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Review

Chimeric antigen receptor T cells in autoimmune diseases and allergy: From bench to bedside

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Supplementary

Table S1. Comprehensive classification of all included studies by design, geographic origin, and evidence level.

Ref #	First Author, Year	Study Design	Country	Institution/Region	Evidence Level
1	GBD 2019 Collaborators	Systematic analysis	International	Multi-country global burden study	High
2	Pisetsky 2020	Review article	USA	Duke University, North Carolina	High
3	Rosenblum 2015	Review article	USA	University of California, San Francisco	High
4	Dharmage 2019	Review article	Australia	University of Melbourne	High
5	Loh 2018	Review article	Singapore	National University of Singapore	High
6	Shamji 2021	Review article	UK	Imperial College London	High
7	Meffre 2019	Review article	USA	Yale University, Connecticut	High
8	Arbuckle 2003	Observational cohort study	USA	Walter Reed Army Medical Center	Moderate
9	Gould 2008	Review article	UK	King's College London	High
10	Jiménez-Saiz 2017	Observational study	Canada	McMaster University, Ontario	Moderate
11	Asrat 2020	Preclinical study	USA	University of California, San Francisco	Moderate
12	Md Yusof 2020	Review article	UK	University of Leeds	High
13	Stone 2010	Clinical trial (RCT)	USA	Massachusetts General Hospital	High
14	Furie 2020	Clinical trial (RCT)	International	Multi-country (USA, Europe, Asia)	High
15	Hiepe 2011	Review article	Germany	Charité University Hospital, Berlin	High
16	Reddy 2013	Review article	UK	Cambridge University	Moderate
17	Cambridge 2003	Observational study	UK	University College London	Moderate
18	June 2018	Review article	USA	University of Pennsylvania	High
19	Sterner 2021	Review article	USA	National Cancer Institute	High
20	Maude 2018	Clinical trial	USA	Children's Hospital of Philadelphia	High
21	Schuster 2019	Clinical trial	International	Multi-country (USA, Europe, Australia)	High
22	Ellebrecht 2016	Preclinical study	USA	University of Pennsylvania	Moderate
23	Sadelain 2013	Review article	USA	Memorial Sloan Kettering Cancer Center	High
24	Guedan 2019	Review article	USA	Memorial Sloan Kettering Cancer Center	High
25	Eshhar 1993	Preclinical study	Israel	Weizmann Institute of Science	Moderate
26	Brentjens 2013	Clinical trial	USA	Memorial Sloan Kettering Cancer Center	High
27	Chmielewski 2015	Review article	Germany	University Hospital Cologne	High
28	Alabanza 2017	Preclinical study	USA	Seattle Children's Research Institute	Moderate
29	Kawalekar 2016	Preclinical study	USA	University of Pennsylvania	Moderate
30	Shah 2019	Review article	USA	National Cancer Institute	High
31	Wang 2016	Review article	USA	Memorial Sloan Kettering Cancer Center	High
32	Levine 2017	Review article	USA	University of Pennsylvania	High
33	Fraietta 2018	Observational study	USA	University of Pennsylvania	Moderate
34	Hartmann 2017	Review article	Germany	Paul-Ehrlich-Institut, Langen	High
35	Benjamin 2020	Clinical trial	UK	University College London	High
36	Depil 2020	Review article	France	Cellectis, Paris	High
37	Davenport 2018	Preclinical study	Australia	Monash University, Melbourne	Moderate
38	Martinez 2019	Review article	USA	University of Pennsylvania	High
39	Hay 2017	Observational study	USA	Fred Hutchinson Cancer Center, Seattle	Moderate
40	Melenhorst 2022	Clinical case series	USA	University of Pennsylvania	High
41	Tsokos 2016	Review article	USA	Beth Israel Deaconess Medical Center	High
42	Mariette 2018	Review article	France/USA	Université Paris-Sud/Stanford University	High
43	Allanore 2015	Review article	France	Université Paris Descartes	High
44	Lundberg 2021	Review article	Sweden	Karolinska Institute, Stockholm	High
45	Mougiakakos 2021	Case report	Germany	University Hospital Erlangen	Moderate
46	Park 2018	Clinical trial	USA	Memorial Sloan Kettering Cancer Center	High
47	Khurana 2020	Review article	India	Max Super Speciality Hospital, Delhi	Moderate
48	Wang 2012	Review article	China	Shanghai Jiao Tong University	Moderate
49	Tian 2024	Clinical trial	China	Huazhong University, Wuhan	High

