**Background**

- Many payers, particularly state Medicaid programs with a large burden of chronic hepatitis C (HCV) patients, limit access to direct-acting antivirals (DAAs) to patients with marked fibrosis, citing high regimen costs as a necessity to prioritize patients for treatment.  
- Liver fibrosis has been used as a marker for prioritizing patients, giving highest priority to patients with METAVIR fibrosis scores of F3 or F4. A higher score indicates higher disease severity.  
- Analysis tools using claims data to estimate fibrosis scores and utilization of health care resources in a specific population would be valuable to payers that are considering lessening coverage requirements based on fibrosis score thresholds.

**Objective**

- To develop and assess a method for determining the METAVIR fibrosis score for patients diagnosed with HCV utilizing a health plan’s administrative paid claims data.

**Methods**

- Historical, cross-sectional cohort from a Medicaid payer perspective  
- Two data sources were used: 1) prior authorization (PA) requests from the patient management system, and 2) Medicaid paid claims data.  
- Inclusion criteria: adult Oklahoma Health Care Authority (OHCa) Medicaid members (18-64 years) diagnosed with chronic HCV and who had a PA submission (i.e., both approved and unapproved requests) for treatment with one of the newer DAAs during the study period of 07/01/2014-10/31/2017; up to 1 year pre-index period was utilized with ≥6 months continuous eligibility.  
- Exclusion criteria included members with dual-Medicare eligibility; history of or complications from a liver transplantation; and members without hospital, medical, or pharmacy claims during their study period  
- The primary outcome was METAVIR fibrosis score, an ordinal measure, with categories consisting of F0, F1, F2, F3, and F4  
- Proportional-odds ordered logit model was specified using robust statistical inference via Huber-White standard errors (heteroscedasticity consistent) for all cases and non-cirrhotic cases; a sensitivity analysis with a forward-stepwise logit regression was conducted, implementing p<0.10 for variable removal and p<0.05 for variable addition  
- Support Vector Machines (SVM), a machine learning algorithm for classification and regression analyses, was specified with a multiclass (i.e., class-against-class method), full model, radial basis function kernel; tuning was conducted via modifications of margin of error parameters and gamma scaling factors in the nonlinear kernel as a scaling factor for linear components, with findings calculated as a percentage that were support vectors.

**Results**

**Objective 1: Multivariable Regression Analysis for Outcome of METAVIR Fibrosis Score among Medicaid Beneficiaries with Hepatitis C**

<table>
<thead>
<tr>
<th>Model</th>
<th>Overall Pseudo R²</th>
<th>95% CI</th>
<th>8.00%</th>
<th>0.508</th>
<th>2.401</th>
<th>Liver</th>
<th>1.424*</th>
<th>0.988</th>
<th>0.923</th>
<th>0.785</th>
<th>7.546**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>0.620</td>
<td>(0.393,47.302)</td>
<td>(1.215,2.355)</td>
<td>(0.242,1.065)</td>
<td>(0.848,5.171)</td>
<td>(1.162,2.411)</td>
<td>(0.278,1.836)</td>
<td>(0.510,3.167)</td>
<td>(0.397,2.458)</td>
<td>(0.404,1.529)</td>
<td>(0.457**</td>
</tr>
<tr>
<td>Stepwise</td>
<td>0.668</td>
<td>(0.397,47.302)</td>
<td>(1.215,2.355)</td>
<td>(0.242,1.065)</td>
<td>(0.848,5.171)</td>
<td>(1.162,2.411)</td>
<td>(0.278,1.836)</td>
<td>(0.510,3.167)</td>
<td>(0.404,1.529)</td>
<td>(0.457**</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>0.735</td>
<td>(0.404,1.529)</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
</tr>
<tr>
<td>t 2017</td>
<td>0.786</td>
<td>(0.404,1.529)</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
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<td>(0.457**</td>
</tr>
<tr>
<td>t 2016</td>
<td>0.826</td>
<td>(0.404,1.529)</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
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<td>(0.457**</td>
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<td>(0.457**</td>
</tr>
<tr>
<td>t 2015</td>
<td>0.866</td>
<td>(0.404,1.529)</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
<td>(0.457**</td>
</tr>
<tr>
<td>t 2014</td>
<td>0.970</td>
<td>(0.404,1.529)</td>
<td>(0.457**</td>
<td>(0.457**</td>
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</tbody>
</table>

**Objective 2: Predictive Modeling of Hepatitis C Treatment Utilization Among Medicaid Beneficiaries with Hepatitis C**

- A total of 1,096 Medicaid members were eligible for the study  
- Average age 48.8±10.6 years, 43.3% were male, 68.8% were genotype-1  
- Notable univariable associations with increasing METAVIR score and clinical comorbidities included: increased percentage of GERD, diabetes, CHF, and Deyo-Charlson scores (p<0.05); most clinical associations were consistent among non-cirrhotic cases, though noting insignificant associations with METAVIR scores and ascites (p=0.185)  
- The multivariable analysis across all cases indicated significantly higher associations (p<0.05) with higher METAVIR scores and several factors including male sex (OR=1.82), age (OR=1.05), genotype other than 1 (OR=1.67), DAA treatment length (OR=1.19), diabetes (OR=1.69), Hepatocellular carcinoma (OR=5.45), cirrhosis (OR=21.23), varices (OR=7.55), and GERD (OR=1.42)

**Limitations**

- METAVIR scoring was based on MD-reported PA submissions using various techniques (e.g., biopsy, non-invasive scoring methods)  
- Liver-related comorbidities and extrapathic manifestations of Hepatitis C may be associated with varying standards of care and clinician perception  
- Administrative claims data are for billing purposes and may contain errors  
- Caution should be exerted concerning generalizability to other health care settings and patient populations.

**Conclusions**

- This investigation observed numerous multivariable clinical associations with METAVIR fibrosis scores in Medicaid members, with machine learning suggesting moderate to strong predictive capabilities when tuned.  
- Information extracted from administrative claims data may be suitable for categorizing chronic HCV patients by METAVIR classification, without availability of actual laboratory results.  
- Disease severity prediction via a claims-based proxy may assist policymakers with appropriate resource allocation and benefit design.

**Disclosure Statement**

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