Full re-emergence of invasive pneumococcal disease among adults in Germany after strong reduction throughout SARS-CoV-2 pandemic lockdown

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BACKGROUND

Streptococcus pneumoniae remains a leading cause of infectious disease among children and older adults. Since 1998, PPV23 vaccination has been recommended for adults ≥60 years, but uptake is <20%. In July 2006, vaccination with a pneumococcal conjugate vaccine (PCV) was generally recommended in Germany for all children ≤24 months. Apart from a strong direct effect, PCV vaccination has shown limited herd protection among non-vaccinated children and adults. Since March 2020, the SARS-CoV-2 pandemic has strongly deregulated daily life. Here, we present data on invasive pneumococcal disease (IPD) cases among adults in Germany in the era of conjugate vaccination during the SARS-CoV-2 pandemic.

METHODS

The GNRCS has monitored the epidemiology of IPD in Germany since 1992. All isolates were serotyped using the Neufeld-Quellung-reaction.

RESULTS

From the start of the SARS-CoV-2 pandemic in March 2020, a strong reduction in IPD cases was observed among all ages, in Germany. For adults 18 years and older case numbers were reduced by up to 80%. Case numbers started to increase again in October 2021, but a full return to the pre-pandemic level was only observed in the second part of 2022. From December 2022 to February 2023, an extreme surge in IPD cases was observed (**Fig. 1**).

Not all serotypes showed similar behavior during these case number fluctuations. Serotypes 12F and 22F were more strongly affected during the pandemic, and after the pandemic serotype 3 increased disproportionally (**Fig. 2**).

Serotype 12F almost disappeared among adults in 2021, reducing from 109 isolates (4.3%) in June 2019 – March 2020 to 14 isolates (0.9%) in June 2021 – March 2022, and has not returned to pre-pandemic levels since (25 isolates (0.8%) in June 2022 – March 2023 (**Fig. 3**). Although the secular trend shows fluctuations of 12F prevalence over a 15 year period, the reduction in prevalence cannot be fully explained by this (**Fig. 4**).

From 2006, PCV-vaccination has changed the serotype distribution both among children as well as among adults, with PCV13 vaccine-serotype cases reducing. This herd-protection effect was not observed for serotype 3, and less strong for serotypes 19A, 19F and 4 (**Fig. 5**).

From December 2022 till February 2023, a strong surge in IPD cases was observed among adults (**Fig. 1**), mainly caused by serotype 3 (**Fig. 5**). The serotype distribution of this surge was very different with PCV13 serotypes increasing strongly (**Fig. 6**).

From 2006 to 2021, the prevalence of PCV13 serotypes among adults ≥18 years and ≥60 years reduced from 70% to 30%. In 2021-2023, PCV13 serotypes became more prevalent in both age groups, 44.2% and 43.6%, respectively. Future vaccine formulations would cover 75.0% (PCV24) and 83.9% (V116), in 2022-2023 (**Figs. 7, 9**).

For adults ≥18 years coverage increase for PCV15 (compared to PCV13) would have been 9.1% in 2019-2020, and 5.2% in 2022-2023, for PCV20 34.4% and 25.2%, for PCV24 42.2% and 30.8%, and for V116 53.9% and 39.7%. For adults ≥60 years coverage increases were 10.0% and 5.8% for PCV15 in 2019-2020 and 2022-2023, respectively, for PCV20, 32.6% and 23.7%, for PCV24 40.1% and 29.3% and for V116 55.4% and 41.9% (**Figs. 8, 10**).

