Economic Burden, Healthcare Resource Utilization and Costs of Metabolic Dysfunction-Associated Steatohepatitis (MASH) in Germany: A Claims Data Analysis

Yestle Kim[1]; Jennifer S. Haas[2]; Melinda Daumont[1], John O'Donnell[1], Hardo Fischer [1], Frank Tacke[3], Jörn M. Schattenberg[4]

[1]Madrigal Pharmaceuticals, West Conshohocken, PA, USA, [2] Cencora, Hannover, Lower Saxony, Germany, [3]Medical Department, Division of Hepatology and Gastroenterology, Charité - Universitätsmedizin Berlin, Campus Virchow-Klinikum (CVK) and Campus Charité Mitte (CCM), Berlin, Germany, [4]Department of Internal Medicine II, Saarland University Hospital, Homburg, Germany

OBJECTIVES

- Metabolic Dysfunction-Associated Steatohepatitis (MASH) constitutes a significant public health challenge, exerting a substantial economic impact on healthcare systems. (1,2)
- With the rising prevalence of MASH in Germany (2), a comprehensive understanding of its associated healthcare resource utilization (HCRU) and costs is critical.
- This study was designed to generate evidence on the economic burden of MASH within the German healthcare landscape and builds upon an earlier analysis with a 1-year baseline period.

METHODS

Study design and data source

- A retrospective data analysis was conducted utilizing statutory health insurance claims data from 2016 to 2023 from the representative InGef research database.
- Patients with MASH were identified by ICD-10-GM diagnosis code K75.8 (MASH) in 2018 to 2022.

Inclusion and exclusion criteria

- **Inclusion criteria:**
  - ≥1 diagnosis during an inpatient encounter and/or ≥2 diagnoses codes in the outpatient setting.
- **Index quarter:**
  - The first observable MASH diagnosis during the observation period
- **Exclusion criteria:**
  - Presence of other liver-related diseases in the 2-year baseline period

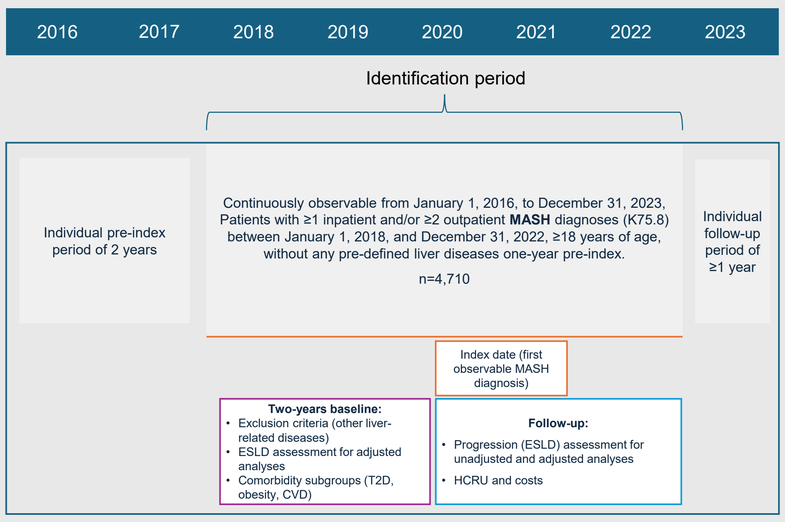
Outcomes

- **Baseline:**
  - Presence of end-stage liver disease (ESLD) and comorbid conditions in a 2-year baseline period prior to the index quarter.
- **Follow-up:**
  - Follow-up included the index quarter and all subsequent quarters within the study timeframe (minimum 1-year follow-up).
- ESLD severity levels (from least to most severe): *Compensated cirrhosis (CC); Decompensated cirrhosis (DCC); Hepatocellular Carcinoma (HCC); Liver transplant (LT)*
- Healthcare resource utilization (HCRU) and costs associated with MASH for patients with and without ESLD in the follow-up.
- Progression and non-progression groups:
  - Progression (P): Patients with any ESLD diagnosis in the follow-up.
  - Non-progression (NP): Patients who did not progress to ESLD during follow-up (no ESLD diagnosis).

