

Supplemental Online Content

Nephew LD, Knapp SM, Mohamed KA, et al. Trends in racial and ethnic disparities in the receipt of lifesaving procedures for hospitalized patients with decompensated cirrhosis in the US, 2009-2018. *JAMA Netw Open*. 2023;6(7):e2324539. doi:10.1001/jamanetworkopen.2023.24539

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This supplemental material has been provided by the authors to give readers additional information about their work.

eTable 1. ICD9 and 10 Codes used for inclusion, exclusion and procedure identification

Condition	ICD9 Codes	ICD10 codes
Cirrhosis	571.2, 571.5, 571.6	K74*, K70.3*, K70.2
Complications		
Ascites	789.5* but not 789.51	R18.8, K70.31, K70.11, K71.51
Variceal hemorrhage	456.0, 456.20	I85.01, I 85.11
Hepatic encephalopathy	348.31, 348.30, 348.39, 572.2, 070.2, 070.4, 070.6, 070.71, 780.09	G93.40, G93.41, G93.49, R40, K70.41, K71.11, K72.01, K72.11, K72.91, B19.0, B19.11, B19.21
Hepatorenal Syndrome	572.4	K76.7
HCC	155.0	C22.0, C22.8, C229
Hepatorenal syndrome	572.4	K76.7
Procedures		
Upper Gastrointestinal Endoscopy	45.13, 45.14, 45.16, 45.30, 45.34, 42.23, 42.24, 42.92, 43.41, 44.13, 44.14, 44.22, 44.43, 46.85, 49.95, 99.29, 98.02, 98.03	0DJ08ZZ, 0D983ZX, 0D958ZX, 0DJ08ZZ, 0D953ZX, 0DJ68ZZ, 0D963ZX, 0DJ07ZZ, 0D568ZZ, 0D578ZZ, 0D588ZZ, 0D598ZZ, 0D5A8ZZ, 0D718ZZ, 0D728ZZ, 0D738ZZ, 0D748ZZ, 0D758ZZ, 0D768ZZ, 0D778ZZ, 0D788ZZ, 0D798ZZ, 0D7A8ZZ, 0D718DZ, 0D728DZ, 0D738DZ, 0D748DZ, 0D758DZ, 0D768DZ, 0D778DZ, 0D788DZ, 0D798DZ, 0D7A8DZ, 0D9180Z, 0D918ZX, 0D918ZZ, 0D9280Z, 0D928ZX, 0D928ZZ, 0D9380Z, 0D938ZX, 0D938ZZ, 0D9480Z, 0D948ZX, 0D948ZZ, 0D9580Z, 0D958ZX, 0D958ZZ, 0D9680Z, 0D968ZX, 0D968ZZ, 0D9780Z, 0D978ZX, 0D978ZZ, 0D9880Z, 0D988ZX, 0D988ZZ, 0D9980Z, 0D998ZX, 0D998ZZ, 0D9A80Z, 0D9A8ZX, 0D9A8ZZ, 0DB18ZX, 0DB18ZZ, 0DB28ZX, 0DB28ZZ, 0DB38ZX, 0DB38ZZ, 0DB48ZX, 0DB48ZZ, 0DB58ZX, 0DB58ZZ, 0DB68ZX, 0DB68ZZ, 0DB78ZX, 0DB78ZZ, 0DB88ZX, 0DB88ZZ, 0DB98ZX, 0DB98ZZ, 0DBA8ZX, 0DBA8ZZ, 0DC18ZZ, 0DC28ZZ, 0DC38ZZ, 0DC48ZZ, 0DC58ZZ, 0DC68ZZ, 0DC78ZZ, 0DC88ZZ, 0DC98ZZ, 0DCA8ZZ, 0DJ08ZZ
Variceal Ligation or Other Control of bleeding	42.91, 42.33, 44.43, 49.95, CCS# Procedure Category 68	06L30ZZ, 0D554ZZ, 0D518ZZ, 0D528ZZ, 0D538ZZ, 0D548ZZ, 0D558ZZ, 0D568ZZ, 0W3P8ZZ, 3E0G8TZ, 0DQ78ZZ, 0DQ68ZZ, 0DQ28ZZ, 0DQ38ZZ, 0DQ58ZZ, 0DQ48ZZ, 06L38CZ, 06L34CZ, 06L38ZZ, 3E0G8GC, 06L28CZ, 06L28ZZ

Condition	ICD9 Codes	ICD10 codes
Insertion of Sengstaken tube /esophageal tamponade	96.06	0DL57DZ, 0DL58DZ
Transjugular Intrahepatic Portosystemic shunt	39.1	06183J4, 06184J4, 06183JY, 061847Y 061849Y, 06184AY, 06184JY, 06184KY 06184ZY, 06183DY, 06184DY
Hemodialysis	39.95, V45.1, V45.11, V56.0, CCS# Procedure Category 58	Z992, Z4901, Z4931, 5A1D*
Liver Transplant	50.5*, 00.91, 00.92, 00.93	0FY00Z0, 0FY00Z1, 0FY00Z2
Red Blood Cell Transfusion	99.04	30233N1, 30243N1, 30233N0, 30233P0, 30233P1
Platelets Transfusion	99.05	30233R1, 30243R1, 30230R0
Fresh Frozen Plasma Transfusion	99.07	30233K1, 30243K1, 30233K0, 30233L0, 30233L1
Etiology of Liver Disease		
Alcohol	571.0, 571.1, 571.2, 571.3	K70*
NASH	571.5, 571.40, 571.41, 571.49 AND Code for Diabetes% OR Obesity (V85.3* V85.4*, 278.00*, 278.01*, 278.02*)	K73.x, K74.60, K74.69 AND Code for Diabetes% OR Obesity (Z68.3* Z68.4*, E66.0* E66.01* E66.09* E66.1* E66.2* E66.3* E66.8* E66.9*)
Hepatitis C	070.44, 070.54, 070.70, 070.71, V026.2	B18.2, B19.20, B19.21, Z22.52
Other	273.4, 275.1, 275.01, 275.03, 571.42, 571.6, 571.6, 571.6, 576.1, 070.49, 070.59, 07.06, 07.09, 573.3, 571.40, 571.41, 571.49, 571.49, 571.9, 573.9	E88.01, E83.00, E83.01, E83.09, E83.110, E83.118, K75.4, K74.3, K74.4, K74.5, K83.01, K83.09, B17.2, B17.8, B19.0, B19.9, K71.6, K73.9, K73.0, K73.2, K73.8, K74.1, K76.89, K76.9
HBV	070.20, 070.21, 070.22, 070.23, 070.32, 070.33, V02.61	B18.0, B18.1, Z22.51, B19.10, B19.11
Cholestatic	571.6, 576.1	K74.3, K74.4, K74.5, K83.01, K83.09, K83.8, K83.9
Autoimmune	571.42	K75.4
Other	273.4, 275.1, 275.01, 275.03, 070.49, 070.59, 070.6, 070.9, 573.3, 571.40, 571.41, 571.49 571.5, 571.8 571.9 573.0, 573.8, 573.9, 751.62, 453.0, 570, V02.60, V02.69, 070.43, 070.53	E88.01, E83.00, E83.01, E83.09, E83.110, E83.118, B17.2, B17.8, B17.9, B18.8, B18.9, B19.0, B19.9, K71*, K72*, K73*, K74.60, K74.69, K73.9, K73.0, K73.2, K73.8, K74.1, K75.3, K75.89, K75.9, K76.1, K76.3, K76.4, K76.5, K76.89, K76.9 K77*, Q44.6, I82.0, Z22.50, Z22.59
Related conditions		
Sepsis	CCS# category 2	A021, A207, A227, A267, A327, A392, A393, A394, A400, A401, A403, A408, A409, A4101, A4102, A411

