

Clinical and economic burden of patients with and without light chain (AL) amyloidosis: A matched case-control analysis of insurance claims

A. D'Souza, MD, MS¹; M.S. Broder, MD, MSHS²; A. K. Das, MBBS, MPH, PhD²; E. Chang, PhD²; T.P. Quock^{3*}; I. Sprinz³; A. Conrad³; M.H. Tarbox, MPP²

¹ Medical College of Wisconsin, Milwaukee, WI, USA; ² PHAR (Partnership for Health Analytic Research), Beverly Hills, CA, USA; ³ Prothena Biosciences Inc., South San Francisco, CA, USA.

* Formerly Prothena Biosciences Inc., South San Francisco, CA, USA.

BACKGROUND & OBJECTIVE

- Amyloid light chain (AL) amyloidosis is among the most severe forms of systemic amyloidosis.^{1,2}
 - Prognosis depends on the level of organ involvement, particularly cardiac involvement.
- Healthcare resource utilization (HCRU) and costs are expected to be higher in persons with AL amyloidosis than those without; however, real-world estimates of HCRU and costs are limited.³
 - Many older studies used the International Classification of Diseases, Ninth Edition, Clinical Modification (ICD-9-CM) diagnosis codes 277.30 or 277.39 to identify patients, and these codes are not specific to AL amyloidosis subtype.⁴⁻⁸
 - ICD-10-CM code E85.81, specific to AL amyloidosis, was introduced in 2017 enabling claims-based research specific to this patient population.
- Objective:** To compare real-world HCRU, including hospitalizations and emergency department (ED) visits, and costs between persons with and without AL amyloidosis.

RESULTS

Demographic and clinical characteristics (Table 1)

- We identified 574 persons with AL amyloidosis and 1,148 non-AL matched controls (2018), 588 persons with AL amyloidosis and 1,176 non-AL matched controls (2019), and 667 persons with AL amyloidosis and 1,334 non-AL matched controls (2020).
- Persons with AL amyloidosis had a higher comorbidity burden than non-AL matched controls (P<0.001 for all years) – Mean (SD) Charlson Comorbidity Index score: 4.2 (2.8) vs. 1.0 (1.8); 4.0 (2.7) vs. 1.0 (1.9); 4.1 (2.8) vs. 1.0 (1.7).

Table 1. Demographic and clinical characteristics of persons with AL amyloidosis and non-AL matched controls

	2018		2019		2020	
	Persons with AL Amyloidosis N = 574	Non-AL Matched Controls ^a N = 1,148	Persons with AL Amyloidosis N = 588	Non-AL Matched Controls ^a N = 1,176	Persons with AL Amyloidosis N = 667	Non-AL Matched Controls ^a N = 1,334
Age, mean (SD) [median]	61.5 (10.2) [61]	61.5 (10.2) [61]	60.8 (9.9) [60]	60.8 (9.9) [60]	62.5 (10.2) [62]	62.5 (10.2) [62]
18-34, n (%)	6 (1.0)	12 (1.0)	5 (0.9)	10 (0.9)	4 (0.6)	8 (0.6)
35-54	117 (20.4)	234 (20.4)	130 (22.1)	260 (22.1)	135 (20.2)	270 (20.2)
55-64	280 (48.8)	560 (48.8)	309 (52.6)	618 (52.6)	311 (46.6)	622 (46.6)
65+	171 (29.8)	342 (29.8)	144 (24.5)	288 (24.5)	217 (32.5)	434 (32.5)
Female, n (%)	259 (45.1)	518 (45.1)	251 (42.7)	502 (42.7)	299 (44.8)	598 (44.8)
Region, n (%)						
Midwest	153 (26.7)	306 (26.7)	189 (32.1)	378 (32.1)	231 (34.6)	462 (34.6)
Northeast	159 (27.7)	318 (27.7)	122 (20.7)	244 (20.7)	121 (18.1)	242 (18.1)
South	182 (31.7)	364 (31.7)	204 (34.7)	408 (34.7)	227 (34.0)	454 (34.0)
West	80 (13.9)	160 (13.9)	73 (12.4)	146 (12.4)	88 (13.2)	176 (13.2)
Insurance type, n (%)						
Commercial	346 (60.3)	692 (60.3)	384 (65.3)	768 (65.3)	380 (57.0)	760 (57.0)
Medicare	140 (24.4)	280 (24.4)	110 (18.7)	220 (18.7)	175 (26.2)	350 (26.2)
Other	88 (15.3)	176 (15.3)	94 (16.0)	188 (16.0)	112 (16.8)	224 (16.8)
CCI, mean (SD) [median]^b	4.2 (2.8) [4]	1.0 (1.8) [0]	4.0 (2.7) [4]	1.0 (1.9) [0]	4.1 (2.8) [4]	1.0 (1.7) [0]
CHF, n (%) ^b	287 (50.0)	53 (4.6)	287 (48.8)	44 (3.7)	360 (54.0)	60 (4.5)
Renal disease ^b	263 (45.8)	56 (4.9)	250 (42.5)	67 (5.7)	315 (47.2)	75 (5.6)
Multiple myeloma ^b	333 (58.0)	2 (0.2)	336 (57.1)	1 (0.1)	374 (56.1)	2 (0.1)

