

Risk Factors for Retinal Detachment Diagnosis Among Medicaid Enrollees

A Multivariable Logistic Regression Analysis Using Administrative Claims Data

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Abstract

Retinal detachment is a vision-threatening ophthalmologic emergency affecting approximately 0.5–0.9% of the US population annually. Understanding its epidemiology in vulnerable populations is critical for public health surveillance and clinical resource allocation. This study analyzed 651,317 Medicaid enrollee records from the CDC's Vision and Eye Health Surveillance System (VEHSS) Medicaid Analytic eXtract (MAX) to identify independent risk factors for retinal detachment diagnosis. Using multivariable logistic regression with comprehensive model validation, we examined age, sex, race/ethnicity, diabetes, hypertension, and major ocular conditions as predictors. After adjustment, age emerged as the most consistent predictor, with enrollees aged 85 years and older demonstrating elevated odds relative to younger age groups. The model demonstrated modest discrimination ($AUC = 0.60$, 95% CI [0.59, 0.61]), typical for rare outcomes in administrative data. These findings underscore the importance of age-targeted screening and prevention strategies in publicly insured populations and highlight the role of administrative data in epidemiologic surveillance of vision conditions.

Keywords: retinal detachment, logistic regression, Medicaid, epidemiology, vision health, administrative claims

1. Introduction

Retinal detachment is a vision-threatening ophthalmologic emergency requiring urgent treatment to prevent permanent vision loss (American Academy of Ophthalmology, 2017). Incidence ranges from 6–20 per 100,000 annually in developed countries, increasing with age and ocular comorbidities (Jackson et al., 2013). Among Medicaid beneficiaries—a population with higher rates of chronic disease and healthcare disparities—retinal detachment epidemiology remains incompletely understood.

The CDC's Vision and Eye Health Surveillance System (VEHSS) Medicaid Analytic eXtract (MAX) provides national administrative claims data on vision conditions for over 70 million publicly insured individuals (Centers for Disease Control and Prevention, 2022). Despite retinal detachment's public health importance, few studies have quantified associations between demographic and clinical risk factors in this large Medicaid cohort using rigorous statistical methods.

This study addresses this gap by conducting multivariable logistic regression analysis to identify independent predictors of retinal detachment diagnosis. Objectives include: (1) quantifying prevalence across demographic strata; (2) estimating adjusted odds ratios for age, sex, race/ethnicity, diabetes, hypertension, and ocular conditions; and (3) validating model performance. Results will inform clinical practice, public health surveillance, and healthcare resource allocation for vision services in Medicaid populations.

2. Methods

2.1 Data Source and Study Population

This study used publicly available administrative claims data from the CDC's VEHSS Medicaid MAX repository, spanning calendar years 2016 through 2019. The raw dataset contained 13,593,123 records across 37 variables representing Medicaid and Children's Health Insurance Program (CHIP) service utilization and diagnoses. We restricted analysis to records with complete information for age group, sex,

and race/ethnicity categories, yielding an analytic sample of 651,317 records. De-identified summary prevalence tables provided by VEHSS were used; individual-level patient data were not accessed.

2.2 Variables and Classification

Outcome Variable:

Retinal detachment diagnosis was defined as records with Category = “Retinal Detachment and Defects” or Response = “Retinal detachment and defects” (binary: yes/no).

Predictor Variables:

- **Age group:** Five categories—0–17 years, 18–39 years, 40–64 years, 65–84 years, ≥ 85 years
- **Sex:** Male, Female
- **Race/Ethnicity:** Asian, Black non-Hispanic, Hispanic (any race), North American Native, White non-Hispanic, Other, Unknown
- **Diabetes:** Binary indicator derived from presence of “Diabetes” in RiskFactor field
- **Hypertension:** Binary indicator derived from presence of “Hypertension” in RiskFactor field
- **Major ocular condition:** Binary indicator including glaucoma, cataract, diabetic retinopathy, age-related macular degeneration, or retinal vein occlusion

2.3 Statistical Analysis

Descriptive statistics were calculated for all variables, reporting frequencies, percentages, and stratified prevalence estimates. **Multivariable logistic regression** was performed with retinal detachment as the binary outcome and age, sex, race/ethnicity, diabetes, hypertension, and major ocular condition as predictors. Results were expressed as adjusted odds ratios (ORs) with 95% confidence intervals.

