

## Supplemental Online Content

Rodriguez LA, Schmittiel JA, Liu L, et al. Hepatocellular carcinoma in metabolic dysfunction-associated steatotic liver disease. *JAMA Netw Open*. 2024;7(7):e2421019.  
doi:10.1001/jamanetworkopen.2024.21019

**eTable 1.** Identification of Prevalent Metabolic Dysfunction-Associated Steatotic Liver Disease

**eTable 2.** *ICD-9* and *ICD-10* Diagnosis Codes Used to Identify HCC and Comorbidities

**eFigure.** Cumulative Incidence Curves Showing the Cumulative Incidence of HCC in a Cohort of Patients With MASLD Followed Up From 2009 to September 30, 2021

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

**eTable 1.** Identification of Prevalent Metabolic Dysfunction-Associated Steatotic Liver Disease

Data Sources	MASLD*
<b>ICD-based</b> <ul style="list-style-type: none"> <li>• Outpatient encounter</li> <li>• Hospital discharge</li> <li>• Problem list</li> </ul>	ICD-9-CM diagnosis codes: 571.9 (chronic liver disease NOS) ICD-10-CM diagnosis codes: K76.0 (fatty [change of] liver, NEC), K73.8 (other hepatitis, NEC), K75.81 (Nonalcoholic steatohepatitis)
<b>Imaging-based</b> Imaging studies of interest based on CPT-4 codes: <ul style="list-style-type: none"> <li>• Ultrasound: 76700, 76705</li> <li>• Computerized tomography: 74150, 74160, 74170, 74175, 74176, 74177, 74178</li> <li>• Magnetic resonance imaging: 74181, 74182, 74183</li> </ul>	Using SAS regular expression to search for terms of interest in “Impression Section” in members with completed imaging studies: <ul style="list-style-type: none"> <li>• Fatty liver</li> <li>• Hepatic steatosis</li> <li>• Increased liver echogenicity</li> </ul> Terms negating MASLD of interest: <ul style="list-style-type: none"> <li>• Hepatitis C</li> <li>• Autoimmune hepatitis</li> <li>• Primary biliary cirrhosis</li> </ul>
<b>Dallas Steatosis Index-based</b> <ul style="list-style-type: none"> <li>• Completed laboratory tests: Triglyceride, Alanine aminotransferase (ALT)</li> <li>• Body mass index</li> </ul>	Dallas Steatosis Index (DSI) calculated as: $-9.4 + 0.316$ (if $\geq 50$ years-of-age and female) + 2.4 (if known diabetes) + 0.02 (equals 0 if diabetic; if not diabetic equals glucose concentration in mg/dL) + 0.3 (if known hypertension) + 0.5 (if Hispanic/Asian/Other Race/Ethnicity) + Ln (triglycerides in mg/dL) + 0.4 (if ALT 13.5–19.49 IU/L) + 1.1 (if ALT 19.5–40 IU/L) + 1.5 (if ALT >40 IU/L) + 0.7 (if not black and BMI 25–27.49 kg/m <sup>2</sup> ) + 1.4 (if not black and BMI 27.5–34.9 kg/m <sup>2</sup> ) + 1.9 (if not black and BMI 35–37.49 kg/m <sup>2</sup> ) + 2.6 (if not black and BMI >37.5 kg/m <sup>2</sup> ) - 0.2 (if black and BMI 25–27.49 kg/m <sup>2</sup> ) + 0.9 (if black and BMI 27.5–34.9 kg/m <sup>2</sup> ) + 0.8 (if black and BMI 35–37.49 kg/m <sup>2</sup> ) + 1.8 (if black and BMI >37.5 kg/m <sup>2</sup> ) Source: <a href="https://doi.org/10.1016/j.cgh.2020.01.020">https://doi.org/10.1016/j.cgh.2020.01.020</a>

Abbreviations: ALT, alanine transaminase; BMI, body mass index; CPT, current procedural terminology; ICD, International Classification of Diseases; MASLD, metabolic dysfunction-associated steatotic liver disease; NEC, not elsewhere classified; NOS, not otherwise specified.

