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Supplementary information

Innovative antibody therapeutic development in China compared with the USA and Europe

In the format provided by the authors and unedited

Data sources
Top-level data used in our analyses of antibody therapeutics were collected during May–August 2025 from public sources, including company websites, press releases and presentations, clinical trials registries, regulatory agencies, literature reports and reviews, as well as public data available from IMGT/mAb-DB (https://www.imgt.org/IMGTindex/IMGTmAb-DB.php), TheraSAbDab (https://opig.stats.ox.ac.uk/webapps/sabdab-sabpred/sabdab), and YAbS (https://db.antibodysociety.org). Data were cross-checked with the ADC and Bispecific modules of Beacon (beacon-intelligence.com), which is a commercial database of antibody therapeutics. Because the data are from public sources, the dataset may not be completely comprehensive, as not all companies disclose relevant information such as events or molecular formats (for example, ADC, bispecific) in a timely manner.

Definition of terms and inclusion/exclusion criteria
We define an antibody as a recombinant protein with at least one antigen-binding site derived from an antibody gene and a sequence that is unique compared to antibodies previously evaluated in clinical studies. We focused on two categories of 'enhanced' antibody therapeutics (that is, those with functionality not found in a canonical antibody): 1) antibody–drug conjugates (ADCs), and 2) bi- or multi-specific antibodies. Here, we defined ADCs as drugs that are composed of an antibody conjugated to a toxic small molecule; this definition excludes unconventional ADCs such as antibody–oligonucleotide conjugates and immune stimulator antibody conjugates. We defined bi- or multi-specifics as antibodies that bind two or more epitopes on the same or different antigens. As here the term 'antibody' applies to proteins with at least one antigen-binding site derived from an antibody gene, the bi- or multi-specific antibody category includes immunoconjugates comprising an antibody fused with a non-antibody targeted protein, such as recombinant TGF beta receptor or T cell receptor.

We further limited our dataset to enhanced antibody therapeutics that originated at companies based in China, the US, or Europe and that entered clinical development between January 1, 2015, and December 31, 2024. The clinical study start date is defined as the earlier of either the date for a clinical trials application submitted to any regulatory agency or the start date listed in a clinical trials registry for a first-in-human study. Molecules for which a clinical trial application was submitted by the end of 2024, but for which no active first-in-human study had been identified by mid-June 2025, were excluded.

Data categories
Molecules were assigned a single country of origin, one general molecular category (for example, ADC, bispecific) based on the format, one development stage (clinical phase, regulatory review, approved, terminated) based on the most advanced stage achieved as of mid-2025, and one therapeutic area based on the indication relevant to the most advanced development stage.

Of the 776 molecules in the dataset, 424 originated in either the US or Europe and 352 originated in China. The dataset included 279 (36%) ADCs, 22 (3%) ADC bispecifics, and 475 (61%) bi- or multi-specifics. As molecules could be assigned only one general molecular category, ADCs and ADC bispecifics were combined for analyses shown in Figure 2. Of the bi- or multi-specifics, 51 were multi-specific and 63 were immunoconjugates (60 bispecific, 3 multispecific).

The majority (512, 66%) of molecules in the dataset were active, including 492 molecules in clinical studies, 4 in regulatory review, and 16 approved. Of those in clinical studies, 58 (35 China originated, 23 US/Europe originated) had reached late-stage clinical studies, defined here as a pivotal phase II, phase II/III, or phase III study.

The ADCs and bi- or multi-specific antibodies approved during 2015–2025 (as of August 31, 2025), in regulatory review in any country, or in late-stage clinical studies are provided in Supplementary Table 1.

The following colour codes are used in this table: purple-highlighted rows: China origin; yellow-highlighted rows: origin outside of China, US, Europe; green-highlighted rows: investigational product candidates undergoing regulatory review; red text: approval in 2025.

Most of the molecules (693, 89%) were evaluated as treatments for cancer. The remaining 83 molecules (11%) were evaluated for a variety of non-cancer indications, including 44 for immune-mediated or inflammatory disorders, 12 for infectious diseases, and 11 for ophthalmic disorders. The results for our analyses of the molecules for cancer are shown in Figure 2. Of the molecules for cancer, 329 (47%) and 364 (53%) originated in China and the US or Europe, respectively. Percentages shown in the bar charts in Figure 2c,d are presented in Supplementary Table 2.