Condition	ICD9 Codes	ICD10 codes
		A412, A413, A414, A4150, A4151, A4152, A4153, A4159 A4181, A4189, A419, A427, A5486, B007, B377, I76, O0337, O0387, O0487, O0737 O0882, O85, O8604, P360, P3610, P3619, P362, P3630 P3639, P364, P365, P368, P369, R6520, R6521, T8144XA T8144XD
AKI	584.5, 584.6, 584.7, 584.8, 584.9, 586, 572.4	K76.7* N17*
Mechanical Ventilation	528.81, 96.71, 96.70, 96.72, 96.04, CCS# procedure category 216	J96.00, J96.90, 09HN7BZ, 09HN8BZ 0BH13EZ, 0BH17EZ, 0BH18EZ, 0CHY7BZ, 0CHY8BZ, 0DH57BZ, 0DH58BZ, 0WHQ73Z, 0WHQ7YZ 5A09357, 5A09457, 5A09557 5A1935Z, 5A1945Z, 5A1955Z
Heart Failure	398.91, 402.11, 402.91, 404.01, 404.11, 404.03, 404.13, 404.91, 404.93, 428x	I09.81, I11.0, I13.0, I13.2, I50x

* indicates any codes starting with ICD code stem were include

% Diabetes diagnosis defined using Elixhauser indicators for diabetes or diabetes complications

Clinical Categorization software (CCS, <https://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp>)

eTable 2. Trend in adjusted odds ratios for procedures of interest by racial and ethnic group as depicted in Figure 1 and 2.

	2009 Adjusted* Odds Ratio (95% CI)	2018 Adjusted* Odds Ratio (95% CI)	p-value for the trend over study period ^{&}	Disparity Changing Over Time? [^]	Disparity Present in 2018? [%]
EGD in Variceal Bleeding ^{\$}					
Black vs. White	0.87 (0.81, 0.93)	0.94 (0.88, 1.01)	0.19	–	✔
Hispanic vs. White	1.08 (1.03, 1.13)	0.96 (0.91, 1.00)	0.003	✓	✔
Other vs. White	1.13 (1.04, 1.22)	0.95 (0.89, 1.02)	0.006	✓	✔
TIPS for Variceal Bleeding ^{\$#}					
Black vs. White	0.57 (0.49, 0.65)	0.59 (0.52, 0.67)	0.73	–	⚠
Hispanic vs. White	0.85 (0.78, 0.92)	0.96 (0.89, 1.04)	0.06	–	✔
Other vs. White	0.85 (0.74, 0.96)	0.88 (0.79, 0.99)	0.68	–	✔
TIPS for Ascites ^{@#}					
Black vs. White	0.43 (0.38, 0.48)	0.41 (0.37, 0.45)	0.55	–	⚠
Hispanic vs. White	0.72 (0.67, 0.77)	0.86 (0.81, 0.92)	< 0.001	✓	⚠
Other vs. White	0.73 (0.66, 0.81)	0.88 (0.81, 0.96)	0.02	✓	⚠
Hemodialysis for AKI/HRS [!]					
Black vs. White	1.12 (1.07, 1.17)	1.34 (1.29, 1.38)	<0.001	✗	⚠
Hispanic vs. White	1.31 (1.26, 1.35)	1.27 (1.23, 1.30)	0.27	–	⚠
Other vs. White	1.08 (1.02, 1.14)	1.28 (1.23, 1.33)	<0.001	✗	⚠
Liver Transplant					
Black vs. White	0.51 (0.47, 0.56)	0.65 (0.61, 0.70)	< 0.001	✓	⚠
Hispanic vs. White	0.95 (0.89, 1.02)	0.74 (0.70, 0.78)	<0.001	✗	⚠
Other vs. White	0.85 (0.77, 0.93)	1.09 (1.02, 1.16)	< 0.001	✓	✔
Death					
Black vs. White	1.21 (1.17, 1.25)	1.07 (1.05, 1.10)	<0.001	✓	⚠
Hispanic vs. White	0.96 (0.93, 0.98)	0.90 (0.88, 0.92)	0.002	✗	✔
Other vs. White	0.98 (0.94, 1.02)	0.99 (0.96, 1.02)	0.78	–	✔

* The OR are predicted values from the models presented in Figures 1 and 2 and are provided as examples to improve interpretation. All models included a core set of co-variables: race (Black, Hispanic, Other and White as the reference group); year; race-year interaction effect; age (18-44, 45-64, ≥65); gender; insurance (Medicaid, Medicare, Private, Other); modified ECI (0-3, 4-6, ≥7); hospital region (Midwest, Northeast, South, West); urban or rural hospital; teaching or non-teaching hospital; indicators of liver disease etiologies: HCV, HBV, NASH, Cholestatic, Alcohol, Other; indicators for cirrhosis complications: Ascites, VH, HCC, HRS, Sepsis, AKI; and Mechanical Ventilation.

& The overall trend was assessed over the study period and a p < 0.05 for this trend indicates that there was a significant change over time.

[^] “✓” indicates disparity significantly narrowing over study period, “✗” indicates disparity significantly wider over study, “–” indicates disparity no different over study period

[%] ✔ indicates equivalent or better outcome compared to White individuals in 2018, ⚠ indicates worse outcomes compared to White individuals in 2018

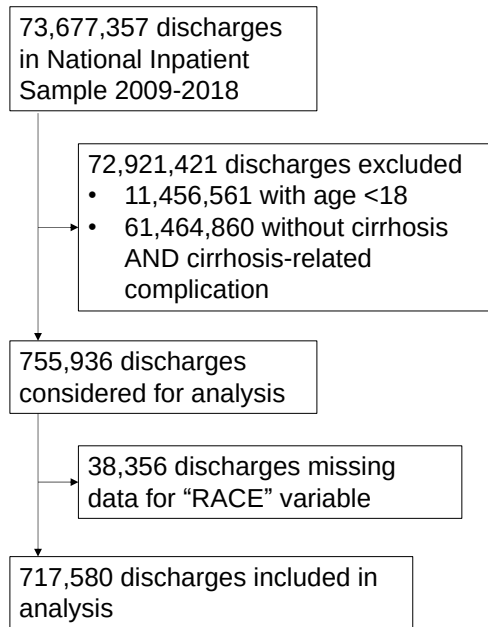
^{\$} model did not include indicator for VH and excluded those with HF (n=3,897)

[#] model includes additional covariable indicator of whether the admission was emergent

[@] model did not include indicator for ascites and excluded those with heart failure (n=69,787)