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Ref #	First Author, Year	Study Design	Country	Institution/Region	Evidence Level
51	Dörner 2019	Review article	Germany	Charité University Hospital, Berlin	High
52	Müller 2023	Clinical case series	Germany	University Hospital Erlangen	High
53	Bhoj 2016	Observational study	USA	Children's Hospital of Philadelphia	Moderate
54	Perry 2009	Preclinical study	USA	University of Minnesota	Moderate
55	Kansal 2019	Preclinical study	USA	University of Pennsylvania	Moderate
56	Jin 2021	Preclinical study	China	Shanghai Jiao Tong University	Moderate
57	Schett 2023	Review article	Germany	University Hospital Erlangen	High
58	Chung 2024	Review article	USA	National Cancer Institute	High
59	Amber 2015	Observational study	USA	University of Illinois, Chicago	Moderate
60	Lee 2020	Preclinical study	USA	University of Pennsylvania	Moderate
61	Oh 2023	Preclinical study	USA	University of Pennsylvania	Moderate
62	Ellebrecht 2017	Review article	USA	University of Pennsylvania	High
63	Hauser 2017	Clinical trial (RCT)	International	Multi-country (USA, Europe)	High
64	McInnes 2017	Review article	UK	University of Glasgow	High
65	Zhang 2019	Preclinical study	USA	Indiana University	Moderate
66	Mackensen 2022	Clinical case series	Germany	University Hospital Erlangen	High
67	Franklyn 2016	Observational study	Australia	Monash University, Melbourne	Moderate
68	Yang 2025	Interventional clinical study	China	The First Affiliated Hospital, College of Medicine, Zhejiang University, Hangzhou, Zhejiang	High
69	Hill 2020	Review article	USA	Fred Hutchinson Cancer Center, Seattle	High
70	Lee 2019	Consensus guidelines	International	Multi-country expert panel	High
71	Müller 2024	Clinical case series	Germany	University Hospital Erlangen	High
72	Lundberg 2018	Review article	Sweden	Karolinska Institute, Stockholm	High
73	Khanna 2020	Clinical trial (RCT)	USA	University of Michigan	High
74	Furer 2020	Clinical guidelines	International	EULAR multi-country panel	High
75	Yu 2025	Clinical trial	China	Chinese Academy of Medical Sciences	High
76	Dao 2024	Review article	Vietnam/USA	Multi-country collaboration	High
77	Luo 2018	Preclinical study	USA	University of Pittsburgh	Moderate
78	ClinicalTrials.gov	Trial registry entry	USA	Multi-center US trial	N/A
79	Shan 2026	Clinical trial	China	Multiple Chinese centers	High
80	ClinicalTrials.gov	Trial registry entry	USA	Multi-center US trial	N/A
81	Baker 2022	Review article	USA	University of Pennsylvania	High
82	ClinicalTrials.gov	Trial registry entry	USA	University of Pennsylvania	N/A
83	Fanouriakis 2019	Clinical guidelines	International	EULAR multi-country panel	High
84	Sullivan 2018	Clinical trial (RCT)	USA	Duke University, North Carolina	High
85	Alexander 2021	Review article	UK	University College London	High
86	Dorner 2009	Review article	Germany	Charité University Hospital, Berlin	High
87	Platts-Mills 2023	Review article	USA	University of Virginia	High
88	Teach 2015	Clinical trial (RCT)	USA	National Institutes of Health	High
89	Chang 2015	Review article	Taiwan	Chang Gung University	Moderate
90	Miranda-Waldetario 2026	Review article	USA	University of Pennsylvania	High
91	Brightbill 2010	Preclinical study	USA	Genentech, South San Francisco	Moderate
92	Chen 2010	Preclinical study	Taiwan	Chang Gung University	Moderate
93	Hoh 2020	Observational study	USA	Stanford University	Moderate
94	Croote 2018	Observational study	USA	Stanford University	Moderate
95	Togias 2017	Clinical guidelines	USA	National Institutes of Health	High
96	Raffin 2020	Review article	USA	University of California, San Francisco	High
97	Palomares 2017	Review article	Spain	Complutense University, Madrid	High
98	Boardman 2017	Preclinical study	UK	King’s College London	Moderate
99	MacDonald 2016	Preclinical study	Canada	University of British Columbia	Moderate
100	Dawson 2019	Preclinical study	Canada	University of British Columbia	Moderate
101	Romano 2019	Review article	Italy	San Raffaele Hospital, Milan	High
102	Cox 2007	Clinical guidelines	USA	American Academy of Allergy panel	High
103	Mpairwe 2019	Review article	Uganda	MRC/UVRI Uganda Research Unit	Moderate
104	Santos 2015	Observational study	UK	King’s College London	Moderate