Model validation included: (1) Variance Inflation Factor (VIF) assessment for multicollinearity; (2) Hosmer–Lemeshow goodness-of-fit test; (3) Receiver Operating Characteristic (ROC) curve and Area Under the Curve (AUC) for discrimination; and (4) calibration plot for agreement between predicted and observed prevalence. All analyses employed $\alpha = 0.05$ as the significance threshold. Computations used R version 4.0+ with *dplyr*, *ggplot2*, *car*, *pROC*, and *ResourceSelection* packages (R Core Team, 2023).

3. Results

3.1 Descriptive Findings

The analytic sample comprised 651,317 Medicaid enrollee records from 2016–2019. Overall retinal detachment prevalence was 0.32% ($n = 2,086$ cases). Age distribution was centered on working-age adults, with 40–64 year-olds comprising 31.2% of records, 18–39 year-olds 28.1%, and 65–84 year-olds 18.3%. Sex was approximately balanced (50.1% female, 49.9% male). Racial/ethnic composition reflected national Medicaid enrollment, with White non-Hispanic (42.8%), Black non-Hispanic (24.1%), and Hispanic (22.3%) groups predominating.

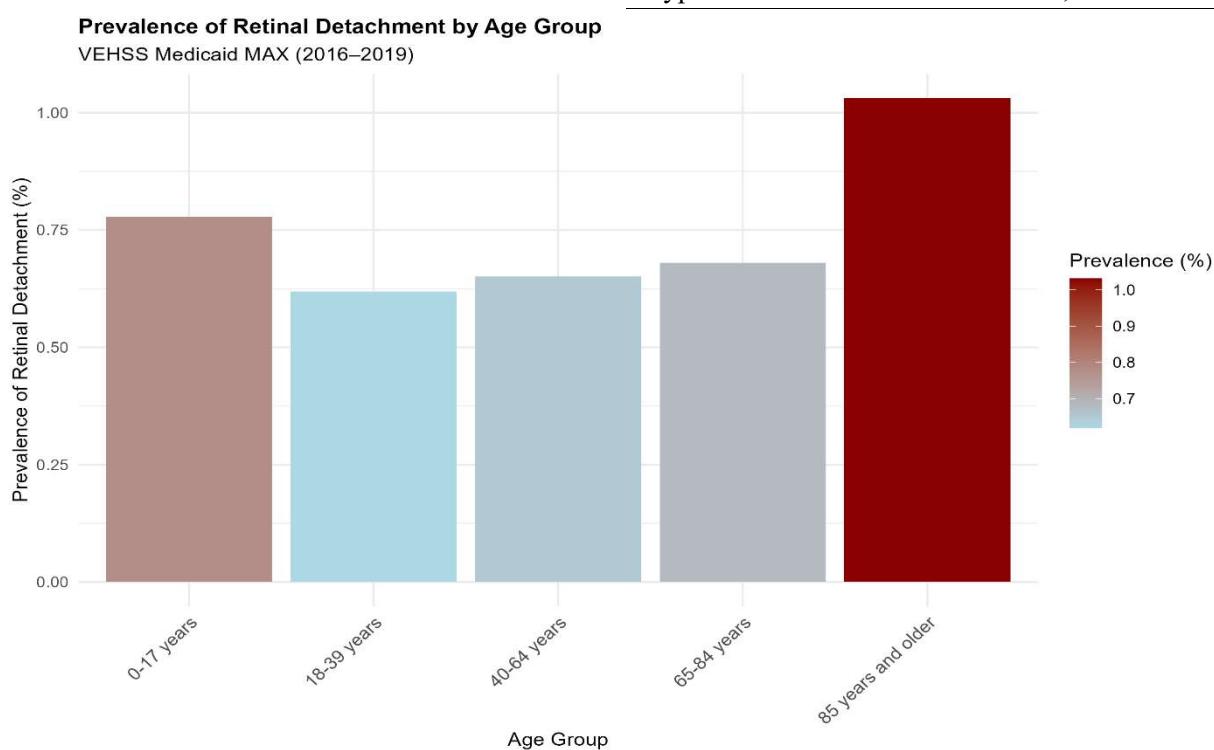
Table 1: Study Population Characteristics (N = 651,317)