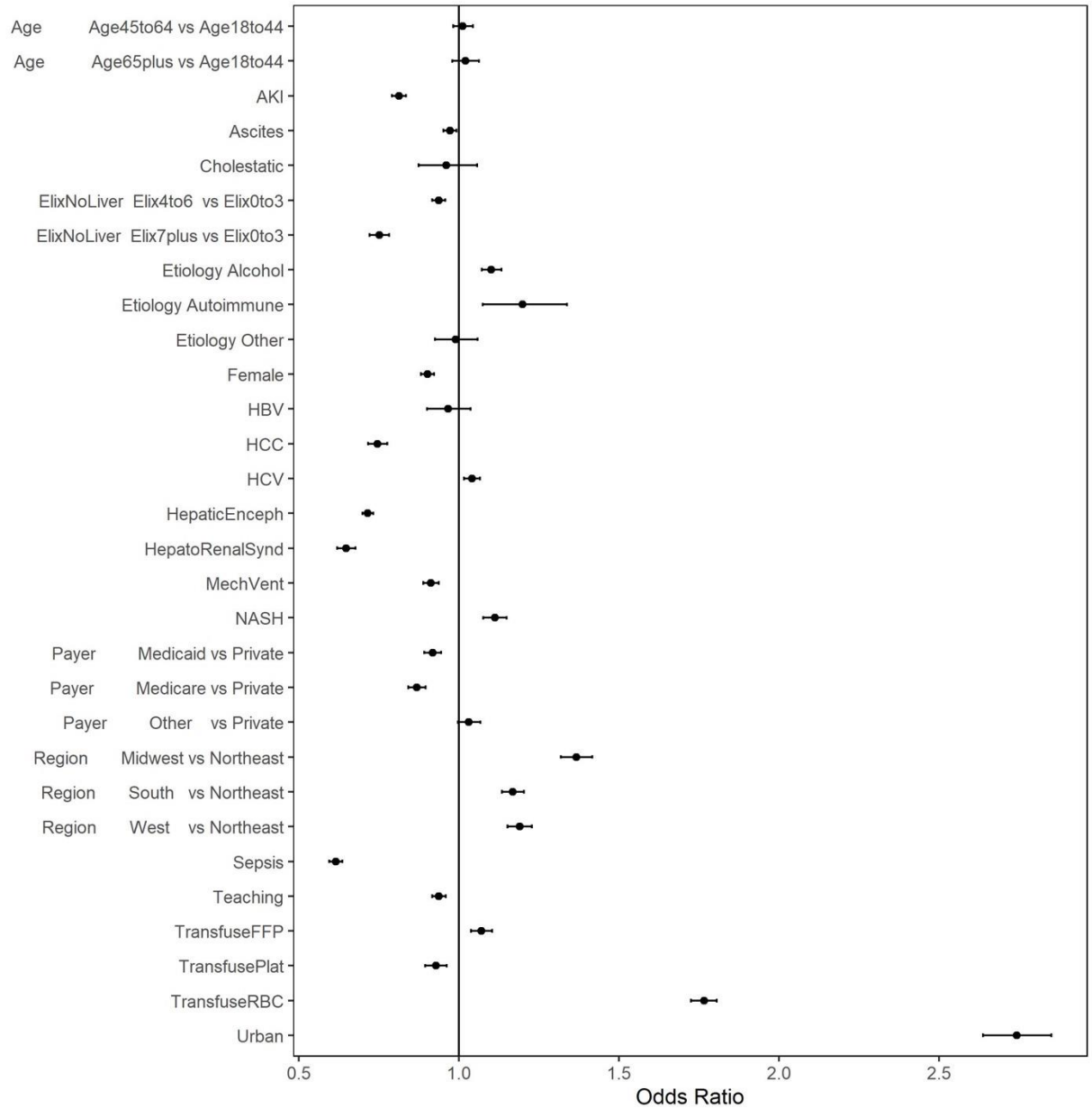
[!] model did not include indicator for AKI/HRS

eFigure 1. Study participation flow diagram

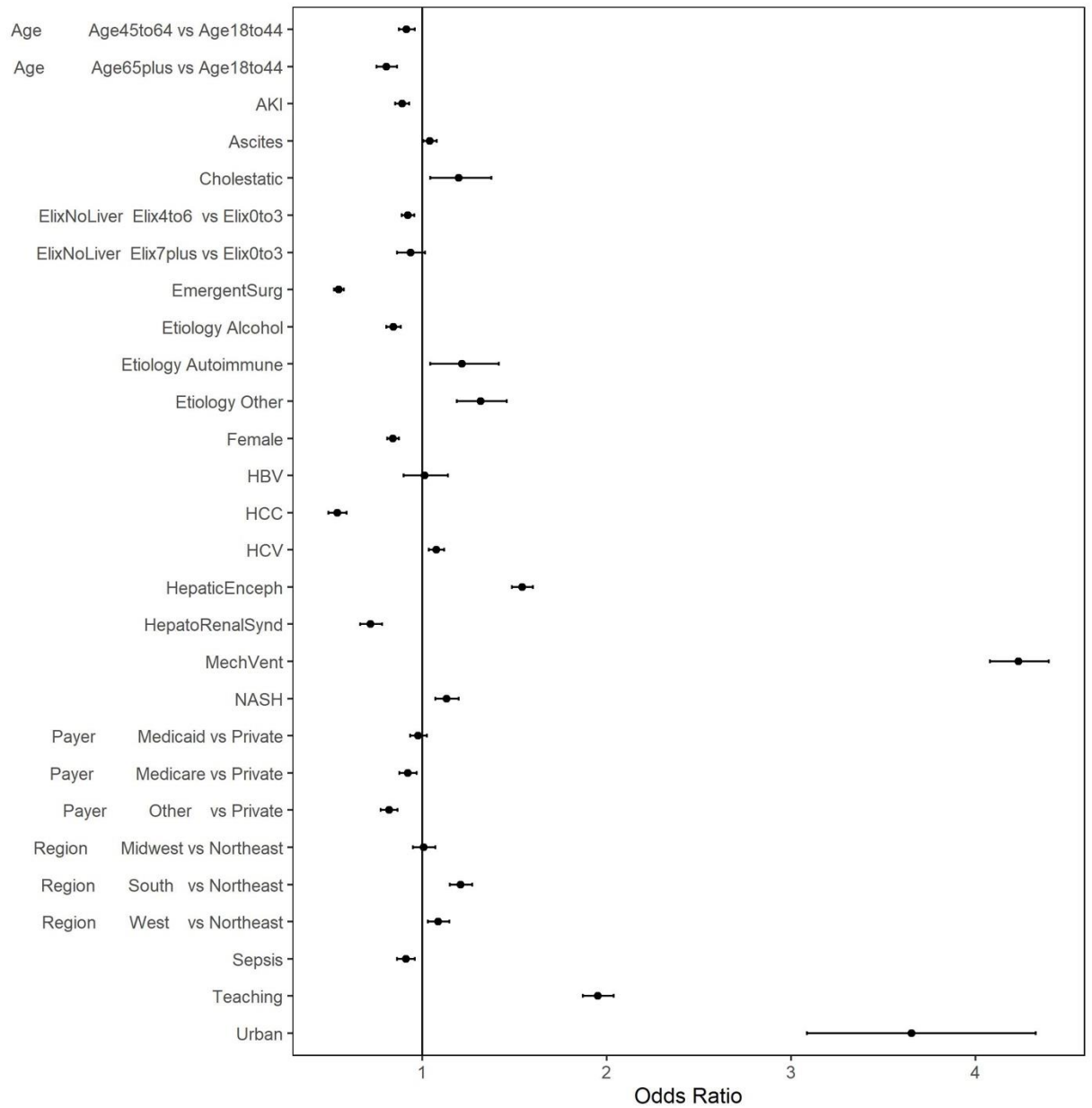


eFigure 2. Co-variates included in model to calculate adjusted odds ratio for each procedure (A. EGD for variceal bleeding, B. TIPS for variceal bleeding, C. TIPS for ascites, D. HD for AKI/HRS, E.LT for decompensated cirrhosis, F. Mortality in decompensated).