Adjusted analyses

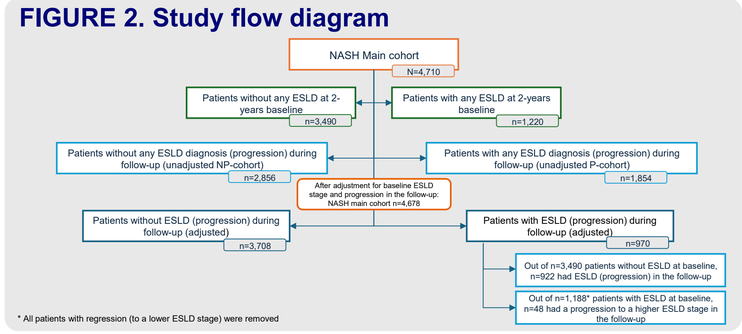
- Patients with ESLD at baseline who progressed to a higher ESLD stage during follow-up were classified as having disease progression.
- **Time to progression** was measured from MASH index diagnosis to the first progression or to a higher ESLD stage in the follow-up.
- **Cost regression analyses:**
  - Generalized linear models (GLM) with log link and gamma distribution were used
  - Dependent variable: all-cause total costs
  - Predictor (independent) variables included ESLD stages (non-progressing, CC, DCC, HCC, LT), age, sex, and comorbidities at baseline (T2D, CVD, and obesity

FIGURE 1. Study design



RESULTS

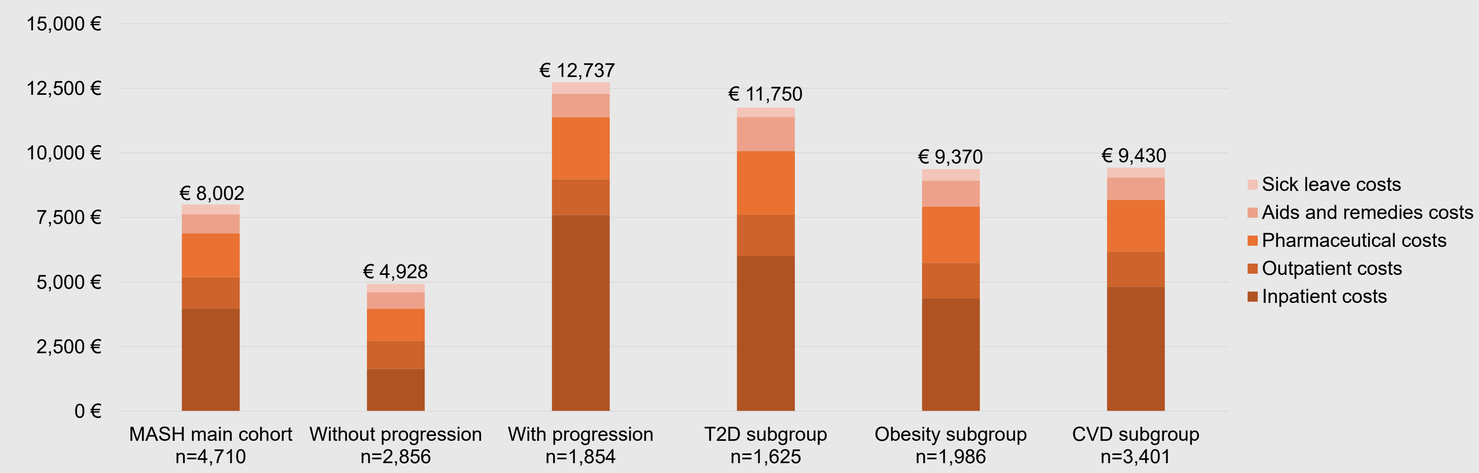
FIGURE 2. Study flow diagram



(Unadjusted) Healthcare costs

- More than 70% of patients with MASH presented with CVD (n=3,401, 72.2%), followed by obesity (n=1,986, 42.2%), and T2D (n=1,625, 34.5%).
- The average cost per patient per year (PPPY) in the P-cohort was €12,737 (SD €25,463), compared to €4,928 (SD €8,690) in the non-progression cohort (NP-cohort) (Figure 3).
- Among subgroups, the T2D subgroup had the highest average costs at €11,750 PPPY (SD €21,543), followed by the obesity subgroup at €9,370 (SD €17,692) and the CVD subgroup at €9,430 (SD €19,608) (Figure 3).
- Inpatient costs PPPY averaged €3,984 (SD €14.727) across the main cohort, with progression patients incurring the highest average inpatient costs at €7,592 PPPY (SD €22,169) compared to €1,641 (SD €4,981) for patients without progression (Figure 3).
- MASH/ESLD-related costs PPPY, relating to inpatient, outpatient (excluding pharmaceuticals), and sick leave, were also notably higher in the P-cohort (€2,233, SD €8,510) compared to the NP-cohort (€377, SD €1,565).