CONCLUSIONS

- During the SARS-CoV-2 pandemic a strong reduction in Adult IPD was observed.
- Serotype distribution changed during and after the pandemic, with 12F and 22F strongly decreasing.
- A full return to pre-pandemic levels was observed by the end of 2022.
- A strong surge of IPD was observed in Dec.2022, with serotype 3 case numbers strongly increasing.
- After the pandemic and during the surge, PCV13 vaccine serotype prevalence increased to 45%.
- Current vaccine coverage for PCV13 among adults ≥60 years of age is 43.6%, PCV15: 49.4%, PCV20: 67.3%, PPV23: 72,4%.
- Future vaccine formulations PCV24 and V116 would cover 72.9% and 85.5% of current serotypes among adults ≥60 years of age.
- The post-pandemic high level of IPD and the high prevalence of PCV13 vaccine serotypes (also among children) is alarming and needs careful observation.

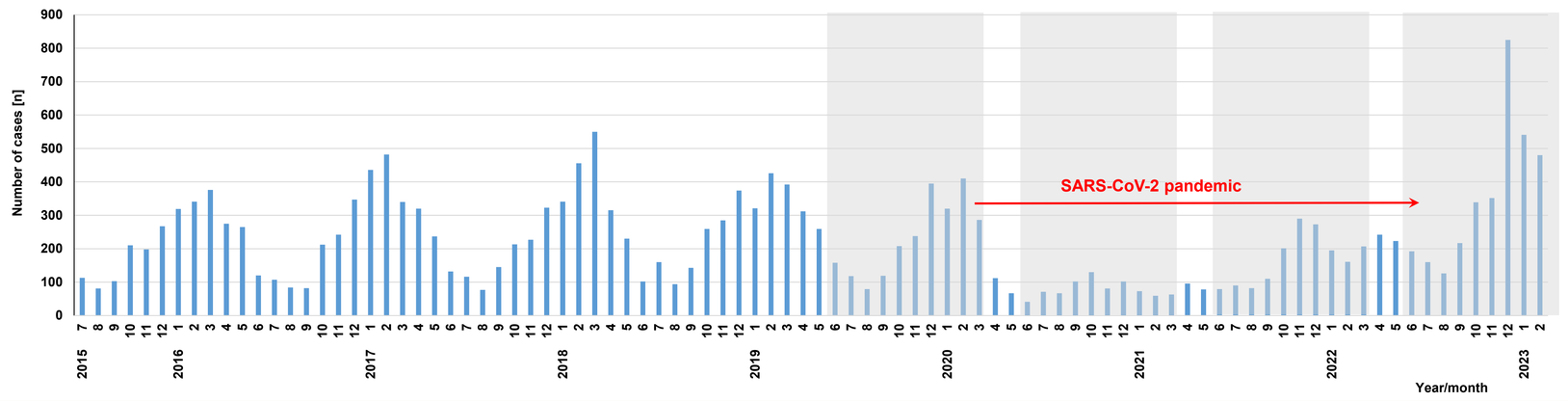

Fig. 1: Number of IPD cases among adults ≥18 years of age per month, July 2015 – February 2023.

