



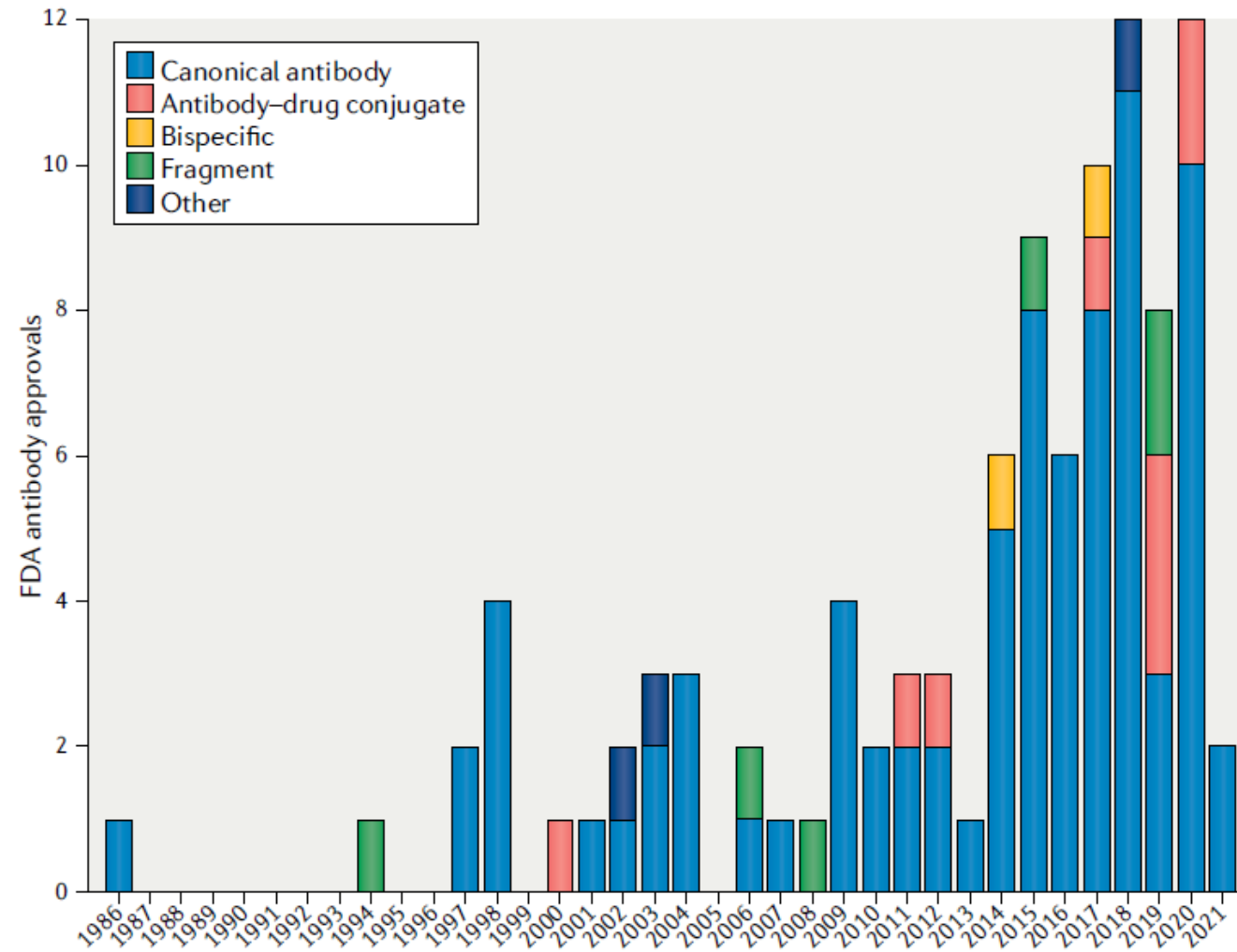
Methods in Drug Development

Antibody Therapeutics

Stunning development of antibodies as therapeutics

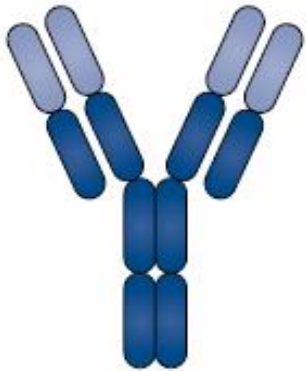


Antibody therapy formats

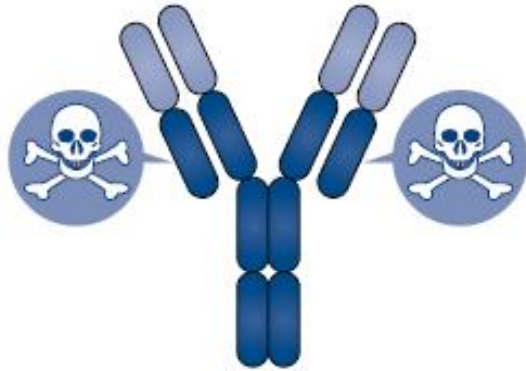


Antibody therapy formats

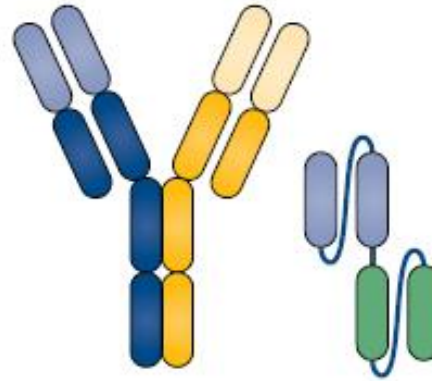
a Canonical antibodies



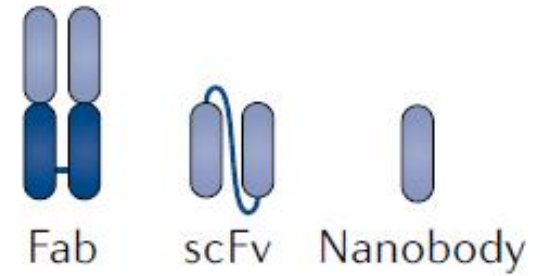
b Antibody–drug conjugates



c Bispecifics

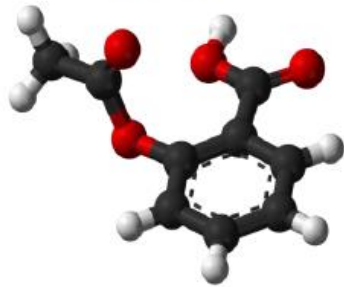


d Fragments



Antibodies versus small molecule drugs

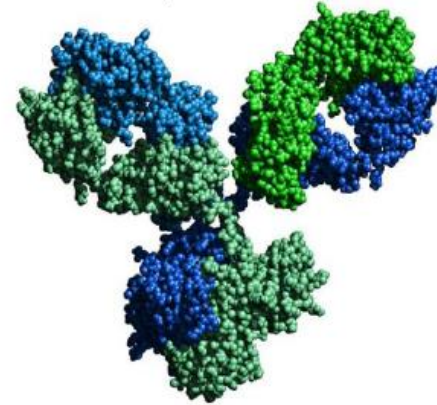
Small Molecule Drug /
Pharmaceutical
Aspirin
21 atoms



Large Molecule Drug
Human Growth Hormone
~3,000 atoms



Large Biologic
Herceptin
~25,000 atoms



Sales (US\$ billion)							
Molecule type	2010	2011	2012	2013	2014	2015	Differences in sales between 2010 and 2015
Small molecules	413	414	402	398	399	401	-12
Therapeutic proteins	70	73	76	79	81	81	11
Monoclonal antibodies	46	52	57	62	67	71	25
Vaccines	24	25	28	30	31	32	8