CCI: Charlson Comorbidity Index; CHF: congestive heart failure.

^a Matched by database, age, sex, U.S. geographic region, and type of insurance. ^b P<0.001 for every year.

METHODS

Study design and data source

- Retrospective case-control analysis using 2018-2020 data from the Merative® MarketScan® Commercial and Medicare Supplemental and the IQVIA Pharmetrics Plus® databases.

Patient population

- Adult persons with ≥1 inpatient or ≥2 outpatient claims for AL amyloidosis (ICD-10-CM code E85.81) in any diagnosis field during the calendar year of the study period (1/1/2018-12/31/2020) in the US (existing or newly diagnosed).
- Continuous enrollment in a health plan in each calendar year was required.
- AL amyloidosis-free persons (non-AL matched controls) were drawn from a 5% random sample from the respective database and exactly matched 2:1 to persons with AL amyloidosis on: age, sex, US geographic region, and type of insurance.
 - Non-AL matched controls met the same age and continuous enrollment criteria as persons with AL amyloidosis.

Healthcare utilization and costs

- Compared to non-AL matched controls, persons with AL amyloidosis had:
 - More frequent hospitalizations and ED visits (P<0.001 for all years):
 - 37.6% of persons with AL amyloidosis had hospitalizations (mean [SD] number of hospitalizations: 0.80 [1.42]) and 36.1% had ED visits vs. 6.5% of non-AL matched controls had hospitalizations (mean [SD] number of hospitalizations: 0.09 [0.42]) and 17.1% had ED visits (2018); 39.1% (0.83 [1.50]) and 36.7% vs. 6.0% (0.11 [0.58]) and 15.1% (2019); 39.0% (0.73 [1.30]) and 33.0% vs. 7.3% (0.11 [0.49]) and 14.3% (2020) (**Table 2**).
 - Significantly greater total healthcare costs (P<0.001 for all years):
 - \$175,875 vs. \$12,168 (2018, adjusted to 2020 USD); \$149,338 vs. \$12,330 (2019, adjusted to 2020 USD); \$142,456 vs. \$9,135 (2020) (**Figure 1**).

Table 2. Healthcare utilization^a among persons with AL amyloidosis and non-AL matched controls