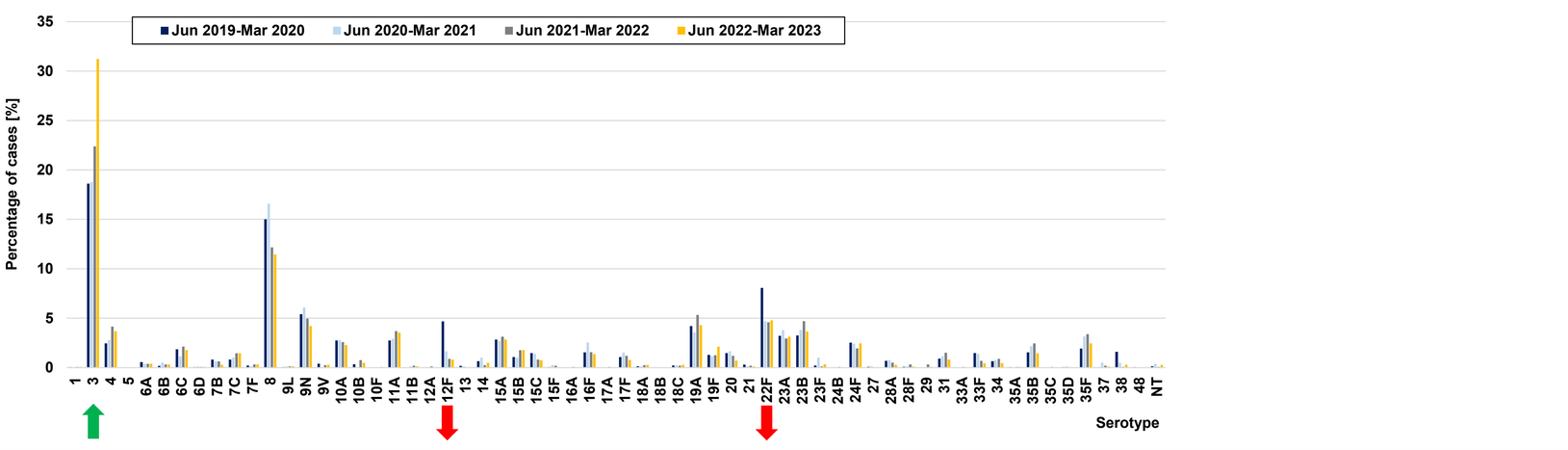

Fig. 2: Prevalence of serotypes in IPD among adults ≥18 years of age during the pandemic measured in the periods June – March

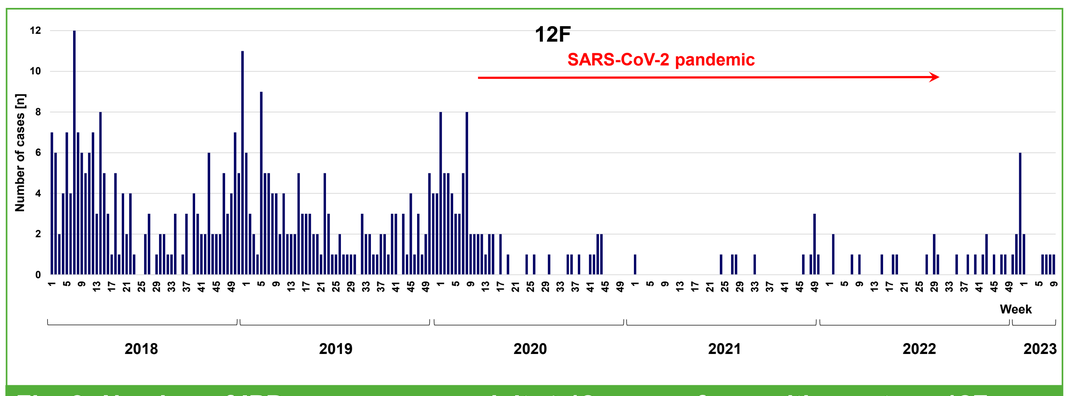

Fig. 3: Number of IPD cases among adults ≥18 years of age with serotype 12F per calendar week, 2018-2023

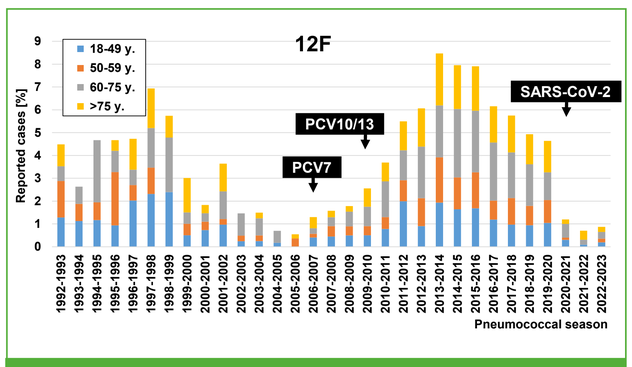

Fig. 4: Percentage of IPD isolates with serotype 12F, isolated from adults ≥18 years of age, 1992-2023