Diseases treated with antibodies

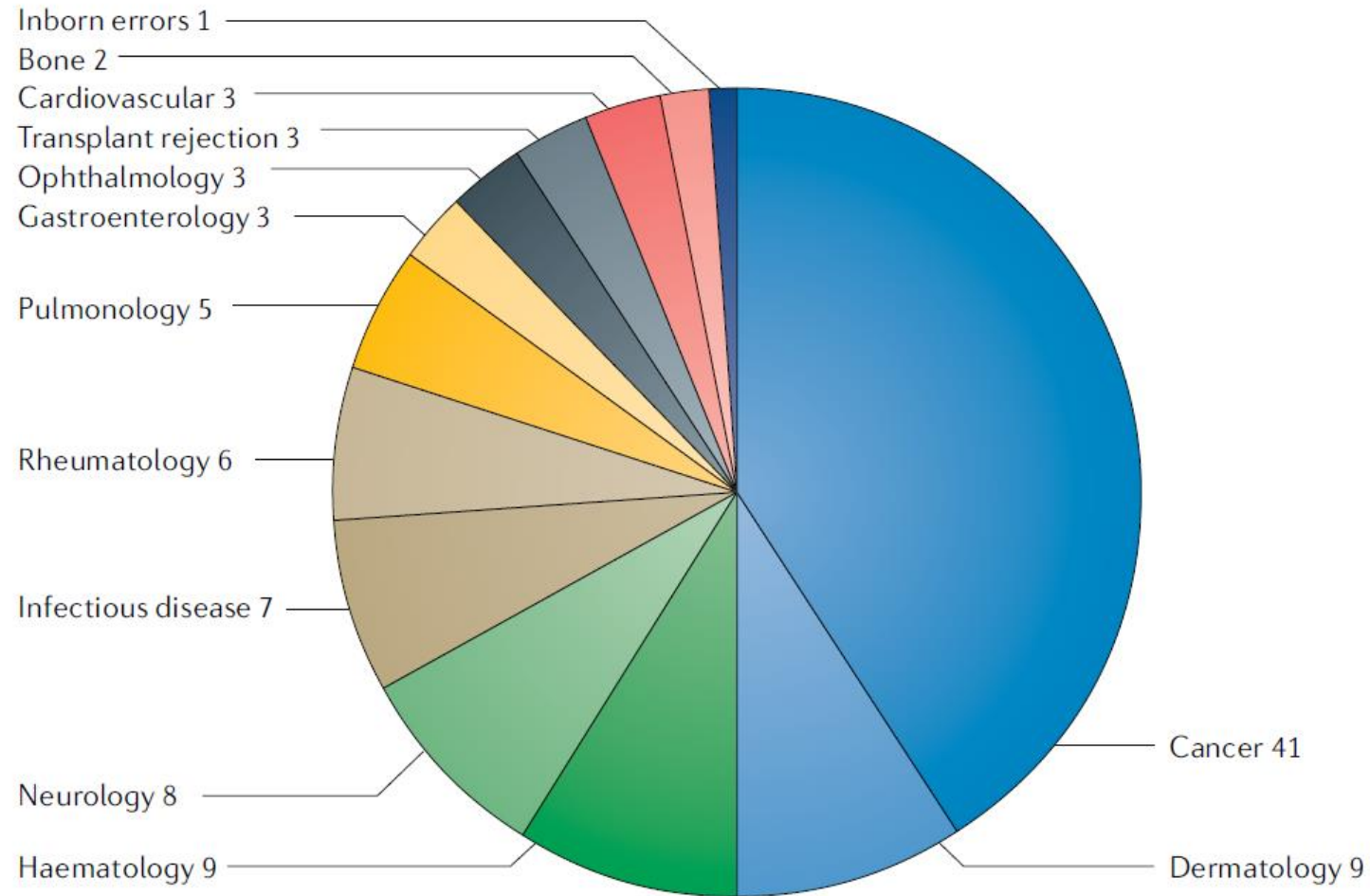
