

Table A1. Opioid pain medications in the study and morphine equivalent conversion factors

Opioid Pain Medications	Morphine Equivalent Conversion Factor
Butorphanol	7
Codeine	0.15
Dihydrocodeine	0.25
Fentanyl	
Fentanyl buccal or sublingual tablets, or lozenge/troche	0.13
Fentanyl film or oral spray	0.18
Fentanyl nasal spray	0.16
Fentanyl (transdermal) patch, extended-released	7.2
Hydrocodone	1
Hydromorphone	4
Levorphanol	11
Meperidine	0.1
Methadone	3
Morphine	1
Oxycodone	1.5
Oxymorphone	3
Pentazocine	0.37
Propoxyphene	0.23
Tapentadol	0.4
Tramadol	0.1

Table A2. Opioid drug use and indicators of problematic opioid prescription among commercially insured enrollees, 2005–

Indicators	2005		2006		2007		2008		2009		2010		2011	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
High-dose opioid														
None	2,584,479	99.1	2,749,870	99.1	3,104,330	99.1	4,533,205	99.1	5,126,865	99.0	4,983,611	98.9	5,437,354	98.9
Once	19,335	0.7	19,929	0.7	23,267	0.7	35,707	0.8	44,152	0.9	45,780	0.9	48,925	0.9
≥2 incidents	3,733	0.1	3,676	0.1	4,352	0.1	6,500	0.1	7,815	0.2	7,838	0.2	8,883	0.2
LA/ER opioids for acute pain														
None	2,570,706	98.6	2,731,285	98.5	3,081,507	98.4	4,503,594	98.4	5,097,793	98.4	4,959,252	98.5	5,413,760	98.5
Once	18,959	0.7	23,294	0.8	28,226	0.9	39,923	0.9	43,399	0.8	41,488	0.8	43,342	0.8
≥2 incidents	17,882	0.7	18,896	0.7	22,216	0.7	31,895	0.7	37,640	0.7	36,489	0.7	38,060	0.7
Opioid overlap														
None	2,451,477	94.0	2,609,808	94.1	2,940,225	93.9	4,287,174	93.7	4,842,283	93.5	4,692,270	93.2	5,117,899	93.1
Once	72,931	2.8	77,273	2.8	90,324	2.9	136,490	3.0	157,918	3.0	166,273	3.3	184,416	3.4
≥2 incidents	83,139	3.2	86,394	3.1	101,400	3.2	151,748	3.3	178,631	3.4	178,686	3.5	192,847	3.5
Opioid/BZD overlap														
None	2,447,848	93.9	2,606,123	94.0	2,936,003	93.7	4,281,365	93.6	4,835,352	93.4	4,683,586	93.0	5,098,629	92.8
Once	61,667	2.4	66,389	2.4	77,444	2.5	116,489	2.5	133,522	2.6	137,412	2.7	152,955	2.8
≥2 incidents	98,032	3.8	100,963	3.6	118,502	3.8	177,558	3.9	209,958	4.1	216,231	4.3	243,578	4.4
Multiple providers														
None	2,465,867	94.6	2,623,736	94.6	2,987,980	95.4	4,388,876	95.9	4,949,150	95.6	4,897,861	97.2	5,345,039	97.3
Yes	141,680	5.4	149,739	5.4	143,969	4.6	186,536	4.1	229,682	4.4	139,368	2.8	150,123	2.7
≥4 Providers	67,540	2.6	70,864	2.6	68,025	2.2	87,678	1.9	108,414	2.1	64,774	1.3	69,519	1.3
≥5 Providers	34,770	1.3	35,814	1.3	34,504	1.1	44,407	1.0	54,440	1.1	32,328	0.6	34,106	0.6
Number of Indicators														
None	2,274,154	87.2	2,418,539	87.2	2,730,042	87.2	3,988,413	87.2	4,488,447	86.7	4,386,068	87.1	4,774,070	86.9
One	210,788	8.1	226,196	8.2	259,721	8.3	382,220	8.4	448,269	8.7	427,159	8.5	478,405	8.7
One incident	152,985	5.9	165,607	6.0	183,348	5.9	262,031	5.7	306,638	5.9	271,239	5.4	301,427	5.5
≥2 incidents	57,803	2.2	60,589	2.2	76,373	2.4	120,189	2.6	141,631	2.7	155,920	3.1	176,978	3.2
Two	76,812	2.9	81,479	2.9	92,351	2.9	135,013	3.0	158,219	3.1	150,954	3.0	165,401	3.0
≥ Three	45,793	1.8	47,261	1.7	49,835	1.6	69,766	1.5	83,897	1.6	73,048	1.5	77,286	1.4