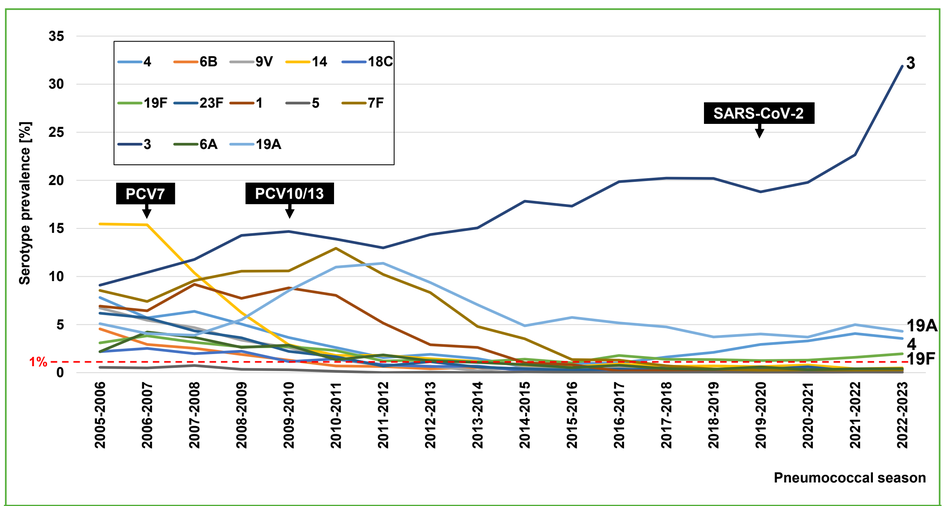

Fig. 5: Prevalence of PCV13 serotype in IPD cases among adults ≥18 years , 2005-2023

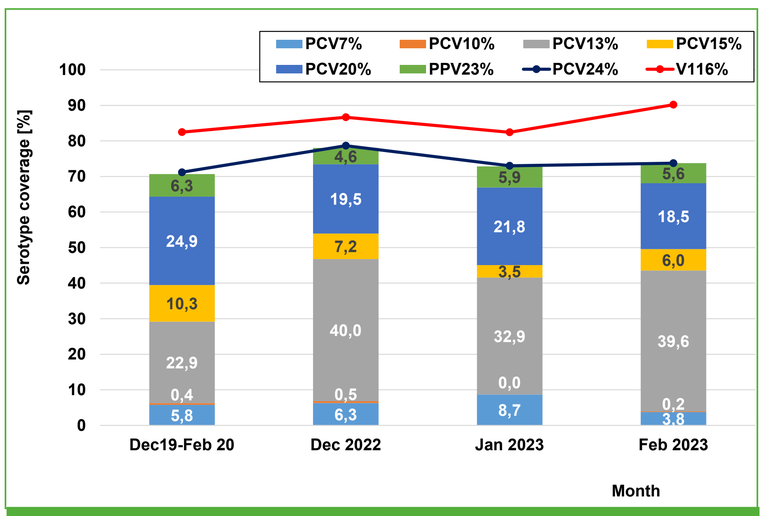

Fig. 6: Serotype coverage of current and future vaccine formulations in IPD among adults ≥18 years , December 2022 – February 2023