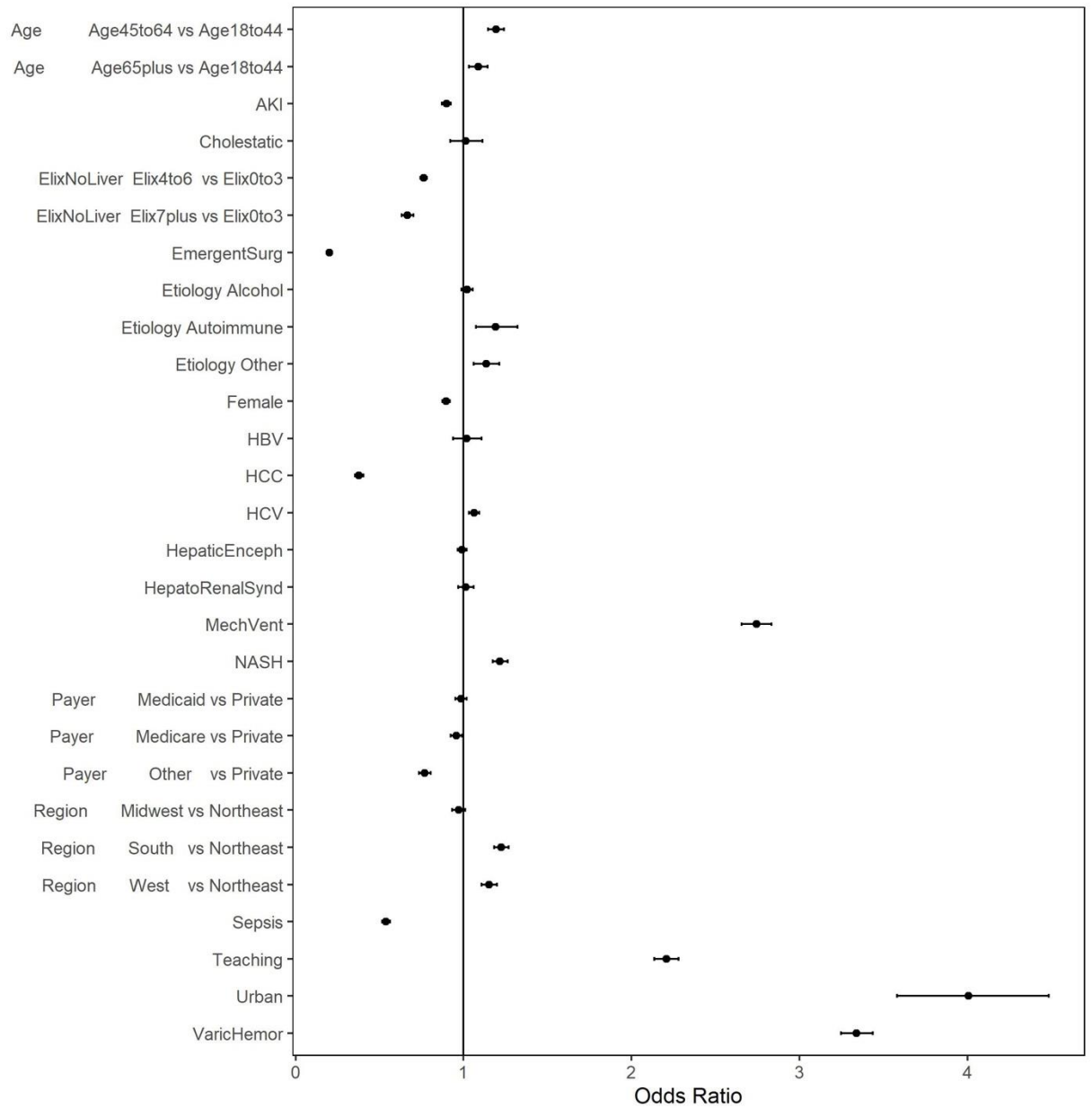
A. EGD for variceal bleeding



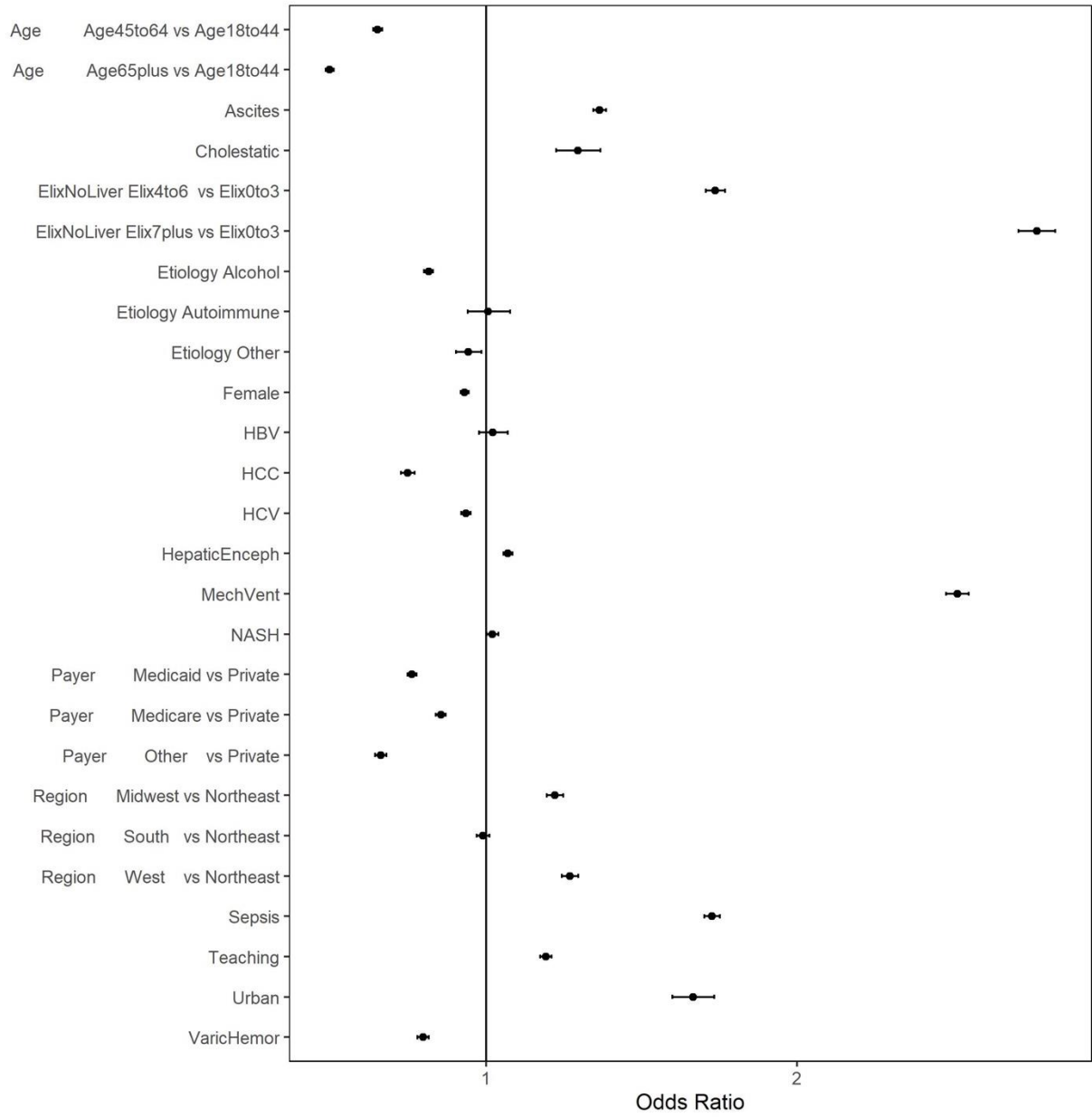
B. TIPS for variceal bleeding



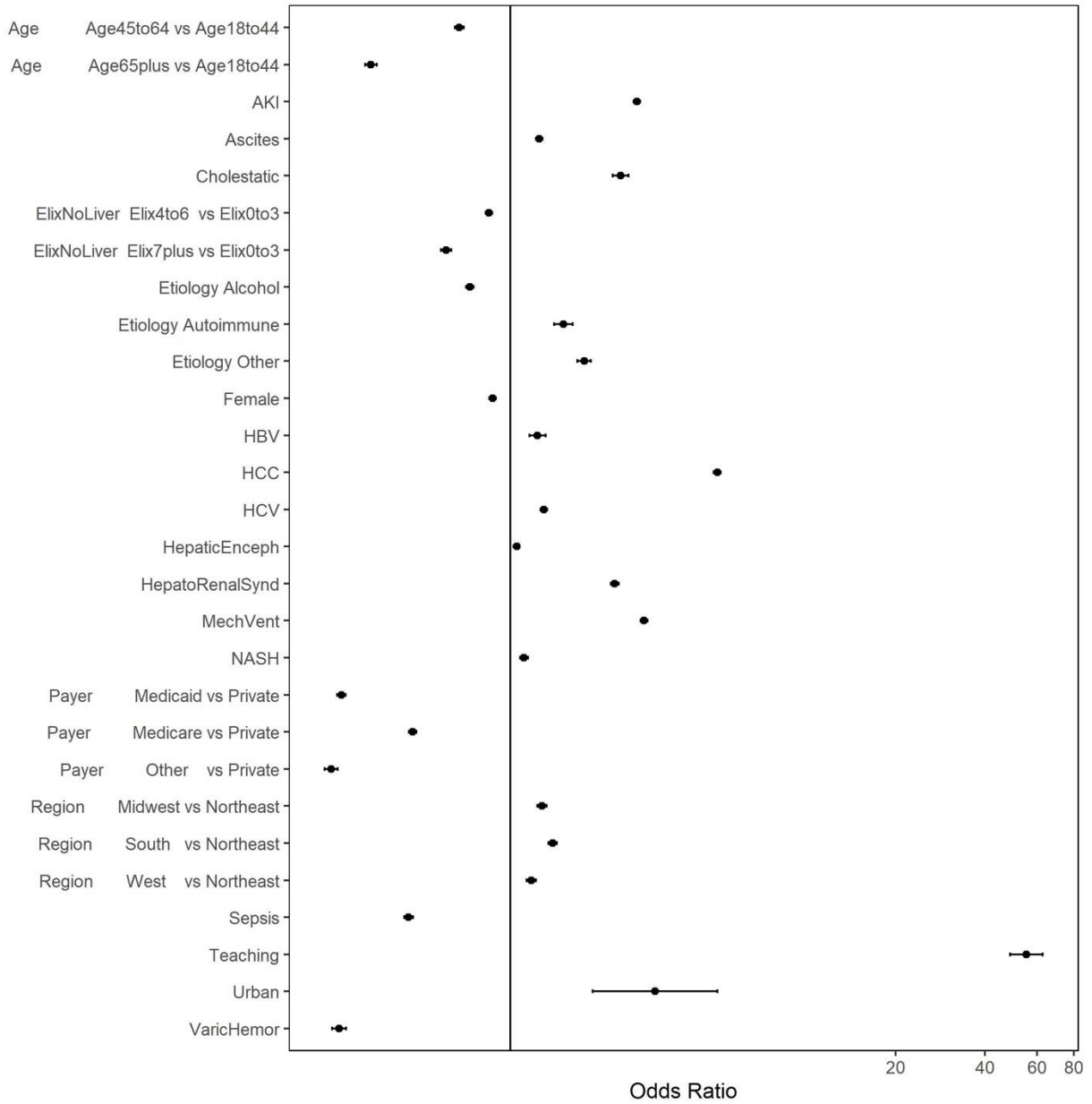
C. TIPS for ascites