	2018		2019		2020	
	Persons with AL Amyloidosis N = 574	Non-AL Matched Controls ^b N = 1,148	Persons with AL Amyloidosis N = 588	Non-AL Matched Controls ^b N = 1,176	Persons with AL Amyloidosis N = 667	Non-AL Matched Controls ^b N = 1,334
Any inpatient hospitalizations, n (%)	216 (37.6)	75 (6.5)	230 (39.1)	71 (6.0)	260 (39.0)	98 (7.3)
No. of inpatient hospitalizations, mean (SD)	0.80 (1.42)	0.09 (0.42)	0.83 (1.50)	0.11 (0.58)	0.73 (1.30)	0.11 (0.49)
Days of stay among utilizers, ^c mean (SD) [median]	18.0 (30.1) [9]	5.3 (6.7) [3]	17.3 (26.1) [9]	11.7 (24.4) [5]	15.6 (18.2) [8]	12.9 (41.5) [4]
Any cardiac-related inpatient hospitalizations, n (%)	53 (9.2)	7 (0.6)	57 (9.7)	10 (0.9)	60 (9.0)	12 (0.9)
No. of cardiac-related inpatient hospitalizations, mean (SD)	0.12 (0.42)	0.02 (0.14)	0.14 (0.54)	0.05 (0.34)	0.14 (0.55)	0.03 (0.17)
Any ED visits, n (%)	207 (36.1)	196 (17.1)	216 (36.7)	178 (15.1)	220 (33.0)	191 (14.3)
No. of non-ED outpatient services, mean (SD) [median]	50.9 (43.9) [41]	13.0 (16.1) [8]	49.1 (43.2) [39]	11.9 (14.7) [7]	48.3 (39.1) [39]	11.9 (15.3) [7]
No. of physician office visits, mean (SD) [median]	22.3 (19.3) [17]	9.3 (11.1) [6]	20.9 (16.7) [16]	8.1 (10.0) [5]	19.4 (16.8) [15]	7.4 (9.1) [4]

^a P<0.001 for each variable and every year unless noted. ^b Matched by database, age, sex, U.S. geographic region, and type of insurance.

^c P=0.108 for 2019; P=0.529 for 2020.

- Cases/controls were identified separately from each database, then combined for the final study cohorts.
 - To avoid possible duplicates, one person was randomly excluded among persons with the same gender, region, year of birth, and dates of AL amyloidosis claims.