\* Excluding hepatitis C (ICD-9-CM: 070.41, 070.44, 070.51, 070.54, 070.70, 070.71, V02.62; ICD-10-CM: B17.10, B18.2, Z86.19); autoimmune hepatitis (ICD-9-CM: 571.42 ICD-10-CM: K75.4); primary biliary cirrhosis (ICD-9-CM: 571.6 ICD-10-CM: K74.5); acute alcoholic hepatitis (ICD-9: 571.1; ICD-10: K70.10, K70.11); alcoholic fatty liver (ICD-9: 571.0; ICD-10: K70.0); unspecified alcoholic liver damage (ICD-9: 571.3; ICD-10: K70.40, K70.41, K70.9); alcoholic cirrhosis (ICD-9: 571.2; ICD-10: K70.2, K70.30, K70.31); alcohol use disorder (ICD-9: 305.00–305.03; ICD-10: F10.1x); and chemical dependency treatment (ICD-9: 304.61-6, 304.70-72, 304.80-82, 304.90-92; ICD-10: F19.20).

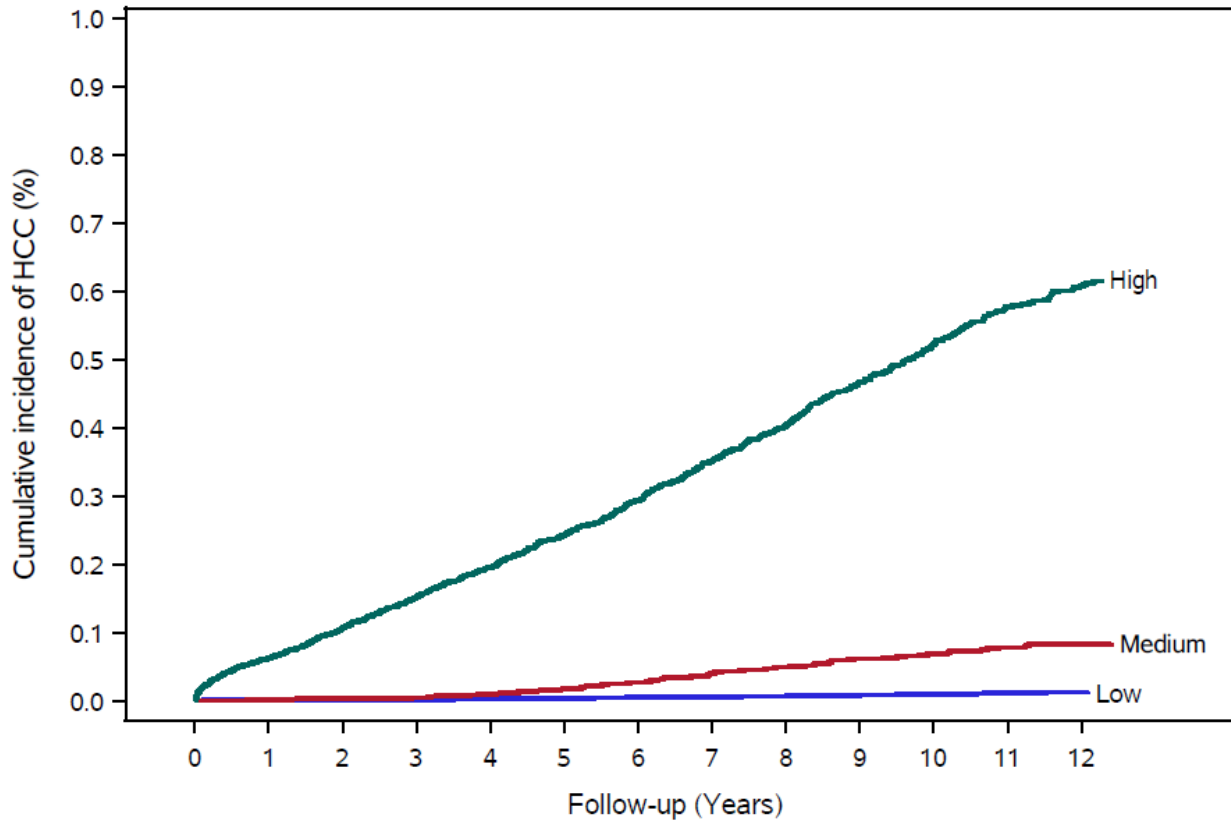
**eTable 2.** ICD-9 and ICD-10 Diagnosis Codes Used to Identify HCC and Comorbidities