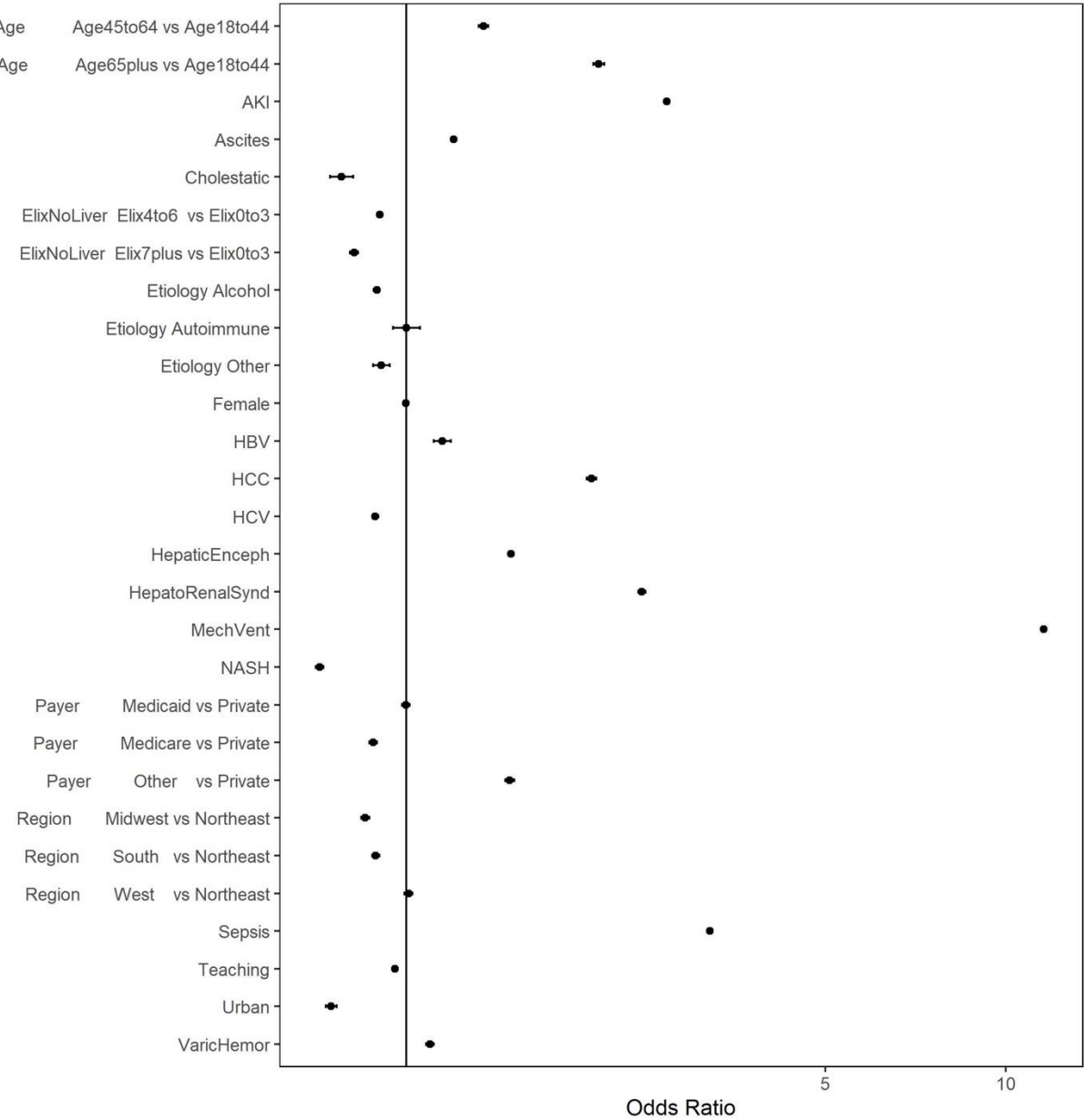
D. HD for AKI



E. Liver Transplant (x-axis on logarithmic scale)

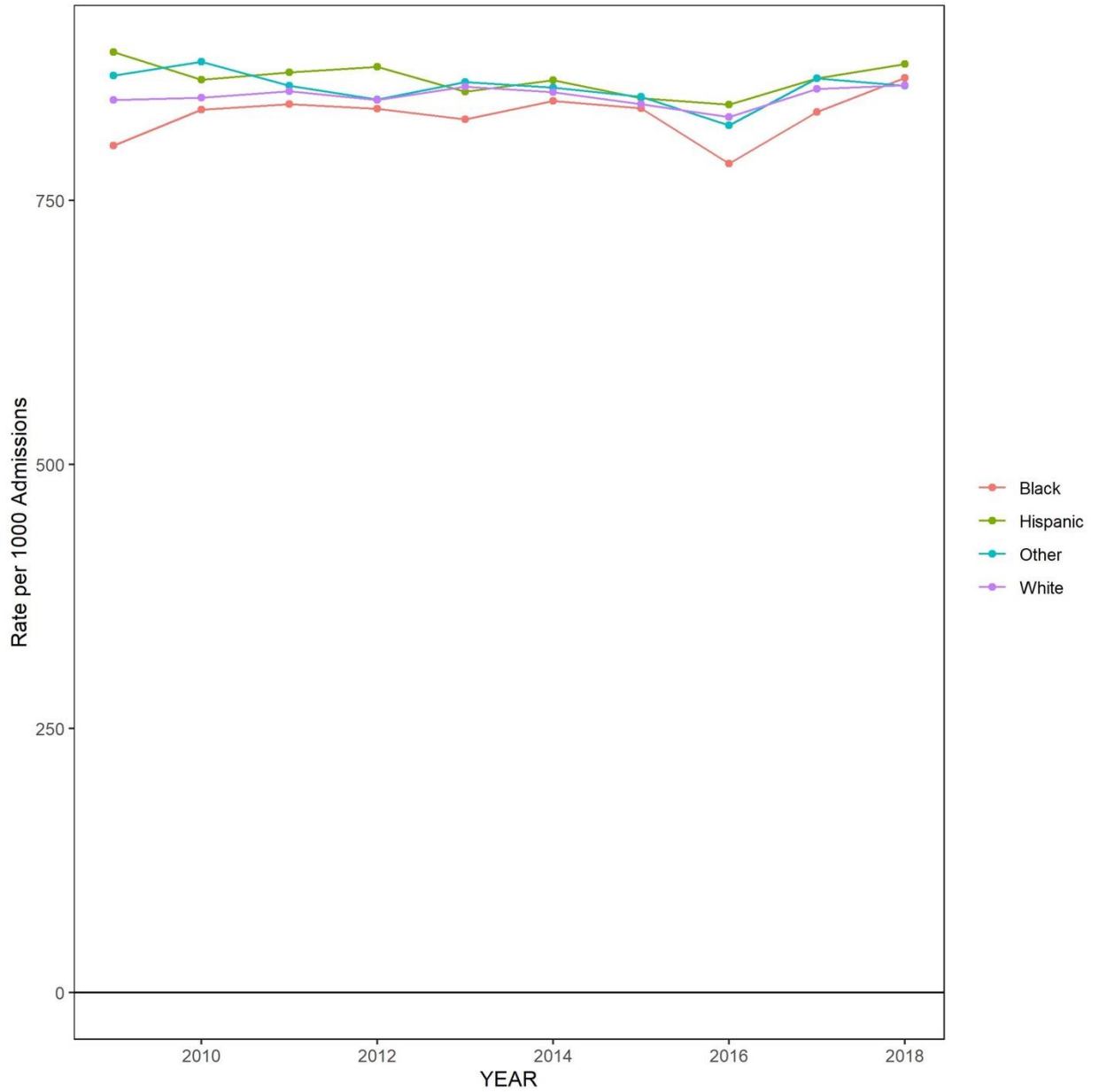


F. Mortality (x-axis on logarithmic scale)

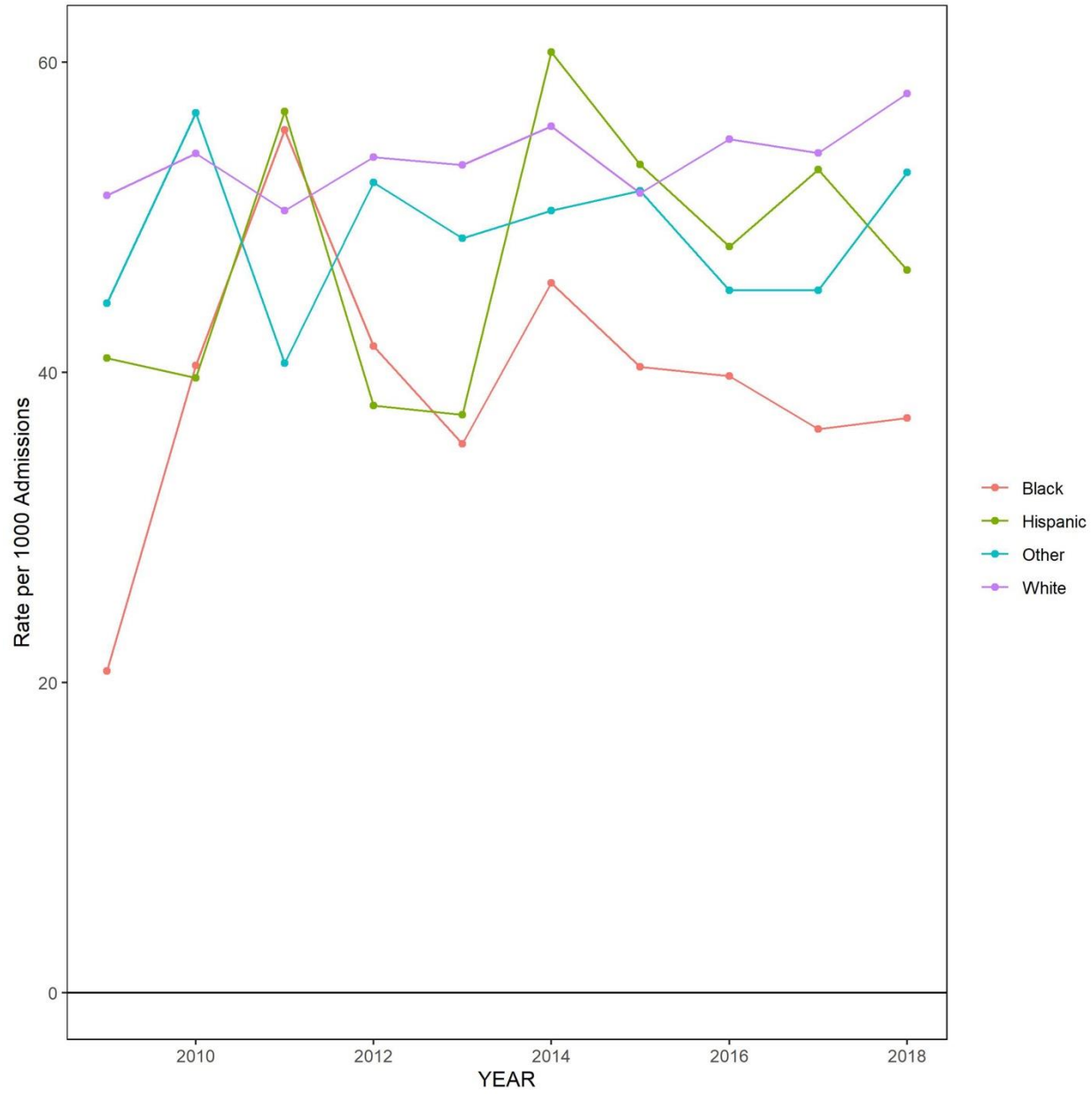


eFigure 3. Annual standardized procedures and mortality rates by race-year
(A. EGD for variceal bleeding, B. TIPS for variceal bleeding, C. TIPS for ascites, D. HD for AKI/HRS, E.LT for decompensated cirrhosis, F. Mortality in decompensated).