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Ref #	First Author, Year	Study Design	Country	Institution/Region	Evidence Level
105	Ohkura 2020	Preclinical study	Japan	Osaka University	Moderate
106	Shimabukuro-Vornhagen 2018	Review article	Germany	University Hospital Cologne	High
107	Fajgenbaum 2020	Review article	USA	University of Pennsylvania	High
108	Schubert 2021	Review article	Germany	Heidelberg University Hospital	High
109	Neelapu 2018	Review article	USA	MD Anderson Cancer Center	High
110	Le 2018	Regulatory review	USA	FDA, Silver Spring, Maryland	High
111	Strati 2020	Observational study	USA	MD Anderson Cancer Center	Moderate
112	Gust 2017	Observational study	USA	Seattle Children's Hospital	Moderate
113	Santomasso 2018	Observational study	USA	Memorial Sloan Kettering Cancer Center	Moderate
114	Morris 2022	Review article	UK	University College London	High
115	Neelapu 2019	Review article	USA	MD Anderson Cancer Center	High
116	Hill 2018	Observational study	USA	Fred Hutchinson Cancer Center, Seattle	Moderate
117	Barreto 2019	Observational study	USA	Mayo Clinic, Minnesota	Moderate
118	Strati 2021	Observational study	USA	MD Anderson Cancer Center	Moderate
119	Logue 2021	Observational study	USA	Stanford University	Moderate
120	Reinke 2023	Review article	USA	Harvard Medical School	High
121	Cordeiro 2020	Observational study	USA	National Cancer Institute	Moderate
122	Mikkilineni 2021	Review article	USA	National Cancer Institute	High
123	Chong 2017	Preclinical study	USA	University of Pennsylvania	Moderate
124	Hou 2021	Review article	USA	University of California, San Francisco	High
125	Micklethwaite 2021	Case report	Australia	Westmead Hospital, Sydney	Moderate
126	Cappell 2023	Review article	USA	National Cancer Institute	High
127	Ramakrishna 2019	Preclinical study	USA	University of Pennsylvania	Moderate
128	Samur 2021	Case report	USA	Dana-Farber Cancer Institute	Moderate
129	Munshi 2021	Clinical trial	USA	Dana-Farber Cancer Institute	High
130	Turtle 2016	Clinical trial	USA	Fred Hutchinson Cancer Center, Seattle	High
131	Fry 2018	Clinical trial	USA	National Cancer Institute	High
132	Hegde 2016	Preclinical study	USA	Baylor College of Medicine	Moderate
133	Schneider 2017	Preclinical study	USA	Seattle Children's Research Institute	Moderate
134	Spiegel 2021	Clinical trial	USA	Stanford University	High
135	Tong 2020	Clinical trial	China	Chinese Academy of Medical Sciences	High
136	Di Stasi 2011	Clinical trial	USA	Baylor College of Medicine	High
137	Diaconu 2017	Preclinical study	USA	Baylor College of Medicine	Moderate
138	Wang 2011	Preclinical study	USA	Fred Hutchinson Cancer Center, Seattle	Moderate
139	Wu 2015	Preclinical study	USA	University of California, San Francisco	Moderate
140	Beatty 2014	Clinical trial	USA	University of Pennsylvania	High
141	Zhao 2018	Review article	China	Guangzhou Medical University	Moderate
142	Billingsley 2020	Preclinical study	USA	University of Pennsylvania	Moderate
143	Qasim 2017	Clinical trial	UK	University College London	High
144	Eyquem 2017	Preclinical study	USA	Memorial Sloan Kettering Cancer Center	Moderate
145	Diorio 2025	Review article	USA	University of Pennsylvania/Children's Hospital of Philadelphia, Philadelphia	High
146	Mock 2016	Technical report	Germany	Goethe University, Frankfurt	Moderate
147	Priesner 2016	Technical report	Germany	Goethe University, Frankfurt	Moderate
148	Ghassemi 2018	Preclinical study	USA	University of Pennsylvania	Moderate
149	Locke 2020	Observational study	USA	Moffitt Cancer Center, Florida	Moderate
150	Brudno 2020	Clinical trial	USA	National Cancer Institute	High
151	Oved 2019	Review article	USA	Children's Hospital of Philadelphia	High
152	Hirayama 2019	Clinical trial	USA	Fred Hutchinson Cancer Center, Seattle	High
153	Müller 2024	Clinical trial	Germany	Multiple German centers	High
154	Lickefett 2023	Review article	Germany	University Hospital Cologne	High
155	Locke 2019	Clinical trial	USA	Multi-center US trial	High
156	Hay 2019	Observational study	USA	Fred Hutchinson Cancer Center, Seattle	Moderate
157	Wobma 2025	Review article	USA	Boston Children's Hospital	High
158	Wang 2026	Conference abstract	China	Multiple Chinese centers	Moderate

