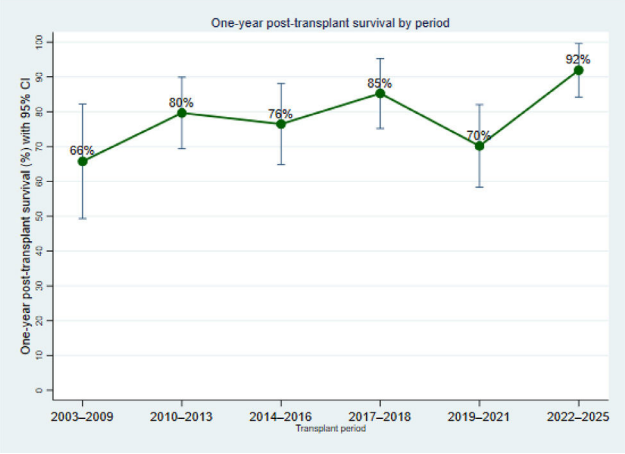
Table 1. Recipient and donor characteristics over time (n=305).

	2003–2009 (n=33)	2010–2013 (n=59)	2014–2016 (n=51)	2017–2018 (n=48)	2019–2021 (n=57)	2022–2025 (n=57)
RECIPIENT						
Age (median, IQR)	55.2 (45.5–59.8)	56.6 (48.6–61.6)	56.2 (48.6–62.0)	54.6 (46.3–62.0)	58.8 (50.1–64.9)	54.2 (42.8–60.2)
Male	67%	56%	61%	65%	72%	56%
BMI (median, IQR)	23.0 (22.0–27.0)	24.0 (22.0–27.0)	24.0 (22.0–30.0)	24.0 (22.0–28.0)	26.0 (24.0–29.0)	24.0 (21.0–25.0)
Diabetes	17%	38%	33%	29%	46%	33%
Dyslipidemia	14%	19%	18%	13%	23%	17%
Chronic RRT*	64%	51%	59%	58%	46%	61%
MELD-Na (median, IQR)	28.0 (23.8–33.2)	23.7 (20.2–30.7)	24.0 (19.6–31.5)	22.5 (20.1–27.3)	21.3 (16.9–27.0)	22.5 (18.7–27.5)
MELD exception	32%	34%	32%	36%	37%	54%
Cirrhosis vs liver PKD**	82% / 12%	63% / 27%	69% / 23%	73% / 19%	72% / 12%	56% / 26%
CIRRHOSIS ETIOLOGY						
MASLD	11%	19%	31%	17%	29%	37%
ALD	26%	32%	11%	49%	46%	25%
HCV	37%	38%	23%	20%	19%	19%
HBV	7%	3%	0%	14%	7%	9%
PBC	0%	5%	11%	6%	2%	6%
AIH	4%	5%	9%	6%	5%	6%
CKD ETIOLOGY						
Diabetic nephropathy	6%	22%	23%	19%	26%	26%
Hypertensive nephropathy	3%	15%	2%	8%	7%	14%
Glomerulonephritis	15%	14%	14%	19%	5%	5%
PKD	15%	29%	23%	21%	16%	32%
Other/Unknown	54%	34%	47%	35%	46%	40%
DONOR						
Age (median, IQR)	32.0 (20.0–46.0)	32.5 (21.5–42.5)	34.0 (27.0–50.0)	32.0 (20.5–42.0)	41.0 (27.0–53.0)	34.0 (25.0–46.0)
Male	66%	59%	68%	75%	58%	54%
BMI (median, IQR)	24.0 (22.5–27.0)	24.0 (23.0–28.0)	25.0 (24.0–26.5)	24.5 (23.0–26.0)	26.0 (23.0–28.0)	25.0 (23.0–27.0)
Creatinine (median, IQR)	1.0 (0.6-1.2)	1.0 (0.7-1.1)	0.9 (0.7-1.1)	0.9 (0.8-1.2)	1.0 (0.6-1.3)	0.9 (0.7-1.1)
Na (median, IQR)	152.5 (141.0–164.0)	151.0 (145.0–158.0)	151.0 (149.0–157.0)	150.0 (145.0–161.0)	150.0 (144.0–157.0)	151.5 (145.5–160.0)

* Chronic RRT includes patients on maintenance dialysis or with prolonged need for renal replacement therapy prior to transplant.
** Cirrhosis vs liver PKD refers to the primary liver indication for transplantation. Categories are mutually exclusive.

Abbreviations:
AIH, Autoimmune hepatitis; ALD, Alcohol-related liver disease; BMI, Body mass index; CKD, Chronic kidney disease; HBV, Hepatitis B virus; HCV, Hepatitis C virus; IQR, Interquartile range; MASLD, Metabolic dysfunction-associated steatotic liver disease; MELD-Na, Model for End-Stage Liver Disease–Sodium; Na, Serum sodium; PKD, Polycystic kidney disease; PBC, Primary biliary cholangitis; RRT, Renal replacement therapy.

One-year post-transplant survival by period.



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EVIDENCE-BASED DIGITAL SUPPORT IN HEPATOLOGY: RETRIEVAL-AUGMENTED GENERATION'S ROLE IN AUTOIMMUNE LIVER DISEASES MANAGEMENT

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Introduction and Objectives: Autoimmune liver diseases (AILDs) present significant diagnostic and management challenges. Following our initial evaluation of Large Language Models (LLMs), we developed and assessed three specialized Retrieval-Augmented Generation (RAG) systems. These systems incorporated comprehensive clinical guidelines and medication safety information to enhance decision support accuracy. Our aim was to evaluate the effectiveness of Retrieval-augmented AI systems in providing evidence-based recommendations for AILD management.

Materials and Methods: We engineered three distinct RAG systems: HepaChat, RAG-ChatGPT, and RAG-Claude. Each system integrated 13 international clinical guidelines spanning AIH, PBC, and PSC management. Additionally, we incorporated a comprehensive database containing 12,465 FDA medication warnings to ensure safety protocol adherence. Ten liver specialists (six European, four American) evaluated system responses to 56 standardized clinical questions using a 1-10 Likert scale. Questions addressed disease comprehension, therapeutic approaches, and clinical decision-making across all three major AILDs.

Results: Quantitative analysis revealed HepaChat's superior performance (mean score 7.58±1.48) with 33 best-rated responses, compared to RAG-Claude (7.22±1.58, 12 best-rated) and RAG-ChatGPT (7.21±1.67, 9 best-rated). Geographic stratification unveiled variations in evaluation patterns (Americas: 7.97 vs Europe: 6.40). Disease-specific analysis demonstrated HepaChat's excellence in AIH (Europe: 7.12, Americas: 8.17) and PSC management in Europe (6.89), while achieving optimal performance in AIH and PBC in the Americas (8.17 and 8.37, respectively). All three systems showed marked improvement over conventional LLMs (2023 benchmark: 6.72±1.67).

Conclusions: This evaluation demonstrates that specialized RAG systems incorporating clinical guidelines and safety protocols can significantly enhance AILD management support. Geographic variations in assessment highlight the importance of considering regional clinical perspectives in AI system development.

Conflict of interest: None

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