

Healthcare resource utilization and costs of patients with warm autoimmune hemolytic anemia: a nationwide population-based study in Taiwan, 2017-2022

Dae Young Yu, PhD¹, Tse-Chih Chou, MS², Shu-Chen Chang, PhD², Hsiao-Wen Kao, MD³, I-Ching Tsai¹, Ann Leon⁴, Concetta Crivera⁴, Alexis Krumme⁴, Chee Jen Chang, PhD^{2,5,6,7,8}, David Bin-Chia Wu, PhD^{1,9,10}

¹Johnson & Johnson, Singapore; ²Research Services Center for Health Information, Chang Gung University, Taoyuan, Taiwan; ³Division of Hematology-Oncology, Department of Internal Medicine, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan; ⁴Johnson & Johnson, USA; ⁵Department of Artificial Intelligence, Chang Gung University, Taoyuan, Taiwan; ⁶Institute of Health Data Science, Chang Gung University, Taoyuan, Taiwan; ⁷Department of Biomedical Sciences, Chang Gung University, Taoyuan, Taiwan; ⁸Clinical Trial Center, Chang Gung Memorial Hospital at Linkou, Taoyuan, Taiwan; ⁹Saw Swee Hock School of Public Health, National University of Singapore; ¹⁰School of Pharmacy, Faculty of Health & Medical Sciences, Taylor’s University Malaysia

Background

- Autoimmune hemolytic anemia (AIHA) is a rare and potentially life-threatening autoimmune disorder caused by autoantibody-mediated premature destruction of healthy red blood cells.^{1,2}
- Warm autoimmune hemolytic anemia (wAIHA) is the most common subtype (70–80%) of AIHA in which the antibodies bind to and attack red blood cells at normal body temperature.^{3,4} Patients with wAIHA have higher all-cause mortality than the general population.⁵

Objective

- There is limited evidence quantifying the healthcare burden of wAIHA, especially in Asia-Pacific.
- The objective of this study was to evaluate healthcare resource utilization (HCRU) and the costs of wAIHA management using a nationwide population-based claims database in Taiwan.

Methods

Data sources

- Data were collected from the National Health Insurance Research Database (NHIRD),⁶ which covers more than 99% of Taiwan’s population, linked with the Taiwan Cancer Registry and National Death Registry.
- This study was approved by the Chang Chung Medical Foundation Institutional Review Board (IRB No. 202400013B0)

Study design and population

- This is a retrospective observational study
- Patients aged ≥18 years with ≥1 diagnosis codes of AIHA (ICD-10 codes starting with D59.1), ≥6 months pre-index enrolment along with at least 12-month post-index period, and on the same claim with ≥1 record of wAIHA-related treatments such as corticosteroids or non-steroidal immunosuppressants on or after the index date (the date of the first observed diagnosis code of AIHA) between January 1, 2017, and December 31, 2022 (Data from 2016 were used for wash-out).
- Patients were categorized as primary or secondary wAIHA based on the presence of underlying diseases. Secondary wAIHA cases included patients with hematologic malignancies, solid tumour (ovarian cancer), immunodeficiencies, or autoimmune diseases within (±) 180 days of the index date and specified infections, i.e. HIV, tuberculosis, brucellosis, or babesiosis ≤180 days before to ≤14 days after the index date; or Hepatitis B or C ≤28 days before to ≤14 days after the index date.

Resource utilization and Cost analysis

- All-cause HCRU was defined as resource use associated with any medical or pharmacy services, regardless of wAIHA diagnosis. Total costs included all direct medical costs from inpatient, outpatient, emergency department, and pharmacy services. Annualised medical costs were calculated by summing total healthcare expenditures during each patient’s follow-up period and dividing by the number of follow-up days, then multiplying by 365 days. All costs were adjusted to 2022 TWD values based on Taiwan’s consumer price index and reported in 2022 TWD and USD.
- To identify major cost drivers, a generalised linear model (GLM) was used with a Gamma distribution and log-link function to account for the right-skewed distribution of the cost data. Independent variables used in the model included age, sex, Charlson Comorbidity Index (CCI), type of wAIHA, and numbers of hospitalisations (excluding intensive care unit [ICU]), ICU admissions, emergency room visits, physician visits, blood transfusions, and intravenous immunoglobulin (IVIG) infusions. Exponentiated coefficients represent the relative change in mean cost associated with each covariate. Values above 1 indicate a higher cost, and values below 1 indicate a lower cost, relative to the reference group or per unit increase.

Results

Table 1. Patients Characteristics

Variable	N (%)
N	1,079
Follow-up period (mean, median, min-max)	3, 3, 1-6
Sex - female (n, %)	709 (65.71%)
Age (mean, SD)	54.95 , 17.49
Primary wAIHA (n, %)	769 (71.27%)
CCI (n, %)	
0	613 (56.81%)
1	246 (22.8%)
2	128 (11.86%)
3	49 (4.54%)
>3	43 (3.99%)
CCI (mean, SD)	0.8 , 1.23

- A total of 1,079 patients were identified, with a median follow-up duration of 3 years. The cohort was predominantly female (65.7%, n = 709), and the mean age at diagnosis was 55.0 years (SD = 17.5). Primary wAIHA accounted for the majority of cases (71.3%, n = 769).