2015^a

^a The population included in this study had at least one opioid prescription. The difference in the value in 2015 compared with the baseline year (2005) is statistically significant ($p < 0.001$) for all indicators. Data source was Truven Health MarketScan Commercial Claims and Encounters data, 2005–2015.

LA/ER: Long acting or extended release, BZD: benzodiazepine

Table A2 (continued). Opioid drug use and indicators of problematic opioid prescription among commercially insured enrollees, 2005–2015^a

Indicators	2012		2013		2014		2015	
	N	%	N	%	N	%	N	%
High-dose opioid								
None	5,438,875	99.0	4,247,917	99.0	4,158,338	99.0	3,103,125	99.0
Once	47,477	0.9	37,944	0.9	35,229	0.8	25,451	0.8
≥2 incidents	8,670	0.2	7,019	0.2	6,516	0.2	4,841	0.2
LA/ER opioids for acute pain								
None	5,414,806	98.5	4,232,889	98.6	4,138,592	98.5	3,096,434	98.8
Once	43,188	0.8	32,435	0.8	33,335	0.8	20,237	0.6
≥2 incidents	37,028	0.7	27,556	0.6	28,156	0.7	16,746	0.5
Opioid overlap								
None	5,122,549	93.2	4,020,474	93.7	3,932,727	93.6	2,955,203	94.3
Once	183,397	3.3	134,303	3.1	135,176	3.2	90,201	2.9
≥2 incidents	189,076	3.4	138,103	3.2	132,180	3.1	88,013	2.8
Opioid/BZD overlap								
None	5,095,710	92.7	3,987,349	92.9	3,895,639	92.8	2,909,473	92.9
Once	155,247	2.8	118,286	2.8	116,881	2.8	86,776	2.8
≥2 incidents	244,065	4.4	187,245	4.4	187,563	4.5	137,168	4.4
Multiple providers								
None	5,339,700	97.2	4,143,458	96.5	4,074,288	97.0	3,024,640	89.8
Yes	155,322	2.8	149,422	3.5	125,795	3.0	108,777	10.2
≥4 Providers	71,467	1.3	67,324	1.6	56,688	1.3	47,689	6.6
≥5 Providers	35,241	0.6	31,998	0.7	26,822	0.6	21,910	4.6
Number of Indicators								
None	4,769,594	86.8	3,728,144	86.8	3,650,258	86.9	2,734,038	87.3
One	485,317	8.8	376,658	8.8	371,497	8.8	272,986	8.7
One incident	305,202	5.6	243,411	5.7	233,798	5.6	174,480	5.6
≥2 incidents	180,115	3.3	133,247	3.1	137,699	3.3	98,506	3.1
Two	163,939	3.0	126,717	3.0	121,755	2.	85,622	2.7
≥ Three	76,172	1.4	61,361	1.4	56,573	1.3	40,771	1.3

^a The population included in this study had at least one opioid prescription. The difference in the value in 2015 compared with the baseline year (2005) is statistically significant ($p < 0.001$) for all indicators. Data source was Truven Health MarketScan Commercial Claims and Encounters data, 2005–2015.