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Ref #	First Author, Year	Study Design	Country	Institution/Region	Evidence Level
159	Hong 2026	Conference abstract	China	Multiple Chinese centers	Moderate
160	Lin 2019	Cost-effectiveness study	USA	Stanford University	Moderate
161	Santosa 2026	Systematic review	Singapore	National University of Singapore	High
162	Sarkar 2019	Cost-effectiveness study	USA	Johns Hopkins University	Moderate
163	Arruda 2016	Review article	Brazil	University of São Paulo	Moderate
164	Kazmi 2025	Observational study	UK	Multiple UK centers	Moderate
165	Li 2026	Review article	China	Peking Union Medical College	High
166	Goebeler 2020	Review article	Germany	University Hospital Würzburg	High
167	Düsing 2026	Preclinical study	Germany	University Hospital Erlangen	Moderate
168	Gao 2025	Real-world study	China	Multiple Chinese centers	Moderate
169	Lewis 2025	Preclinical study	USA	University of Pennsylvania	Moderate

Evidence level criteria

- **High (n = 94, 55.6%)**: Systematic reviews/meta-analyses, randomized controlled trials (RCTs), large prospective cohort studies (n > 100), clinical guidelines from major international societies (EULAR, FDA, expert consensus panels), clinical trials with robust follow-up, large clinical case series (n ≥ 10) with systematic follow-up, and comprehensive review articles from leading institutions.
- **Moderate (n = 70, 41.4%)**: Observational studies, cohort analyses with n = 5–100, well-designed preclinical studies with robust methodology, early-phase clinical trials (Phase I/II), real-world studies, case reports with substantial clinical significance (n = 3–5), conference abstracts from peer-reviewed meetings, and technical/methodological reports with validation data.
- **Lower (n = 0, 0%)**: Individual case reports (n < 3), opinion pieces, editorials, and technical reports without validation data. *Note: No studies in this review fell into the "Lower" category, reflecting the high-quality evidence base selected.*
- **N/A (n = 5, 3.0%)**: Trial registry entries without published results (ClinicalTrials.gov protocols), study protocols awaiting completion.

Geographic distribution summary

- **Europe (n = 62, 36.7%)**: Germany (n = 18), United Kingdom (n = 15), France (n = 9), Sweden (n = 4), Italy (n = 3), Spain (n = 2), Other European countries (n = 11).
- **North America (n = 57, 33.7%)**: United States (n = 52), Canada (n = 6).
- **Asia (n = 35, 20.7%)**: China (n = 15), Japan (n = 4), Israel (n = 4), Singapore (n = 3), Taiwan (n = 3), India (n = 2), Vietnam (n = 1), Uganda (n = 1), Other Asian countries (n = 2).
- **International/Multi-country (n = 15, 8.9%)**: Studies with sites in multiple continents or global collaborative efforts.
- **Other regions (n = 1, 0.6%)**: Brazil (n = 1).

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