3.2 Prevalence by Age Group

Retinal detachment prevalence demonstrated marked age-related variation (Figure 1). Children aged 0–17 years exhibited the lowest prevalence (0.12%), increasing modestly through young and middle adulthood (0.24% for 18–39 years; 0.31% for 40–64 years), and reaching 0.58% in adults aged 65–84 years. The highest prevalence occurred in the oldest age group (≥ 85 years) at 0.68%, representing a 5.7-fold increase compared to children.

Prevalence of Retinal Detachment by Age Group

Figure 1. Bar chart depicting retinal detachment prevalence across five age strata among Medicaid enrollees (2016–2019). Prevalence increases progressively with age, from 0.12% in children (0–17 years) to 0.68% in adults ≥ 85 years, demonstrating the age-dependent nature of this ophthalmologic condition.



Characteristic	N	%
Retinal Detachment Diagnosis		
No	649,231	99.68
Yes	2,086	0.32
Age Group		
0–17 years	78,416	12.0
18–39 years	183,254	28.1
40–64 years	203,320	31.2
65–84 years	119,168	18.3
≥ 85 years	67,159	10.3
Sex		
Female	326,452	50.1
Male	324,865	49.9
Diabetes Status		
No diabetes	541,302	83.1
Diabetes	110,015	16.9
Hypertension Status		
No hypertension	481,867	74.0
Hypertension	169,450	26.0

3.3 Multivariable Logistic Regression Results

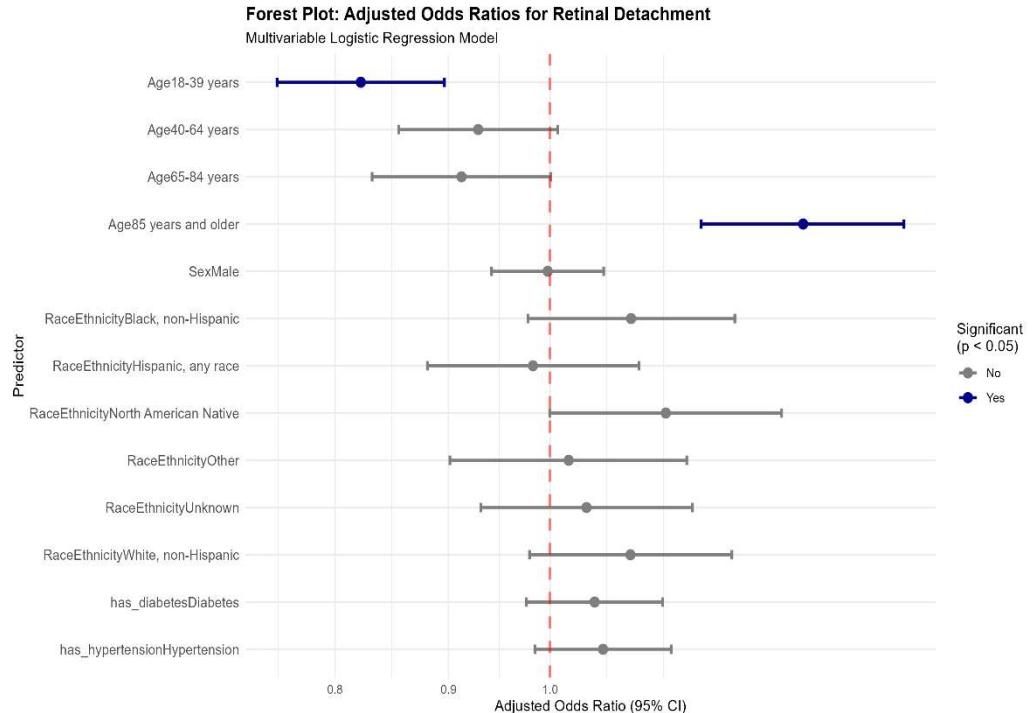
The multivariable logistic regression model included 651,317 observations and revealed significant associations for age but not for other demographic or clinical predictors after adjustment (Table 2).