LA/ER: Long acting or extended release, BZD: benzodiazepine

Table A3. Opioid drug use and indicators of problematic opioid prescription among Medicaid enrollees, 2005–2015^a

Indicators	2005		2006		2007		2008		2009		2010		2011	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
High-dose opioid														
None	556,170	98.9	495,877	98.8	249,827	98.5	406,176	98.7	521,465	98.8	588,917	98.6	556,278	98.6
Once	5,088	0.9	5,116	1.0	3,131	1.2	4,463	1.1	5,155	1.0	6,958	1.2	6,683	1.2
≥2 incidents	906	0.2	879	0.2	711	0.3	946	0.2	1,075	0.2	1,311	0.2	1,296	0.2
LA/ER opioids for acute pain														
None	548,658	97.6	490,210	97.7	246,439	97.1	401,696	97.6	516,306	97.8	584,456	97.9	552,914	98.0
Once	5,592	1.0	5,242	1.0	3,404	1.3	4,845	1.2	5,309	1.0	5,731	1.0	4,982	0.9
≥2 incidents	7,914	1.4	6,420	1.3	3,826	1.5	5,044	1.2	6,080	1.2	6,999	1.2	6,361	1.1
Opioid overlap														
None	518,095	92.2	464,766	92.6	227,343	89.6	366,876	89.1	469,792	89.0	536,448	89.8	506,758	89.8
Once	20,547	3.7	17,842	3.6	11,571	4.6	21,250	5.2	28,404	5.4	28,351	4.7	26,783	4.7
≥2 incidents	23,522	4.2	19,264	3.8	14,755	5.8	23,459	5.7	29,499	5.6	32,387	5.4	30,716	5.4
Opioid/BZD overlap														
None	492,947	87.7	461,573	92.0	217,001	85.5	354,918	86.2	459,352	87.0	517,976	86.7	488,245	86.5
Once	21,762	3.9	15,000	3.0	10,915	4.3	17,549	4.3	21,555	4.1	24,395	4.1	23,490	4.2
≥2 incidents	47,455	8.4	25,299	5.0	25,753	10.2	39,118	9.5	46,788	8.9	54,815	9.2	52,522	9.3
Multiple providers														
None	525,476	93.5	468,773	93.4	228,736	90.2	382,471	92.9	488,740	92.6	551,346	92.3	524,504	93.0
Yes	36,688	6.5	33,099	6.6	24,933	9.8	29,114	7.1	38,955	7.4	45,840	7.7	39,753	7.0
≥4 providers	10,087	1.8	7,684	1.5	7,926	3.1	9,277	2.3	13,240	2.5	16,095	2.7	12,884	2.3
≥5 providers	2,682	0.5	2,485	0.5	2,560	1.0	2,937	0.7	4,472	0.8	5,626	0.9	4,148	0.7
Number of indicators														
None	455,192	81.0	420,671	83.8	193,294	76.2	319,903	77.7	411,579	78.0	466,029	78.0	441,593	78.3
One	65,179	11.6	49,595	9.9	34,709	13.7	54,157	13.2	69,141	13.1	78,562	13.2	73,855	13.1
One incident	39,339	7.0	35,636	7.1	22,236	8.8	33,531	8.1	44,464	8.4	49,443	8.3	44,799	7.9
≥2 incidents	25,840	4.6	13,959	2.8	12,473	4.9	20,626	5.0	24,677	4.7	29,119	4.9	29,056	5.1
Two	26,386	4.7	19,869	4.0	15,847	6.2	24,653	6.0	31,351	5.9	34,545	5.8	32,272	5.7
≥ Three	15,407	2.7	11,737	2.3	9,819	3.9	12,872	3.1	15,624	3.0	18,050	3.0	16,537	2.9

^a The population included in this study had at least one opioid prescription. The difference in the value in 2015 compared with the baseline year (2005) is statistically significant ($p < 0.001$) for all indicators. Data source was Truven Health MarketScan Multi-State Medicaid data, 2005–2015.

LA/ER: Long acting or extended release, BZD: benzodiazepine

Table A3 (continued). Opioid drug use and indicators of problematic opioid prescription among Medicaid enrollees, 2005–2015^a