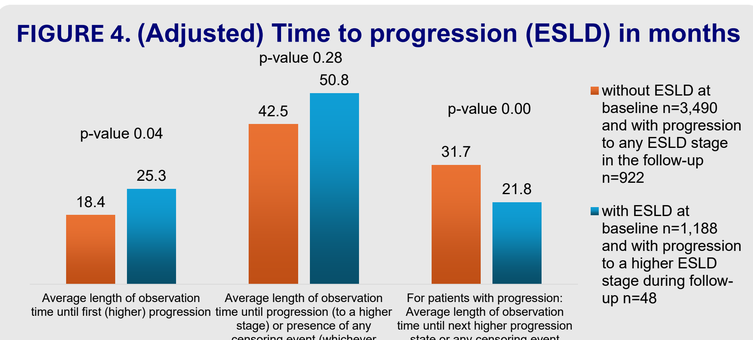
FIGURE 3. (Unadjusted) comparison of average healthcare costs (PPPY) among MASH patients



(Adjusted) Time to progression

- Among patients with ESLD at baseline (n=1,188), a total of 48 patients (4.0%) progressed to a higher ESLD state (Figure 2). The average time to first progression was 8.4 quarters (approx. 25.3 months) (Figure 4).
- Among patients without ESLD at baseline (n=3,490), 922 patients (26.0%) progressed in the follow-up. The average time to first progression was 6.1 quarters (approx. 18.4 months). For patients who progressed further, the average time to the next higher progression state was 10.6 quarters (approx. 31.7 months) (Figure 4).

FIGURE 4. (Adjusted) Time to progression (ESLD) in months



Cost regression analyses

- Predicted costs PPPY increased with disease severity: €6,694 for progression to CC (95% CI: €3,884–€11,538, p = 0.02), €7,224 for DCC (95% CI: €5,839–€8,938, p < 0.01), €12,948 for HCC (95% CI: €6,343–€26,431, p < 0.01), and €75,719 for LT (95% CI: €2,964–€1,934,032, p = 0.07) (Figure 5).
- Baseline comorbidities were significant predictors of higher costs, with T2D increasing costs by 44% (95% CI: 23%–69%), CVD by 51% (95% CI: 26%–80%), and obesity by 20% (95% CI: 3%–39%). Age showed a positive association with costs, while gender was not a significant predictor.
- Among patients with progression (n=970), more severe ESLD states incurred higher costs: €9,853 for DCC (95% CI: €7,144–€13,590), €18,250 for HCC (95% CI: €9,088–€36,647), and €102,381 for LT (95% CI: €5,911–€1,773,215), with variability in pre- and post-transplant care reflected in wide confidence intervals (Table 1).
- Among baseline comorbidities, T2D increased costs by 52% (95% CI: 12%–105%), while CVD and obesity did not show significant associations. Age remained a positive predictor of costs, and gender was not significant (Table 1).

FIGURE 5. Predicted costs PPPY and 95% CI (reference non-progressing MASH patients)

