mixed	13,688.95 (13,379.58 - 14,000.32)	13,915.97 (13,581.09 - 14,250.94)	13,831.35 (13,487.55 - 14,165.14)	14,450.44 (14,074.13 - 14,826.76)	0.73 (0.71 - 0.74)	0.15 (0.15 - 0.14)				
None	14,198.64 (13,689.06 - 14,708.22)	14,739.96 (14,153.13 - 15,326.80)	14,428.15 (13,912.85 - 14,943.44)	14,934.54 (14,461.25 - 15,407.83)	0.56 (0.66 - 0.45)	0.25 (0.19 - 0.33)				
Liver Complications										
Ascites	21,755.09 (19,777.58 - 23,732.59)	21,701.53 (20,014.14 - 23,389.93)	20,514.43 (18,974.30 - 22,054.56)	21,826.55 (20,415.56 - 23,240.54)	0.04 (0.03 - 0.25)	0.80 (0.82 - 0.80)				
Cirrhosis	13,803.36 (13,227.08 - 14,378.64)	14,012.09 (13,480.71 - 14,543.48)	13,830.72 (13,346.34 - 14,315.10)	14,502.65 (13,921.11 - 15,077.19)	0.58 (0.69 - 0.48)	0.24 (0.17 - 0.30)				
Encephalopathy	14,351.19 (12,515.05 - 16,187.33)	15,348.11 (13,794.86 - 16,901.36)	16,009.14 (14,425.69 - 17,592.59)	16,160.91 (14,915.37 - 17,506.44)	0.91 (0.93 - 0.85)	0.05* (0.04** - 0.08)				
Hepatorenal Syndrome	30,225.79 (22,014.03 - 38,437.55)	53,589.05 (28,153.18 - 81,024.91)	36,417.35 (22,447.75 - 50,386.95)	31,513.69 (25,394.58 - 37,632.80)	0.03 (0.16 - 0.04)	0.84 (0.80 - 0.76)				
Varices	16,070.40 (13,959.84 - 18,448.97)	14,940.27 (13,520.80 - 16,357.73)	14,562.10 (13,296.87 - 15,827.33)	14,308.81 (13,917.12 - 14,700.10)	0.41 (0.56 - 0.34)	0.36 (0.24 - 0.42)				
Mixed	17,284.57 (16,236.02 - 18,293.12)	17,687.96 (16,573.59 - 18,802.33)	16,961.22 (15,906.87 - 18,015.56)	17,860.14 (16,879.70 - 18,841.57)	0.11 (0.15 - 0.08)	0.66 (0.61 - 0.72)				
None	13,372.55 (13,093.43 - 13,651.67)	13,494.19 (13,186.90 - 13,801.47)	13,451.95 (13,174.37 - 13,729.52)	14,004.83 (13,682.42 - 14,327.62)	0.70 (0.71 - 0.68)	0.17 (0.16 - 0.18)				