Indicators	2012		2013		2014		2015	
	N	%	N	%	N	%	N	%
High-dose opioid								
None	862,574	98.6	863,863	98.6	941,865	98.8	1,033,735	99.1
Once	10,151	1.2	10,038	1.1	9,179	1.0	7,484	0.7
≥2 incidents	1,969	0.2	2,066	0.2	1,926	0.2	1,461	0.1
LA/ER opioids for acute pain								
None	858,088	98.1	859,895	98.2	938,077	98.4	1,029,279	98.7
Once	7,450	0.9	7,246	0.8	6,773	0.7	6,701	0.6
≥2 incidents	9,156	1.0	8,826	1.0	8,120	0.9	6,700	0.6
Opioid overlap								
None	750,109	85.8	751,289	85.8	840,896	88.2	937,017	89.9
Once	63,632	7.3	63,950	7.3	60,881	6.4	57,807	5.5
≥2 incidents	60,953	7.0	60,728	6.9	51,193	5.4	47,856	4.6
Opioid/BZD overlap								
None	759,900	86.9	761,851	87.0	840,546	88.2	922,873	88.5
Once	34,779	4.0	34,056	3.9	33,562	3.5	34,685	3.3
≥2 incidents	80,015	9.1	80,060	9.1	78,862	8.3	85,122	8.2
Multiple providers								
None	836,314	95.6	840,491	96.0	917,637	96.3	1,009,131	96.8
Yes	38,380	4.4	35,476	4.0	35,333	3.7	33,549	3.2
≥4 providers	12,410	1.4	11,027	1.3	11,091	1.2	10,594	1.0
≥5 providers	3,790	0.4	3,334	0.4	3,432	0.4	3,315	0.3
Number of Indicators								
None	671,375	76.8	672,772	76.8	756,355	79.4	845,579	81.1
One	126,124	14.4	128,439	14.7	129,352	13.6	131,973	12.7
One incident	75,830	8.7	75,484	8.6	76,177	8.0	73,239	7.0
≥2 incidents	50,294	5.7	52,955	6.0	53,175	5.6	58,734	5.6
Two	56,450	6.5	55,171	6.3	49,747	5.2	49,464	4.7
≥ Three	20,745	2.4	19,585	2.2	17,516	1.8	15,664	1.5

^a The population included in this study had at least one opioid prescription. The difference in the value in 2015 compared with the baseline year (2005) is statistically significant ($p < 0.001$) for all indicators. Data source was Truven Health MarketScan Multi-State Medicaid data, 2005–2015.

LA/ER: Long acting or extended release, BZD: benzodiazepine

Table A4. Demographic characteristics of commercial population and their opioid drug use, 2005–2015^a

	2005		2006		2007		2008		2009		2010		2011	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Age														
18–24	253,449	9.7	277,697	10.0	321,721	10.3	473,568	10.4	532,627	10.3	492,440	9.8	609,679	11.1
25–34	470,589	18.0	512,431	18.5	582,979	18.6	883,170	19.3	999,435	19.3	953,720	18.9	1,025,261	18.7
35–44	608,776	23.3	650,805	23.5	724,226	23.1	1,060,196	23.2	1,185,057	22.9	1,138,871	22.6	1,204,088	21.9
45–54	713,806	27.4	750,100	27.0	844,395	27.0	1,216,963	26.6	1,379,330	26.6	1,344,756	26.7	1,429,961	26.0
55–64	560,927	21.5	582,442	21.0	658,628	21.0	941,515	20.6	1,082,383	20.9	1,107,442	22.0	1,226,173	22.3
Mean	42.9		42.7		42.6		42.4		42.4		42.8		42.6	
Sex														
Male	1,086,923	41.7	1,172,570	42.3	1,323,075	42.2	1,943,819	42.5	2,195,214	42.4	2,121,607	42.1	2,349,905	42.8
Female	1,520,624	58.3	1,600,905	57.7	1,808,874	57.8	2,631,593	57.5	2,983,618	57.6	2,915,622	57.9	3,145,257	57.2
Number of opioid Rx obtained														
One	1,451,070	55.6	1,546,297	55.8	1,734,893	55.4	2,530,891	55.3	2,847,301	55.0	2,754,310	54.7	3,008,098	54.7
Two	463,036	17.8	495,807	17.9	556,506	17.8	806,897	17.6	908,290	17.5	881,798	17.5	957,138	17.4
≥Three	693,441	26.6	731,371	26.4	840,550	26.8	1,237,624	27.0	1,423,241	27.5	1,401,121	27.8	1,529,926	27.8
Mean	3.1		3.0		3.1		3.1		3.2		3.2		3.2	

^a The population included in this study had at least one opioid prescription. Data source was Truven Health MarketScan Commercial Claims and Encounters, 2005–2015.