Table 2. All-cause healthcare resource utilisation

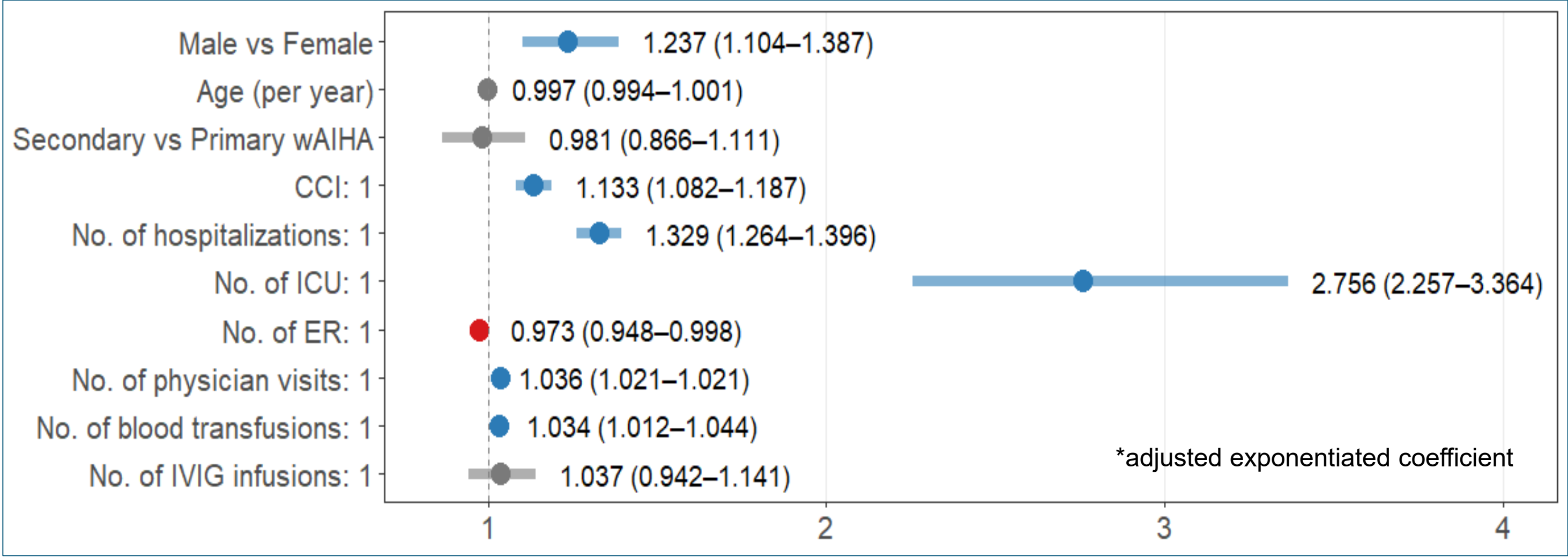
Parameter	(N=1,079)
% of Patients Utilizing Services	n (%)
Outpatient visits	1,078 (99.9%)
Hospitalisation (excluding ICU)	906 (84.0%)
ICU admissions	229 (21.2%)
ER visits	813 (75.4%)
Utilization rate (per patient year)	
Outpatient visits	25.19
Hospitalization (excluding ICU)	1.31
ICU admissions	0.48
ER visits	1.36
Length of stay (days)	
Hospitalization (excluding ICU)	Mean: 10; Median: 7; IQR: 4–12; Range: 1–394
ICU	Mean: 10; Median: 5; IQR: 3–9; Range: 1–373

- Hospitalisation occurred in 84% of patients (1.31 admissions per patient-year; average stay: 10 days). ICU admissions were seen in 21.2% (0.48 per patient-year; average stay: 10 days). Additionally, 75% visited the ER.

Table 3. All-cause medical costs

Parameter	Mean	Median	IQR	Min-max
Cost per hospitalisation event				
USD	3,136	1,700	1,032–3,080	76–228,669
TWD	100,352	54,400	33,024–98,560	2,432–7,317,408
Cost per ICU admission mean				
USD	5,030	2,094	1,049–5,036	180–132,856
TWD	160,960	67,008	33,568–161,152	5,760–4,251,392
Annualised medical cost per patient				
USD	8,458	3,327	1,534–8,933	18–296,252
TWD	270,656	106,464	49,088–285,856	576–9,480,064

Table 4. Cost drivers for all-cause medical costs



- Top 3 cost drivers are ICU admission (adjusted cost ratio: 2.756; 95% CI: 2.257–3.364), followed by additional hospitalizations (1.329; 95% CI: 1.264–1.396) and male gender (1.237; 95% CI: 1.104–1.387).

Conclusions

- This study demonstrates that wAIHA is associated with high healthcare utilization and significant costs.
- Key cost drivers include ICU admissions, additional hospitalizations, and male gender.
- These findings highlight the need for new treatment strategies that offer sustained disease control to reduce hospital and ICU admissions, ultimately lowering the overall disease burden and improving patient outcomes.

1. Eaton WW, et al. J Autoimmun. 2007;29(1):1-9. 2. Zanella A, Barcellini W. Haematologica. 2014;99(10):1547–1554. 3. Hill A, Hill QA. Hematology Am Soc Hematol Educ Program. 2018;2018(1):382–389. 4. Kalfa TA. Hematology Am Soc Hematol Educ Program. 2016;2016(1):690–697. 5. EHA Library. Kjellander C. 06/14/2025; 4161269; PS2195. 6. Hsieh CY et al. Clin Epidemiol. 2019;11:349–358.