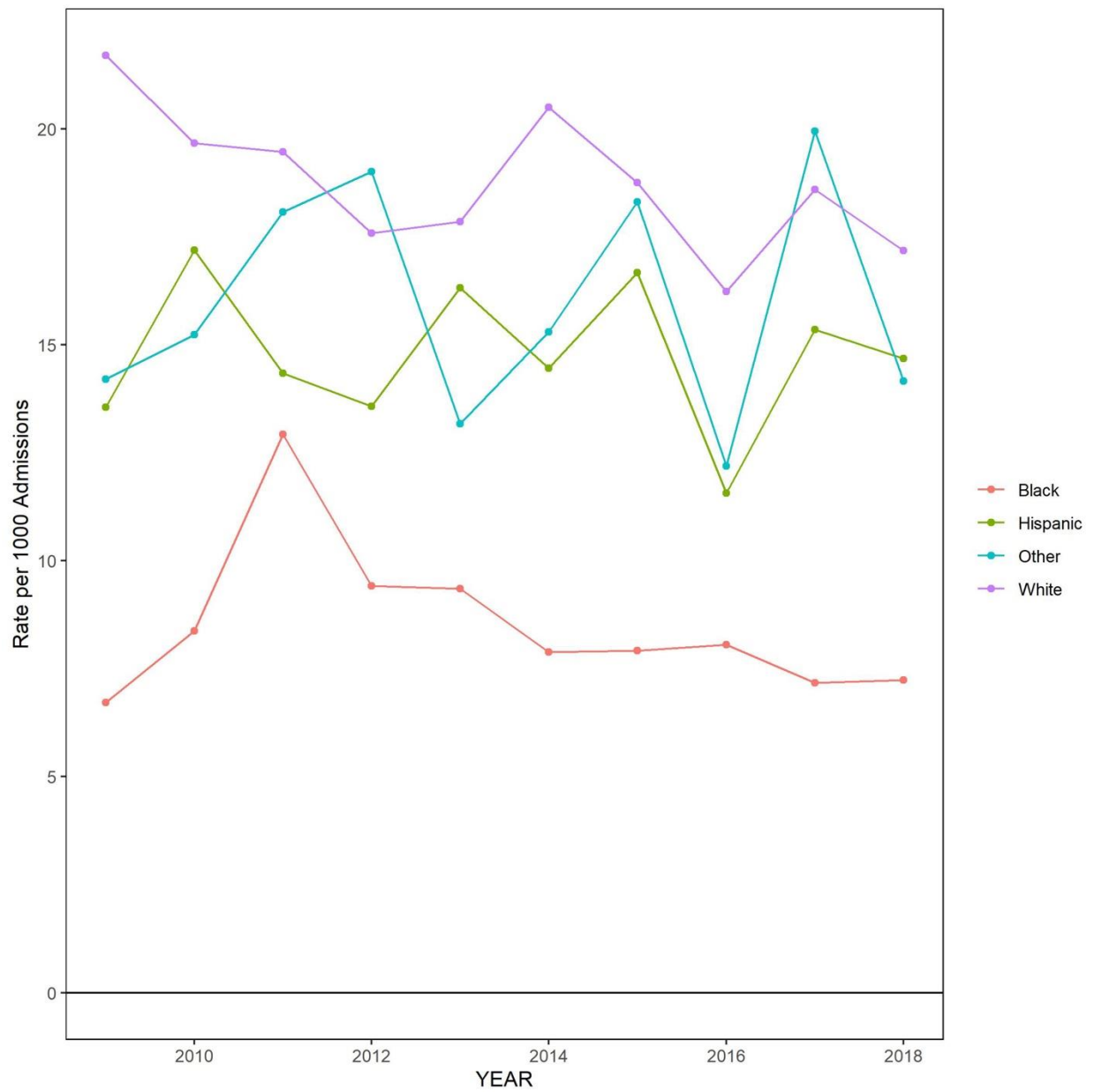
A. EGD for variceal bleeding



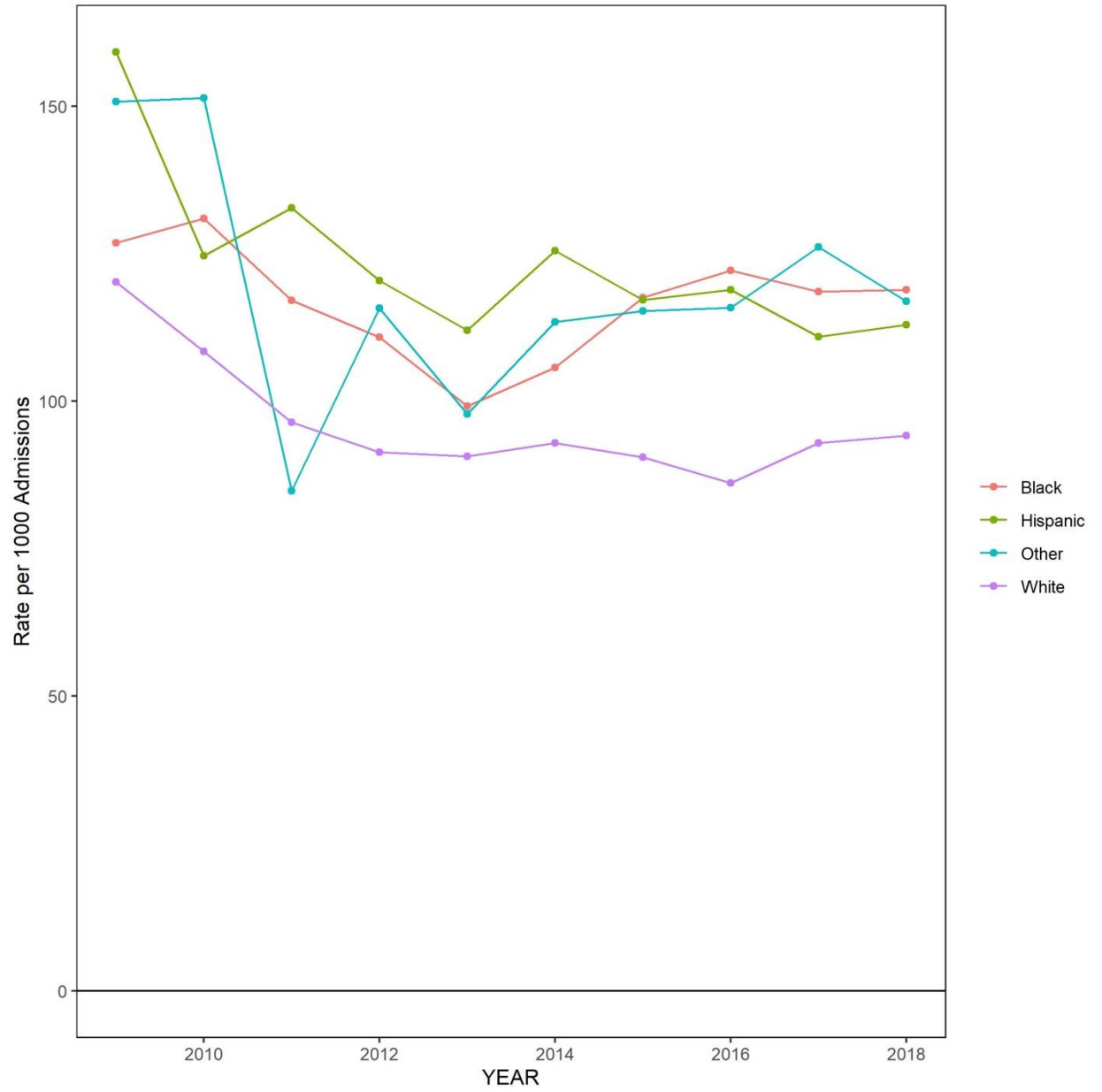