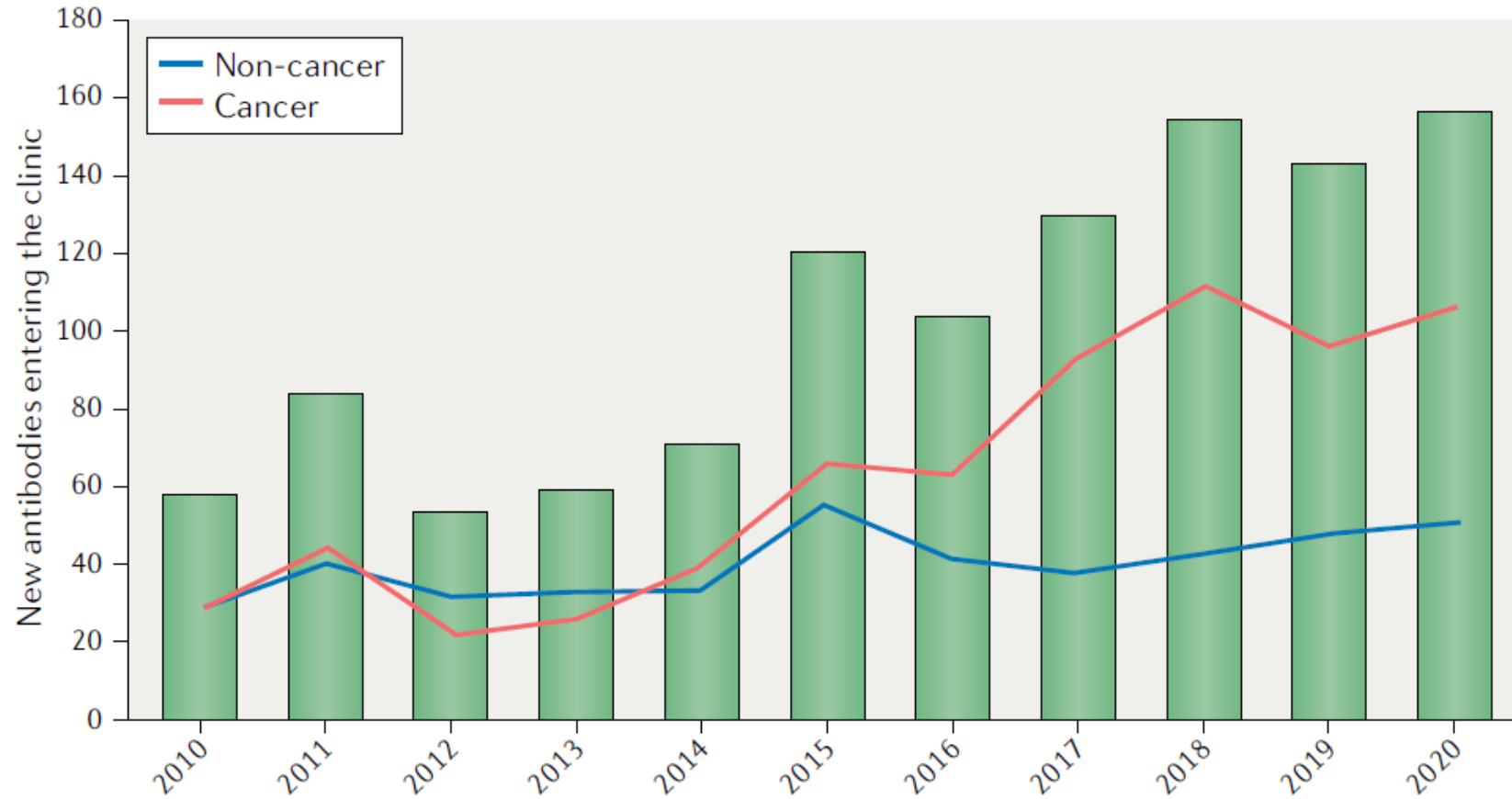