	Serotype	1992-2006	%	Serotype	2019-2020	%	Serotype	2020-2021	%	Serotype	2021-2022	%	Serotype	2022-2023	%
	total	4397	100,0	total	2393	100,0	total	1001	100,0	total	2264	100,0	total	2905	100,0
	PPV23	3839	87,3	PPV23	1705	71,2	PPV23	696	69,5	PPV23	1554	68,6	PPV23	2168	74,6
	PCV20	3795	86,3	PCV20	1531	64,0	PCV20	607	60,6	PCV20	1410	62,3	PCV20	2015	69,4
	PCV15	3318	75,5	PCV15	925	38,7	PCV15	367	36,7	PCV15	920	40,6	PCV15	1435	49,4
	PCV13	3183	72,4	PCV13	709	29,6	PCV13	307	30,7	PCV13	801	35,4	PCV13	1283	44,2
	PCV10	2531	57,6	PCV10	149	6,2	PCV10	69	6,9	PCV10	166	7,3	PCV10	220	7,6
	PCV7	1909	43,4	PCV7	142	5,9	PCV7	66	6,6	PCV7	158	7,0	PCV7	209	7,2
1	14	582	13,2	3	450	18,8	3	198	19,8	3	513	22,7	3	926	31,9
2	3	385	8,8	8	344	14,4	8	156	15,6	8	282	12,5	8	339	11,7
3	4	360	8,2	22F	181	7,6	9N	65	6,5	19A	113	5,0	22F	141	4,9
4	1	298	6,8	9N	124	5,2	22F	46	4,6	23B	109	4,8	19A	125	4,3
5	7F	290	6,6	12F	111	4,6	23B	39	3,9	9N	105	4,6	9N	124	4,3
6	9V	286	6,5	19A	96	4,0	19A	37	3,7	22F	102	4,5	11A	105	3,6
7	23F	255	5,8	23A	78	3,3	35F	37	3,7	4	92	4,1	4	103	3,5
8	6B	174	4,0	23B	78	3,3	23A	35	3,5	11A	79	3,5	23B	101	3,5
9	8	157	3,6	4	70	2,9	4	33	3,3	35F	78	3,4	23A	91	3,1
10	19F	148	3,4	15A	68	2,8	11A	33	3,3	15A	70	3,1	15A	82	2,8
11	6A	139	3,2	24F	68	2,8	15A	29	2,9	10A	66	2,9	24F	70	2,4
12	19A	128	2,9	11A	66	2,8	10A	27	2,7	23A	66	2,9	35F	65	2,2
13	12F	119	2,7	10A	59	2,5	16F	24	2,4	35B	53	2,3	10A	60	2,1
14	9N	114	2,6	35F	48	2,0	35B	23	2,3	24F	49	2,2	19F	57	2,0
15	18C	104	2,4	6C	47	2,0	24F	19	1,9	15B	47	2,1	6C	52	1,8
16	22F	101	2,3	20	37	1,5	33F	14	1,4	6C	47	2,1	15B	51	1,8
17	11A	99	2,3	15C	37	1,5	20	14	1,4	7C	42	1,9	7C	43	1,5
18	10A	78	1,8	33F	35	1,5	6C	14	1,4	16F	38	1,7	35B	42	1,4
19	24F	47	1,1	35B	35	1,5	15C	14	1,4	19F	36	1,6	16F	38	1,3
20	20	37	0,8	38	35	1,5	19F	13	1,3	31	31	1,4	12F	25	0,9
21	5	34	0,8	16F	34	1,4	17F	13	1,3	17F	24	1,1	15C	23	0,8
22	33F	34	0,8	19F	30	1,3	12F	12	1,2	20	24	1,1	31	23	0,8
23	23A	33	0,8	17F	27	1,1	15B	12	1,2	15C	20	0,9	17F	22	0,8
24	6C	30	0,7	15B	26	1,1	7C	9	0,9	33F	17	0,8	20	19	0,7
	Pneumosil	2334	53,1	Pneumosil	182	7,6	Pneumosil	75	7,5	Pneumosil	191	8,4	Pneumosil	247	8,5
	V116	1918	43,6	V116	1999	83,5	V116	824	82,3	V116	1839	81,2	V116	2438	83,9
	PCV24	3978	90,5	PCV24	1719	71,8	PCV24	699	69,8	PCV24	1563	69,0	PCV24	2180	75,0

Fig. 7: Serotype distribution among IPD isolates from adults ≥18 years of age in Germany. Single serotype prevalences are ranked.