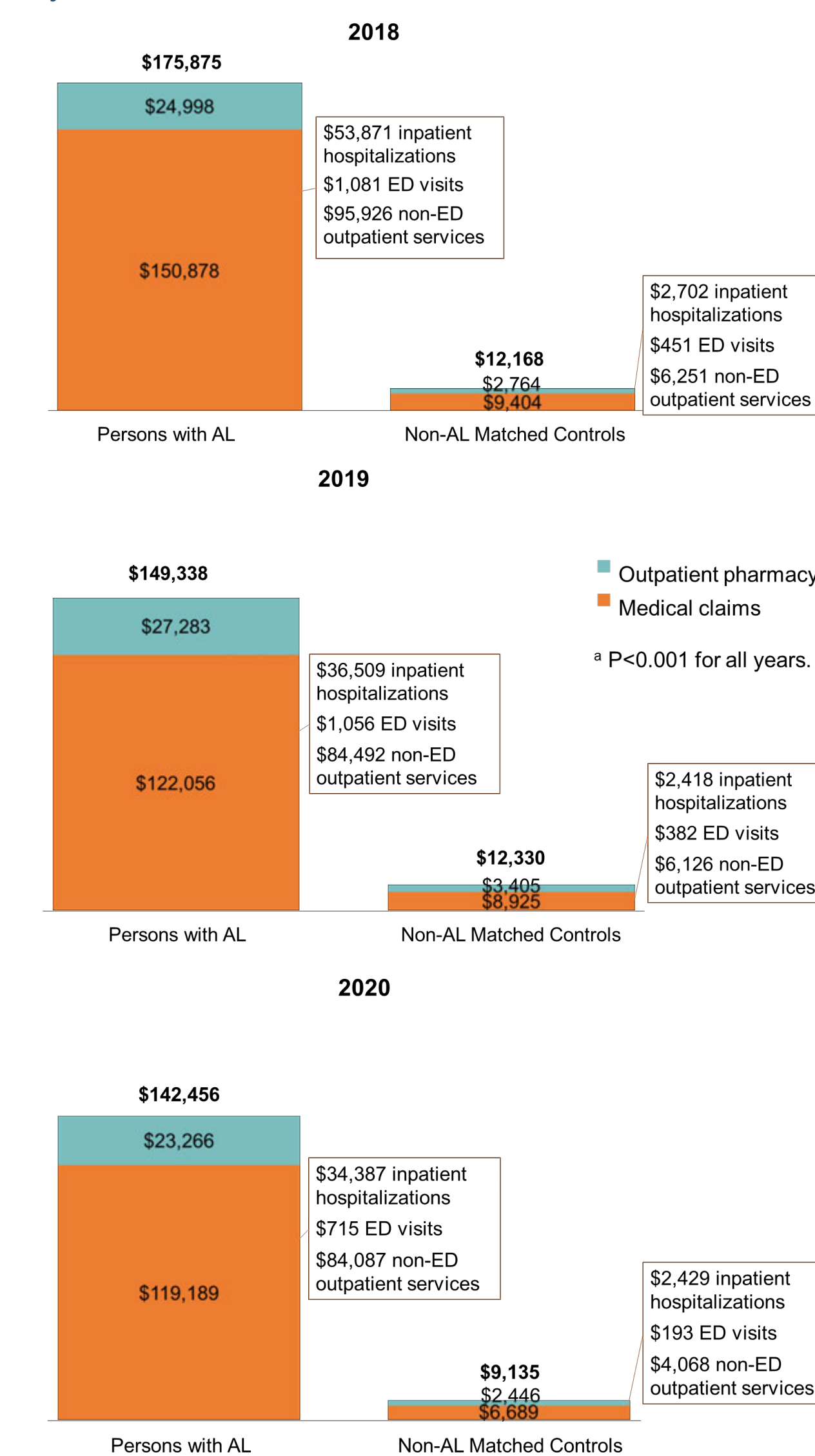
Study measures

- Demographic and clinical characteristics, all-cause HCRU, and costs for the calendar year.

Statistical analysis

- Means, standard deviations (SD), and relative frequencies and percentages were reported for continuous and categorical data, respectively.
- Cost estimates were adjusted to 2020 USD using the Consumer Price Index to adjust for inflation.
- Data transformations and statistical analyses were performed using SAS® version 9.4 (SAS Institute, Cary, NC).

Figure 1. Healthcare costs^a among persons with AL amyloidosis and non-AL matched controls



LIMITATIONS

- Limitations include possible miscoding, a common limitation of claims data research, leading some persons to possibly have been misidentified; however, our methodology for identifying individuals with AL amyloidosis is consistent with previously published work using claims data.^{4,5,8-10}
- This study presents the measures of individuals with varied disease severity; however, we are unable to identify where they are in their AL amyloidosis journey.
- Some persons with AL amyloidosis were included in multiple years, however, each person with AL amyloidosis had a unique matched control in each calendar year. Outcomes (HCRU and costs) were limited to one calendar year even if the patient appeared in multiple years.
- Results may not be generalizable to other populations not covered by commercial and Medicare supplemental insurance.

CONCLUSIONS

- Persons with AL amyloidosis had significantly greater HCRU and costs than matched controls without AL amyloidosis.
- Increased disease awareness, earlier diagnosis, and better treatment options could impact disease prognosis and decrease HCRU/costs.

REFERENCES

- Grogan M, et al. Heart. 2017.
- Al Hamad R, et al. Blood Cancer. 2021.
- Sabinot A, et al. Blood Reviews. 2023.
- Quock TP, et al. J Comp Eff Res. 2018.
- Hari P, et al. Amyloid. 2018.
- Taduru SS, et al. J Card Fail. 2017.
- Isath A, et al. J Arrhythmia. 2020.
- Quock TP, et al. J Comp Eff Res. 2018.
- Hou HA, et al. Sci Rep. 2022.
- Hlavacek P, et al. Future Oncol. 2023.

AUTHOR DISCLOSURES

This analysis was supported by Prothena Biosciences Ltd (Dublin, Ireland), a member of the Prothena Corporation plc group. A Conrad and I. Sprinz are employees of Prothena Biosciences Inc and hold stock in Prothena Corporation plc. TP Quock is a former employee of Prothena Biosciences Inc. A D'Souza is an employee of the Medical College of Wisconsin, was paid by Prothena to consult as a subject matter expert. E Chang, AK Das, MS Broder and MH Tarbox are employees of PHAR, LLC, which received funding from Prothena to conduct the research described.