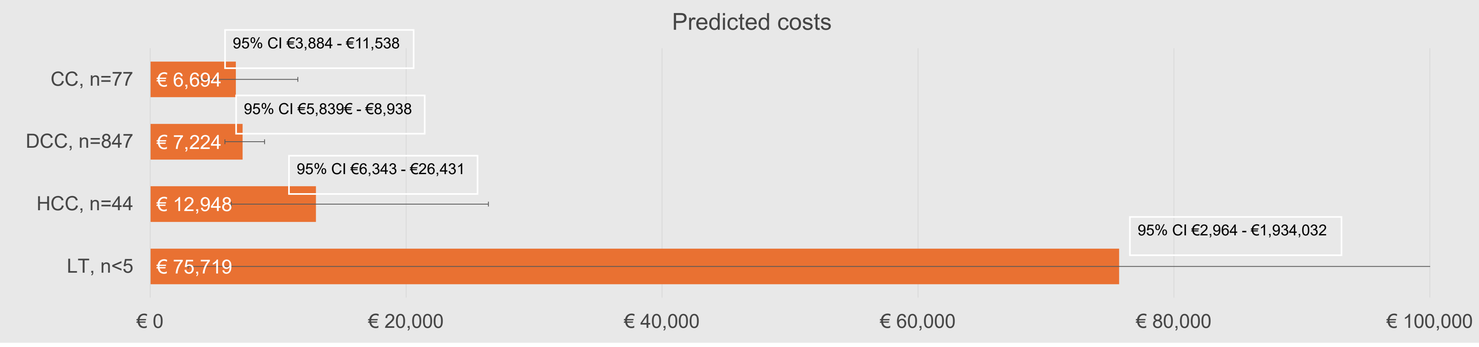


TABLE 1. Regression analysis of all-cause healthcare costs (PPPY) among (adjusted) MASH patients with progression (n=1,160)

Independent Variable		Pr > t	Parameter estimate (exp)	95% CI Lower Limit (exp)	95% CI Upper Limit (exp)	Predicted costs†	95% CI lower Limit	95% Ci Upper Limit
Intercept		0.00	3,109.59	1,517.12	6,636.77			
Age		0.00	1.02*	1.01	1.03			
Gender (reference: female)	male	0.76	0.96	0.74	1.25			
Disease state (reference: CC)	DCC (n=847)	0.88	1.04	0.62	1.64	€ 9,853	€ 7,144	€ 13,590
	HCC (n=44)	0.09	1.92	0.92	4.24	€ 18,250	€ 9,088	€ 36,647
	LT (n>5)	0.10	10.79	1.42	1,560.86	€ 102,381	€ 5,911	€ 1,773,215
Comorbidities at baseline	T2D	0.01	1.52*	1.12	2.05			
	CVD	0.65	1.09	0.74	1.57			
	Obesity	0.87	1.02	0.77	1.38			

† assuming the average age of the patients, and reference values for gender and comorbidities. The intercept refers to the baseline value of the outcome (in this case, costs) when all predictors in the model are set to zero.
Pr > t = Probability t-statistic, represents the p-value associated with a t-test. Significant values are indicated by * (P < 0.05)

CONCLUSION

- **This study builds upon an earlier analysis with a 1-year baseline period, extending the timeframe to capture a broader cohort of patients with ESLD at baseline, confirming earlier findings.**
- **Patients identified as non-ESLD at baseline progressed rapidly to CC within two years, likely reflecting delayed diagnosis and inadequate management of MASH.**
- **Findings suggest that patients in Germany often present late in the disease course, underscoring the need for earlier detection, diagnosis, and treatment.**
- **The economic burden of MASH in Germany is substantial, particularly among patients progressing to advanced ESLD stages, where healthcare costs are significantly higher.**
- **Results reinforce the global need for strategies promoting early detection and intervention to prevent late-stage progression and reduce economic impact.**
- **Limitations: German claims data lack clinical parameters and are primarily collected for reimbursement purposes. Patient identification relied on recorded MASH diagnoses, which may lead to underrepresentation of true prevalence due to undercoding and missed cases.**

DISCLOSURES AND ACKNOWLEDGEMENTS

Madrigal Pharmaceuticals Inc. provided the funding for this research, which was conducted by Pharmalex GmbH (former Xcenda GmbH), part of Cencora Inc. The data analysis was performed in cooperation with Wolfgang Greiner and the Institute for Applied Health Research Berlin (InGef).

REFERENCES

1. Younossi ZM, Golabi P, Paik JM, et al. The global epidemiology of nonalcoholic fatty liver disease (NAFLD) and nonalcoholic steatohepatitis (NASH): a systematic review. Hepatology. 2023;77(4):1335-47. Epub 2023/01/11. doi: https://doi.org/10.1097/hep.0000000000000004.
2. Estes C, Anstee QM, Arias-Loste MT, et al. Modeling NAFLD disease burden in China, France, Germany, Italy, Japan, Spain, United Kingdom, and United States for the period 2016-2030. J Hepatol. 2018;69(4):896-904. Epub 2018/06/11. doi: https://doi.org/10.1016/j.jhep.2018.05.036.

SCAN QR CODE FOR DIGITAL POSTER

Madrigal