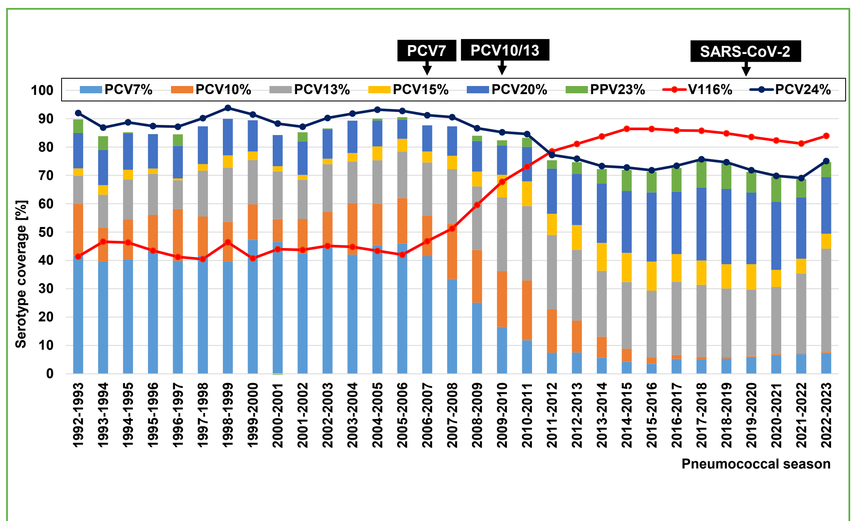

Fig. 8: Serotype coverage of current and future vaccine formulations among IPD isolates from adults ≥18 years of age in Germany.