Fig. 4 | **The FDA's first 100 antibody approvals, by therapeutic area.**

Diseases treated with antibodies



Antibody targets

Table 1 | **Top targets for first 100 mAbs**

Target	mAb count
PD1/PDL1	7
CD20	6
TNF	4
HER2	4
CGRP/CGRPR	4
VEGF/VEGFR	4
IL-6/IL-6R	4
IL-23 p19	3
EGFR	3
CD19	3

Table 2 | **Top investigational mAb targets**

Target	Investigational agent count ^a
PD1/PDL1	80 ^b
CD3	71
HER2	34
CTLA4	25
SARS-CoV-2	22
4-1BB	19
LAG3	19
EGFR	17
CD20	15
CD47	15

Antibody drug sales

Table 3 | Top mAbs, by 2019 sales

Antibody	Target	2019 sales (US\$ billion)
Adalimumab	TNF	19.6
Pembrolizumab	PD1	11.1
Nivolumab	PD1	8.0
Bevacizumab	VEGF	7.1
Rituximab	CD20	6.5
Ustekinumab	IL-12/23	6.5
Trastuzumab	HER2	6.1
Infliximab	TNF	5.3
Denosumab	RANK-L	5.0
Eculizumab	C5	3.9

Ranibizumab	VEGF	3.9
Ocrelizumab	CD20	3.7
Secukinumab	IL-17A	3.6
Pertuzumab	HER2	3.6
Golimumab	TNF	3.4
Omalizumab	IgE	3.2
Daratumumab	CD38	3.0
Vedolizumab	$\alpha 4\beta 7$ integrin	2.5
Dupilumab	IL-4R α	2.3
Tocilizumab	IL-6R	2.3