B. TIPS for variceal bleeding



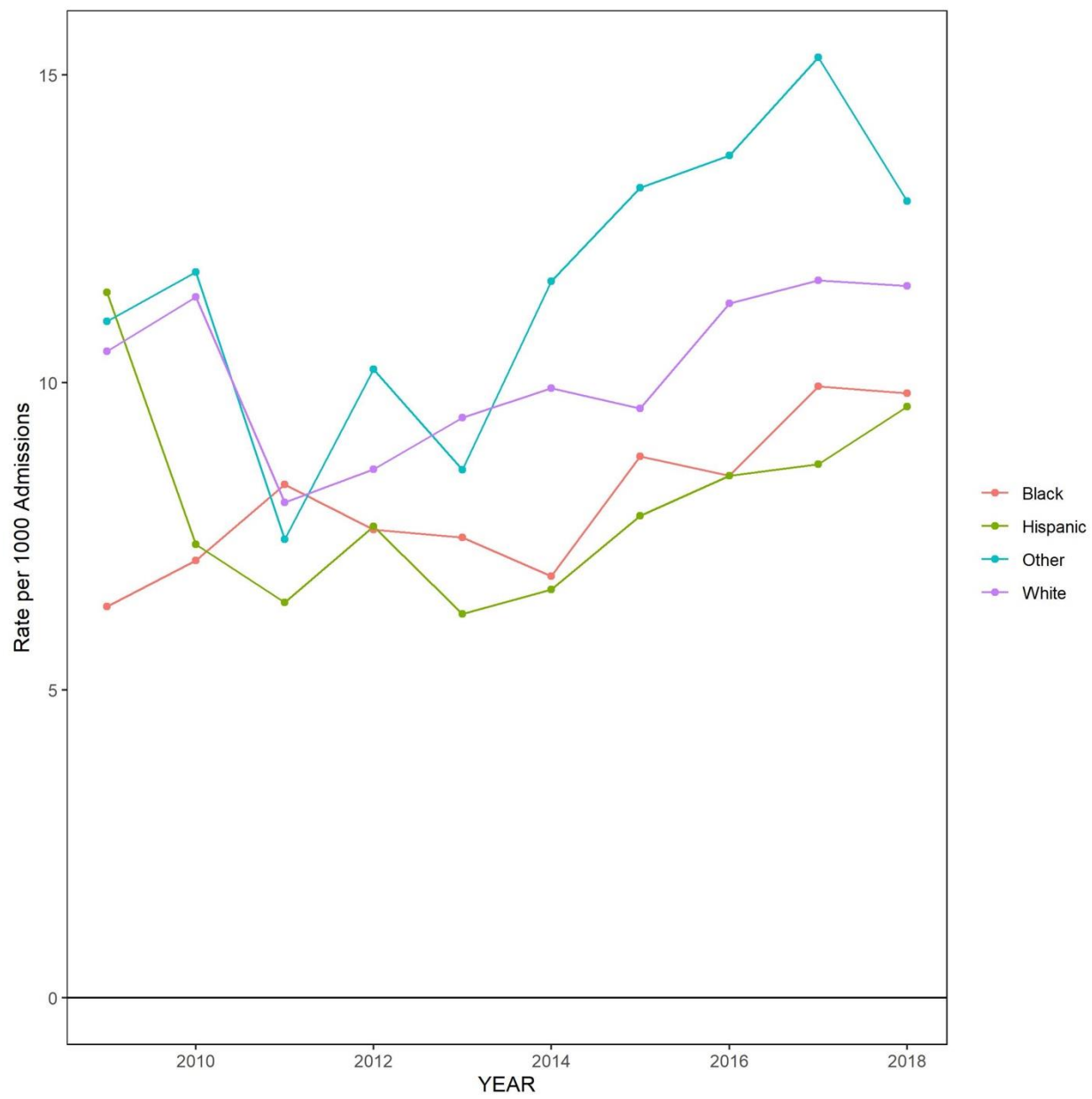
C. TIPS for ascites



D. HD for AKI



E. LT



F. Mortality