Supplementary Table 2 | Distribution of the mechanisms of action for enhanced antibody therapeutics for cancer that originated at companies based in China, the US, and Europe

ADC payload MOA	**US/Europe, %**	**China, %**
DNA binding	22.7	0
Tubulin inhibitor	47.5	28.8
Topoisomerase I inhibitor	19.9	52.5
Other	7.1	0
Undisclosed	2.8	18.8
Bi-/multi-specific MOA	**US/Europe, %**	**China, %**
Cell engager	59.6	30.2
Cell engager immunomodulatory	16.1	16.6
Immunomodulatory only	9.4	16.0
Immunomodulatory TAA and/or TME	6.3	24.9
TAA and/or TME only	6.3	9.5
Radioimmunotherapy	0.9	0.0
Undisclosed	1.3	3.0

Bi-/multi-specific MOA definitions
Cell engager: at least one target on the tumour and at least one target on immune cells
Cell engager immunomodulatory: cell engager with at least one immunomodulatory target
Immunomodulatory only: all targets are immunomodulatory
Immunomodulatory TAA and/or TME: antibody targeting at least one tumour-associated antigen (TAA) or the tumour microenvironment (TME) and at least an immunomodulatory target
TAA and/or TME only: antibody targeting TAA and/or the TME)
Radioimmunotherapy: antibody targeting a TAA conjugated to DOTA, which binds to a radionuclide

Success rate calculations
Single-phase transition rates were calculated as the number of enhanced antibody therapeutics that transitioned from a given phase to the next divided by the sum of the number that transitioned and the number that were terminated at that phase at the time of the calculation. Transitions occurring between phase I to II and phase II to III clinical studies conducted world-wide were included. Candidates in phase I/II studies were classified as phase II; candidates in pivotal phase II or phase II/III studies were classified as phase III. Only the first transition to regulatory review and the first approval granted in any country or region were included; any subsequent marketing application submissions and supplemental approvals of any kind were excluded. Phase I to approval rates were calculated by multiplying the four relevant single-phase transition rates.

Phase transition and approval success rates for our cohorts, as shown in Figure 2a,b, should be considered preliminary and trends in these rates should be considered directional, as the final fates (approval or termination) of only 16% and 54% of the China-originated and US or Europe-originated enhanced antibody therapeutics, respectively, are known (Supplementary Table 3). In contrast, fates are known for higher percentages of the molecules undergoing the phase I to phase II transition and the phase II to phase III transition for the China-originated (60% and 35%) and US or Europe-originated enhanced antibody therapeutics (74% and 60%), respectively. A percentage completion of 100% indicates that the final fates of all molecules in the cohort of interest are known. The success rates we present here may change over time as companies decide their molecules' fates based on clinical study results reported in the future.

Supplementary Table 3 | Number of molecules and percentage with known fates in cohorts used for success rate calculations

Category	Number of molecules, Phase I	Phase I to approval % completion	Phase I to II % completion	Number of molecules, Phase II	Phase II to III % completion
China, 2015-2024	329	16%	60%	164	35%
China, 2015-2024, ADCs	160	10%	56%	80	41%
China, 2015-2024, Bi-/multispecifics	169	22%	64%	84	29%
US or Europe, 2015-2024	364	54%	74%	138	60%
US or Europe, 2015-2024, ADCs	141	52%	74%	52	58%
US or Europe, 2015-2024, Bi-/multispecifics	223	55%	74%	86	62%

Success rates for these cohorts are shown in Figure 2a,b. Percentages completion is calculated by dividing the number of molecules with a known fate (that is, approval or termination) in the cohort by the total number of molecules in the cohort. The method used to calculate the success rates presented here is the same as that used to calculate rates presented in Kaplon & Reichert. Antibodies to watch in 2019. Mabs, 2019 (doi: 10.1080/19420862.2018).1556465 and Crescioli et al. Antibodies to watch in 2024. Mabs, 2024. (doi: 10.1080/19420862.2023.2297450).