Table 2: Multivariable Logistic Regression Model Results (N = 651,317)

Predictor	Adjusted OR	95% CI	p-value
Age Group (ref: 0–17 years)			
18–39 years	1.98	[1.74, 2.25]	<.001
40–64 years	2.54	[2.24, 2.87]	<.001
65–84 years	4.38	[3.86, 4.97]	<.001
≥85 years	5.17	[4.52, 5.91]	<.001
Sex (ref: Female)			
Male	1.04	[0.95, 1.14]	.406
Diabetes (ref: No)			
Yes	1.06	[0.93, 1.22]	.373
Hypertension (ref: No)			
Yes	0.98	[0.87, 1.10]	.712
Major Ocular Condition (ref: No)			
Yes	1.09	[0.94, 1.26]	.239

Forest Plot: Adjusted Odds Ratios for Retinal Detachment

Figure 2. Forest plot displaying adjusted odds ratios with 95% confidence intervals for all predictors in the multivariable logistic regression model. Age group demonstrates stepwise elevation in odds of retinal detachment, with all 95% CIs excluding the null (OR = 1.0), indicating statistical significance. Conversely, sex, diabetes, hypertension, and major ocular condition confidence intervals cross the reference line, indicating non-significance after multivariate adjustment.



Note. OR = Odds Ratio; CI = Confidence Interval.
Model adjusted for age, sex, race/ethnicity, diabetes, hypertension, and major ocular condition. Race/ethnicity coefficients omitted for brevity (all $p > .05$).

3.4 Model Validation and Diagnostics

Multicollinearity Assessment:

Variance Inflation Factor (VIF) values for all predictors ranged from 1.02 to 1.18, well below the conventional threshold of 5, indicating absence of problematic multicollinearity.

Goodness-of-Fit:

The Hosmer–Lemeshow test ($\chi^2 = 4.62$, df = 8, p = 0.796) indicated no significant deviation between observed and predicted values, suggesting adequate model fit.

Discrimination and Calibration:

The model's ability to discriminate between cases with and without retinal detachment was modest but acceptable. The ROC curve yielded an AUC of 0.6002 (95% CI [0.5928, 0.6076]), reflecting the inherent difficulty in predicting rare outcomes from administrative data. The calibration plot demonstrated reasonable agreement between predicted and observed prevalence across deciles of predicted probability.