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

Figures of the Trends

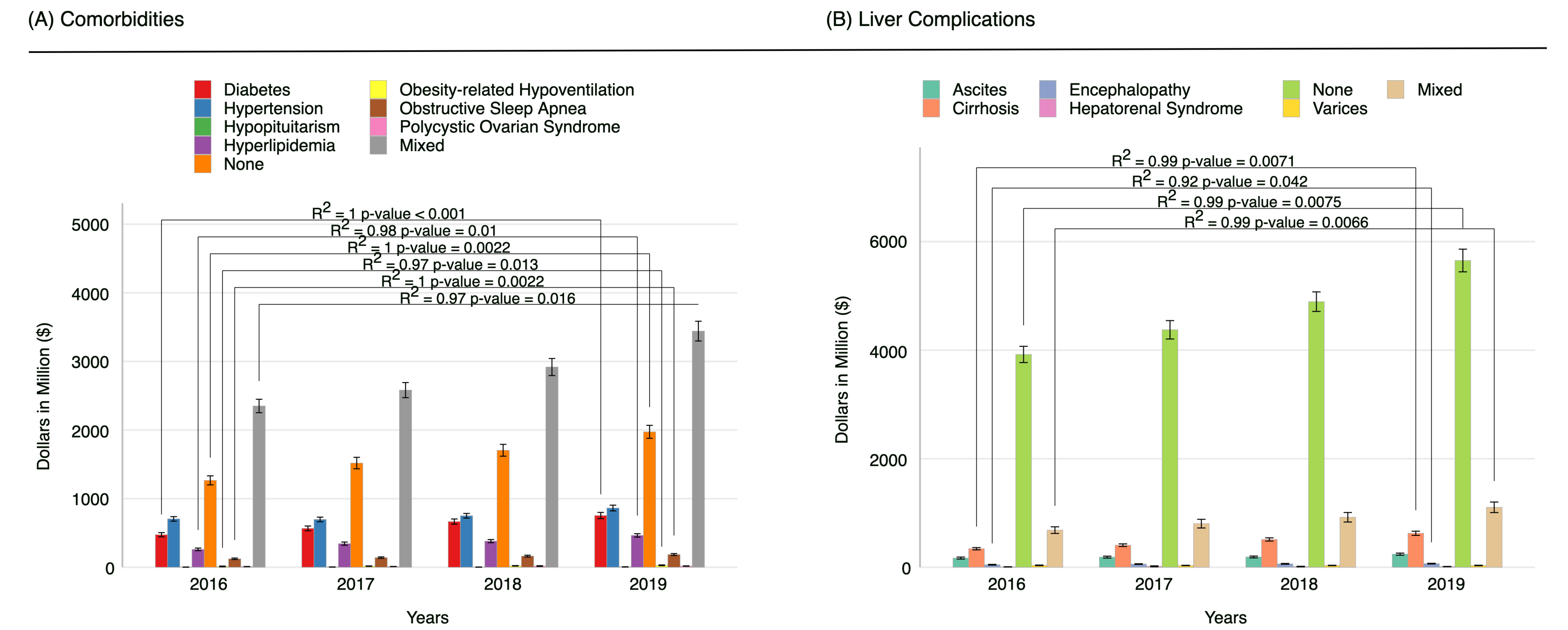
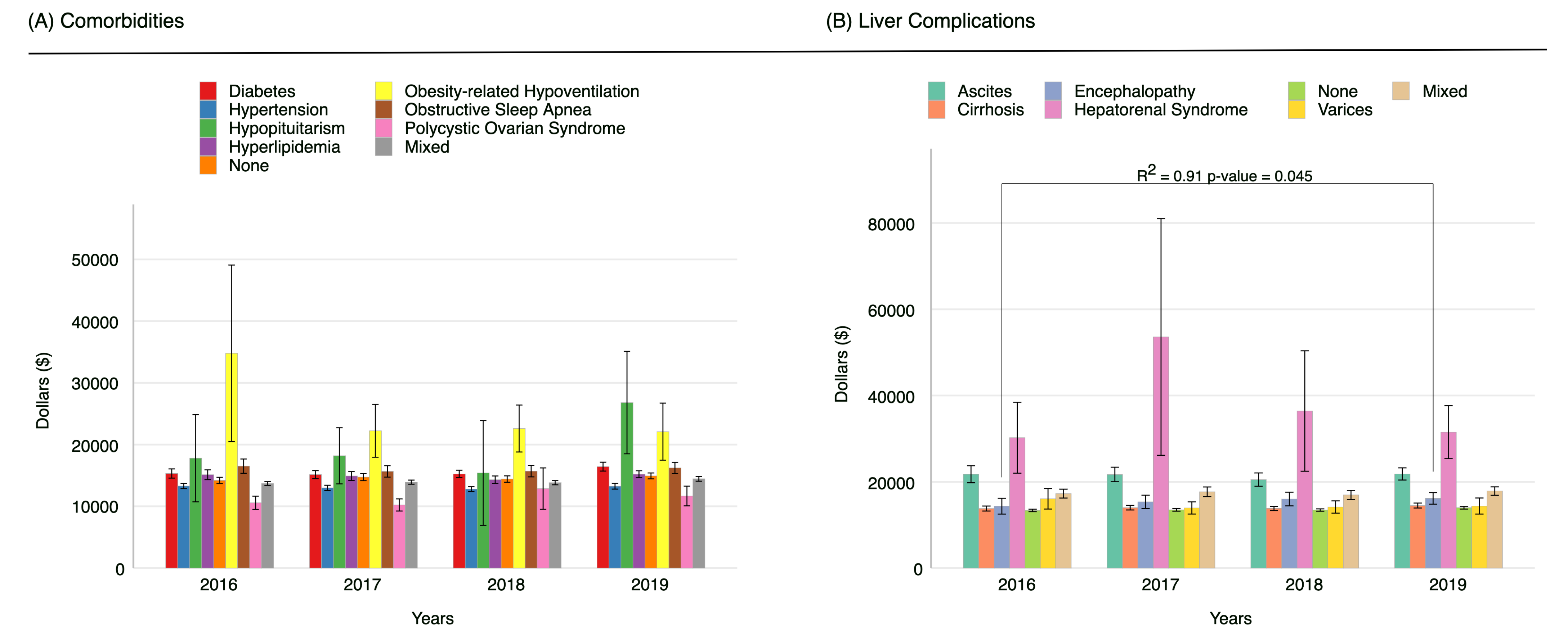


Figure 1B. Inflation-Adjusted Mean Costs to US Hospitals for Non-Alcoholic Steatohepatitis as Stratified by Medical Comorbidities and Liver Complications



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