Condition	ICD-9/10 code(s) used and definition(s)
Cirrhosis	ICD9/10 codes of 456.1, 456.21, 571.2, 571.5, I85.00, I98.2, K70.3, K71.7, K74.6, 572.2, 572.3, 572.4, 456.0, 456.20, 782.4, 789.5, I85.01, I86.4, I98.20, I98.3, K72.1, K72.9, K76.6, K76.7, R17, R18, or FIB4 score $\geq 3.25$
Drug use	292, 292.0, 292.1, 292.11, 292.12, 292.2, 292.8, 292.81, 292.82, 292.83, 292.84, 292.85, 292.89, 292.9, 304, 304.0, 304.00, 304.01, 304.02, 304.03, 304.1, 304.10, 304.11, 304.12, 304.13, 304.2, 304.20, 304.21, 304.22, 304.23, 304.3, 304.30, 304.31, 304.32, 304.33, 304.4, 304.40, 304.41, 304.42, 304.43, 304.5, 304.50, 304.51, 304.52, 304.53, 304.6, 304.60, 304.61, 304.62, 304.63, 304.7, 304.70, 304.71, 304.72, 304.73, 304.8, 304.80, 304.81, 304.82, 304.83, 304.9, 304.90, 304.91, 304.92, 304.93, 305.2, 305.20, 305.21, 305.22, 305.23, 305.3, 305.30, 305.31, 305.32, 305.33, 305.4, 305.40, 305.41, 305.42, 305.43, 305.5, 305.50, 305.51, 305.52, 305.53, 305.6, 305.60, 305.61, 305.62, 305.63, 305.7, 305.70, 305.71, 305.72, 305.73, 305.8, 305.80, 305.81, 305.82, 305.83, 305.9, 305.90, 305.91, 305.92, 305.93, F11, F11.1, F11.10, F11.11, F11.12, F11.120, F11.121, F11.122, F11.129, F11.14, F11.15, F11.150, F11.151, F11.159, F11.18, F11.181, F11.182, F11.188, F11.19, F11.2, F11.20, F11.21, F11.22, F11.220, F11.221, F11.222, F11.229, F11.23, F11.24, F11.25, F11.250, F11.251, F11.259, F11.28, F11.281, F11.282, F11.288, F11.29, F11.9, F11.90, F11.92, F11.920, F11.921, F11.922, F11.929, F11.93, F11.94, F11.95, F11.950, F11.951, F11.959, F11.98, F11.981, F11.982, F11.988, F11.99, F12, F12.1, F12.10, F12.11, F12.12, F12.120, F12.121, F12.122, F12.129, F12.15, F12.150, F12.151, F12.159, F12.18, F12.180, F12.188, F12.19, F12.2, F12.20, F12.21, F12.220, F12.221, F12.222, F12.229, F12.23, F12.25, F12.250, F12.251, F12.259, F12.28, F12.280, F12.288, F12.29, F12.9, F12.90, F12.92, F12.920, F12.921, F12.922, F12.929, F12.93, F12.95, F12.950, F12.951, F12.959, F12.98, F12.980, F12.988, F12.99, F13, F13.1, F13.10, F13.11, F13.12, F13.120, F13.121, F13.129, F13.14, F13.15, F13.150, F13.151, F13.159, F13.18, F13.180, F13.181, F13.182, F13.188, F13.19, F13.2, F13.20, F13.21, F13.22, F13.220, F13.221, F13.229, F13.23, F13.230, F13.231, F13.232, F13.239, F13.24, F13.25, F13.250, F13.251, F13.259, F13.26, F13.27, F13.28, F13.280, F13.281, F13.282, F13.288, F13.29, F13.9, F13.90, F13.92, F13.920, F13.921, F13.929, F13.93, F13.930, F13.931, F13.932, F13.939, F13.94, F13.95, F13.950, F13.951, F13.959, F13.96, F13.97, F13.98, F13.980, F13.981, F13.982, F13.988, F13.99, F14, F14.1, F14.10, F14.11, F14.12, F14.120, F14.121, F14.122, F14.129, F14.14, F14.15, F14.150, F14.151, F14.159, F14.18, F14.180, F14.181, F14.182, F14.188, F14.19, F14.2, F14.20, F14.21, F14.22, F14.220, F14.221, F14.222, F14.229, F14.23, F14.24, F14.25, F14.250, F14.251, F14.259, F14.28, F14.280, F14.281, F14.282, F14.288, F14.29, F14.9, F14.90, F14.92, F14.920, F14.921, F14.922, F14.929, F14.94, F14.95, F14.950, F14.951, F14.959, F14.98, F14.980, F14.981, F14.982, F14.988, F14.99, F15, F15.1, F15.10, F15.11, F15.12,