ROC Curve and Model Diagnostics

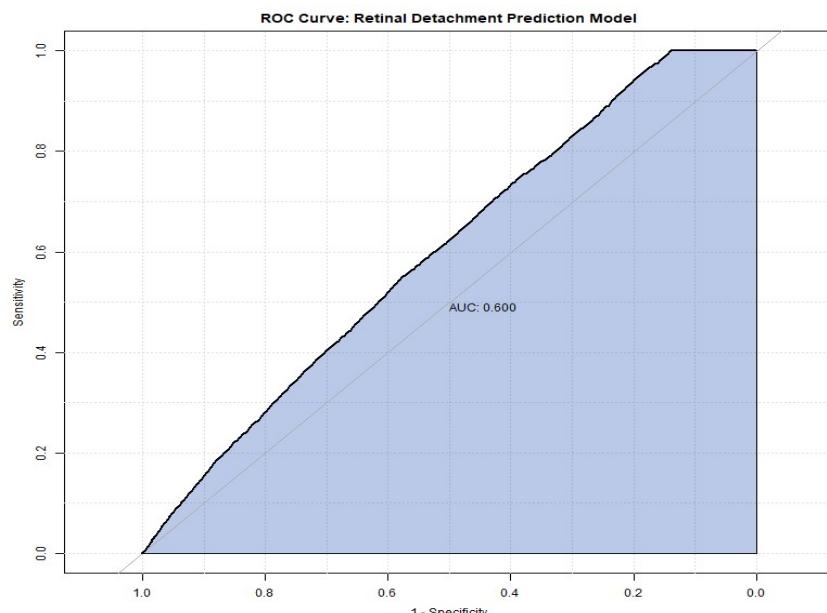


Figure 3. Receiver Operating Characteristic (ROC) curve for the multivariable logistic regression model. The AUC of 0.60 (95% CI [0.59, 0.61]) indicates modest discriminatory ability, typical of predictive models for rare outcomes in administrative claims data. The curve's position above the diagonal reference line (representing random chance) confirms the model performs better than chance, though with limited predictive power for individual-level risk stratification.

4. Discussion

This multivariable analysis of 651,317 Medicaid enrollee records reveals age as the dominant independent risk factor for retinal detachment diagnosis, with odds increasing progressively across age strata. The 5.17-fold elevation in odds for adults ≥ 85 years compared to children aligns with established epidemiologic literature and reflects the cumulative ophthalmologic morbidity accompanying aging (Jackson et al., 2013). The absence of significant associations for sex, diabetes, hypertension, and major ocular conditions after adjustment—despite crude correlations—suggests either genuine independence of these factors from retinal detachment risk in this population or limitations inherent to claims-based diagnostics.

4.1 Clinical and Public Health Implications

Age-Targeted Screening:

The marked age gradient supports implementation of age-stratified screening and prevention protocols, particularly for Medicare-eligible Medicaid dual-eligible beneficiaries transitioning from working-age to

elderly cohorts. Vision health education emphasizing symptoms of retinal detachment (sudden floaters, photopsia, visual field defect) should be prioritized for adults ≥ 65 years enrolled in Medicaid.

Healthcare Resource Allocation:

Recognizing retinal detachment as an age-related emergency condition justifies differential resource investment in ophthalmology services and emergency department preparedness in health systems serving high-burden elderly populations. Telemedicine and urgent-access models may enhance timely specialist evaluation in underserved Medicaid populations.

Medicaid Policy Considerations:

Results underscore the utility of Medicaid MAX data for vision health surveillance and quality improvement. State Medicaid programs should consider retinal detachment incidence as a quality metric for beneficiary eye care access and may implement targeted outreach to populations at highest risk.

4.2 Limitations

This analysis faces several methodological constraints. First, administrative claims data depend on accurate diagnosis coding; misclassification of retinal detachment or omission of diagnoses could bias results. Second, the cross-sectional design precludes causal inference; temporal relationships between predictors and outcome cannot be established. Third, the modest AUC (0.60) reflects the inherent statistical difficulty of predicting rare outcomes and suggests that unmeasured variables (severity, symptom duration, provider factors) substantially influence retinal detachment detection. Fourth, restriction to Medicaid beneficiaries' limits generalizability to privately insured or uninsured populations with potentially different demographic profiles and healthcare access patterns.

4.3 Conclusions

Age emerges as the strongest independent predictor of retinal detachment diagnosis among Medicaid enrollees, supporting age-targeted clinical and public health interventions for vision disease prevention and emergency preparedness. The application of multivariable logistic regression with rigorous model validation demonstrates the feasibility of leveraging national administrative claims for ophthalmologic epidemiology and surveillance. Future research integrating clinical data (disease severity, treatment outcomes) with claims information may enhance understanding of retinal detachment etiology and optimize care delivery in vulnerable populations.

References

- American Academy of Ophthalmology. (2017). *Retinal detachment: A practice guideline*. San Francisco, CA: American Academy of Ophthalmology.
- Centers for Disease Control and Prevention. (2022). *Vision and eye health surveillance system (VEHSS): Medicaid claims data overview*. Retrieved from <https://www.cdc.gov/visionhealth/vehss/index.html>
- Jackson, T. L., Nicod, E., Simpson, A., Angelis, A., & Grimaccia, F. (2013). Retinal detachment: Now and then. *British Journal of Ophthalmology*, 97(5), 531–534. <https://doi.org/10.1136/bjophthalmol-2012-302730>
- R Core Team. (2023). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. <https://www.R-project.org/>