	Serotype	all 1992-2006	%	Serotype	2019-2020	%	Serotype	2020-2021	%	Serotype	2021-2022	%	Serotype	2022-2023	%
	total	2706	100,0	total	1727	100,0	total	696	100,0	total	1616	100,0	total	2163	100,0
	PPV23	2348	86,8	PPV23	1175	68,0	PPV23	469	67,4	PPV23	1074	66,5	PPV23	1567	72,4
	PCV20	2334	86,3	PCV20	1058	61,3	PCV20	407	58,5	PCV20	976	60,4	PCV20	1456	67,3
	PCV15	2056	76,0	PCV15	669	38,7	PCV15	260	37,4	PCV15	650	40,2	PCV15	1068	49,4
	PCV13	1976	73,0	PCV13	496	28,7	PCV13	216	31,0	PCV13	559	34,6	PCV13	943	43,6
	PCV10	1505	55,6	PCV10	77	4,5	PCV10	34	4,9	PCV10	80	5,0	PCV10	110	5,1
	PCV7	1204	44,5	PCV7	73	4,2	PCV7	32	4,6	PCV7	77	4,8	PCV7	106	4,9
1	14	386	14,3	3	336	19,5	3	150	21,6	3	393	24,3	3	729	33,7
2	3	287	10,6	8	207	12,0	8	90	12,9	8	164	10,1	8	209	9,7
3	4	203	7,5	22F	146	8,5	9N	44	6,3	22F	81	5,0	22F	114	5,3
4	9V	183	6,8	9N	87	5,0	22F	33	4,7	19A	79	4,9	19A	95	4,4
5	23F	179	6,6	19A	70	4,1	23A	32	4,6	9N	72	4,5	9N	87	4,0
6	7F	164	6,1	23A	64	3,7	19A	29	4,2	23B	68	4,2	23A	76	3,5
7	1	125	4,6	12F	62	3,6	23B	29	4,2	11A	64	4,0	11A	73	3,4
8	6B	114	4,2	23B	59	3,4	35F	27	3,9	35F	64	4,0	15A	73	3,4
9	6A	99	3,7	15A	58	3,4	11A	24	3,4	15A	59	3,7	23B	68	3,1
10	8	95	3,5	24F	52	3,0	15A	18	2,6	23A	58	3,6	24F	60	2,8
11	19F	86	3,2	11A	51	3,0	16F	18	2,6	10A	48	3,0	35F	53	2,5
12	19A	85	3,1	10A	45	2,6	35B	17	2,4	24F	44	2,7	10A	50	2,3
13	9N	73	2,7	35F	40	2,3	10A	16	2,3	6C	41	2,5	6C	46	2,1
14	22F	61	2,3	6C	37	2,1	24F	12	1,7	35B	39	2,4	19F	43	2,0
15	12F	61	2,3	38	33	1,9	33F	11	1,6	15B	36	2,2	15B	40	1,8
16	11A	59	2,2	15C	32	1,9	20	11	1,6	4	33	2,0	7C	35	1,6
17	18C	53	2,0	4	29	1,7	6C	11	1,6	7C	31	1,9	16F	33	1,5
18	10A	44	1,6	16F	28	1,6	17F	10	1,4	16F	28	1,7	4	30	1,4
19	24F	31	1,1	33F	27	1,6	4	9	1,3	19F	27	1,7	35B	30	1,4
20	6C	24	0,9	20	27	1,6	19F	9	1,3	31	22	1,4	17F	20	0,9
21	23A	24	0,9	35B	26	1,5	15B	9	1,3	17F	19	1,2	31	20	0,9
22	20	21	0,8	15B	24	1,4	15C	9	1,3	12F	14	0,9	15C	19	0,9
23	33F	19	0,7	19F	21	1,2	12F	8	1,1	20	14	0,9	12F	16	0,7
24	15B	19	0,7	31	20	1,2	7B	7	1,0	10B	13	0,8	20	13	0,6
	Pneumosil	1433	53,0	Pneumosil	128	7,4	Pneumosil	56	8,0	Pneumosil	131	8,1	Pneumosil	181	8,4
	V116	1224	45,2	V116	1453	84,1	V116	582	83,6	V116	1333	82,5	V116	1849	85,5
	PCV24	2447	90,4	PCV24	1188	68,8	PCV24	472	67,8	PCV24	1081	66,9	PCV24	1576	72,9

Fig. 9: Serotype distribution among IPD isolates from adults ≥60 years of age in Germany. Single serotype prevalences are ranked.

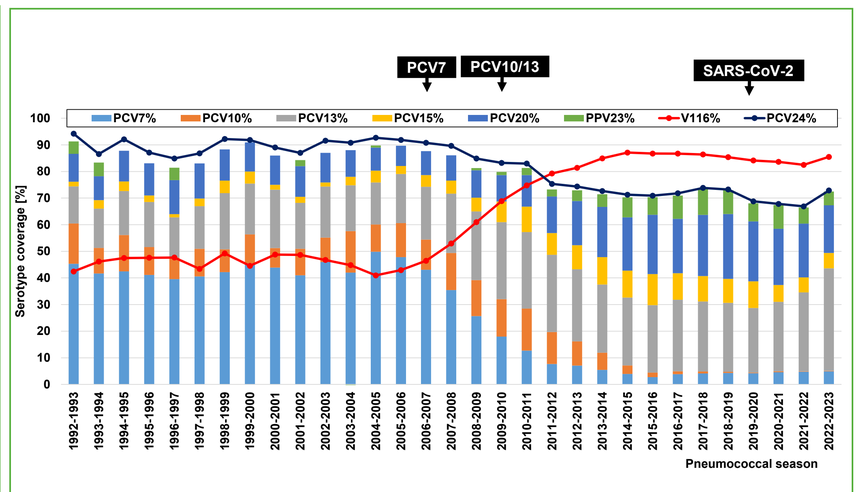

Fig. 10: Serotype coverage of current and future vaccine formulations among IPD isolates from adults ≥60 years of age in Germany.