	F15.120, F15.121, F15.122, F15.129, F15.14, F15.15, F15.150, F15.151, F15.159, F15.18, F15.180, F15.181, F15.182, F15.188, F15.19, F15.2, F15.20, F15.21, F15.22, F15.220, F15.221, F15.222, F15.229, F15.23, F15.24, F15.25, F15.250, F15.251, F15.259, F15.28, F15.280, F15.281, F15.282, F15.288, F15.29, F15.9, F15.90, F15.92, F15.920, F15.921, F15.922, F15.929, F15.93, F15.94, F15.95, F15.950, F15.951, F15.959, F15.98, F15.980, F15.981, F15.982, F15.988, F15.99, F16, F16.1, F16.10, F16.11, F16.12, F16.120, F16.121, F16.122, F16.129, F16.14, F16.15, F16.150, F16.151, F16.159, F16.18, F16.180, F16.183, F16.188, F16.19, F16.2, F16.20, F16.21, F16.22, F16.220, F16.221, F16.229, F16.24, F16.25, F16.250, F16.251, F16.259, F16.28, F16.280, F16.283, F16.288, F16.29, F16.9, F16.90, F16.92, F16.920, F16.921, F16.929, F16.94, F16.95, F16.950, F16.951, F16.959, F16.98, F16.980, F16.983, F16.988, F16.99, F18, F18.1, F18.10, F18.11, F18.12, F18.120, F18.129, F18.14, F18.15, F18.150, F18.151, F18.159, F18.17, F18.18, F18.180, F18.188, F18.19, F18.2, F18.20, F18.21, F18.22, F18.220, F18.221, F18.229, F18.24, F18.25, F18.250, F18.251, F18.259, F18.27, F18.28, F18.280, F18.288, F18.29, F18.9, F18.90, F18.92, F18.920, F18.921, F18.929, F18.94, F18.95, F18.950, F18.951, F18.959, F18.97, F18.98, F18.980, F18.988, F18.99, F19, F19.1, F19.10, F19.11, F19.12, F19.120, F19.121, F19.122, F19.129, F19.14, F19.15, F19.150, F19.151, F19.159, F19.16, F19.17, F19.18, F19.180, F19.181, F19.182, F19.188, F19.19, F19.2, F19.20, F19.21, F19.22, F19.220, F19.221, F19.222, F19.229, F19.23, F19.230, F19.231, F19.232, F19.239, F19.24, F19.25, F19.250, F19.251, F19.259, F19.26, F19.27, F19.28, F19.280, F19.281, F19.282, F19.288, F19.29, F19.9, F19.90, F19.92, F19.920, F19.921, F19.922, F19.929, F19.93, F19.930, F19.931, F19.932, F19.939, F19.94, F19.95, F19.950, F19.951, F19.959, F19.96, F19.97, F19.98, F19.980, F19.981, F19.982, F19.988, F19.99
Hepatocellular carcinoma (HCC)	KPNC Tumor Registry
Human immunodeficiency virus (HIV)	ICD-9 042 to 044.999 inclusive, or ICD-10 B20 to B20.999 inclusive
Metabolic dysfunction-associated steatotic liver disease (MASLD)	ICD-9-CM diagnosis codes: 571.9 (chronic liver disease NOS) ICD-10-CM diagnosis codes: K76.0 (fatty [change of] liver, NEC), K73.8 (other hepatitis, NEC), K75.81 (Nonalcoholic steatohepatitis)
Other immune disease	275.1, E83.01, 275.01, 275.03, E83.110, 273.4, E88.01, 571.5, K74.69
Steatohepatitis	571.1, 571.2, 571.8, K70.10, K70.11, K70.2, K70.30, K70.31, K75.81

Abbreviations: HCC, hepatocellular carcinoma; HIV, human immunodeficiency virus; ICD, International Classification of Diseases; INR, international normalized ratio; KPNC, Kaiser Permanente Northern California; MASLD, metabolic dysfunction-associated steatotic liver disease; NEC, not elsewhere classified; NOS, not otherwise specified.

**eFigure.** Cumulative Incidence Curves Showing the Cumulative Incidence of HCC in a Cohort of Patients With MASLD Followed-Up From 2009 to September 30, 2021 Plotted by low-, medium- and high-risk intervals of HCC risk. HCC, hepatocellular carcinoma; MASLD, metabolic dysfunction-associated steatotic liver disease.



N° at risk	
High	178,930    159,250    131,660    103,778    77,539    48,909
Medium	157,472    146,609    124,772    99,716    75,013    45,808
Low	1,475,059    1,427,067    1,217,530    933,040    659,332    330,536