Rx: Prescription

Table A4 (continued). Demographic characteristics of commercial population and their opioid drug use, 2005–2015^a

	2012		2013		2014		2015	
	N	%	N	%	N	%	N	%
Age								
18–24	629,105	11.4	498,896	11.6	484,334	11.5	358,528	11.4
25–34	1,023,720	18.6	765,450	17.8	753,556	17.9	549,418	17.5
35–44	1,190,597	21.7	921,334	21.5	900,325	21.4	655,703	20.9
45–54	1,408,511	25.6	1,090,237	25.4	1,054,319	25.1	779,923	24.9
55–64	1,243,089	22.6	1,016,963	23.7	1,007,549	24.0	789,845	25.2
Mean	42.6		42.9		42.9		43.2	
Sex								
Male	2,354,150	42.8	1,813,272	42.2	1,786,826	42.5	1,316,510	42.0
Female	3,140,872	57.2	2,479,608	57.8	2,413,257	57.5	1,816,907	58.0
Number of opioid Rx obtained								
One	3,026,660	55.1	2,410,937	56.2	2,376,494	56.6	1,821,130	58.1
Two	952,557	17.3	732,705	17.1	709,732	16.9	525,888	16.8
≥Three	1,515,805	27.6	1,149,238	26.8	1,113,857	26.5	786,399	25.1
Mean	3.2		3.1		3.1		2.9	

^a The population included in this study had at least one opioid prescription. Data source was Truven Health MarketScan Commercial Claims and Encounters, 2005–2015.

Rx: Prescription

Table A5. Demographic characteristics of Medicaid population and their opioid drug use, 2005–2015^a

	2005		2006		2007		2008		2009		2010		2011	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Age														
18–24	164,498	29.3	145,887	29.1	66,863	26.4	117,516	28.6	157,734	29.9	177,380	29.7	159,976	28.4
25–34	173,486	30.9	150,352	30.0	69,781	27.5	124,085	30.1	165,319	31.3	188,498	31.6	179,988	31.9
35–44	113,699	20.2	99,065	19.7	47,726	18.8	75,927	18.4	93,578	17.7	104,949	17.6	100,566	17.8
45–54	68,395	12.2	65,733	13.1	40,989	16.2	58,616	14.2	69,713	13.2	78,892	13.2	76,352	13.5
55–64	42,086	7.5	40,835	8.1	28,310	11.2	35,441	8.6	41,351	7.8	47,467	7.9	47,375	8.4
Mean	33.4		33.7		35.4		34.0		33.3		33.4		33.7	
Sex														
Male	114,707	20.4	104,040	20.7	56,412	22.2	87,447	21.2	111,271	21.1	130,401	21.8	124,999	22.2
Female	447,457	79.6	397,832	79.3	197,257	77.8	324,138	78.8	416,424	78.9	466,785	78.2	439,258	77.8
Race														
White	356,511	63.4	322,100	64.2	157,404	62.1	249,427	60.6	313,729	59.5	361,966	60.6	324,341	57.5
Black	177,590	31.6	153,678	30.6	79,683	31.4	135,178	32.8	180,027	34.1	191,885	32.1	187,682	33.3
Hispanic	5,538	1.0	5,552	1.1	4,173	1.6	7,704	1.9	10,308	2.0	12,420	2.1	11,425	2.0
Others	22,525	4.0	20,542	4.1	12,409	4.9	19,276	4.7	23,631	4.5	30,915	5.2	40,809	7.2
Number of opioid Rx obtained														
One	230,001	40.9	203,868	40.6	101,747	40.1	164,352	39.9	209,018	39.6	236,502	39.6	227,646	40.3
Two	101,309	18.0	88,508	17.6	43,227	17.0	71,985	17.5	93,637	17.7	104,945	17.6	98,187	17.4
≥Three	230,854	41.1	209,496	41.7	108,695	42.8	175,248	42.6	225,040	42.6	255,739	42.8	238,424	42.3
Mean	4.4		4.4		4.9		4.8		4.8		4.7		4.7	

^a The population included in this study had at least one opioid prescription. Data source was Truven Health MarketScan Multi-State Medicaid data, 2005–2015.

Rx: Prescription

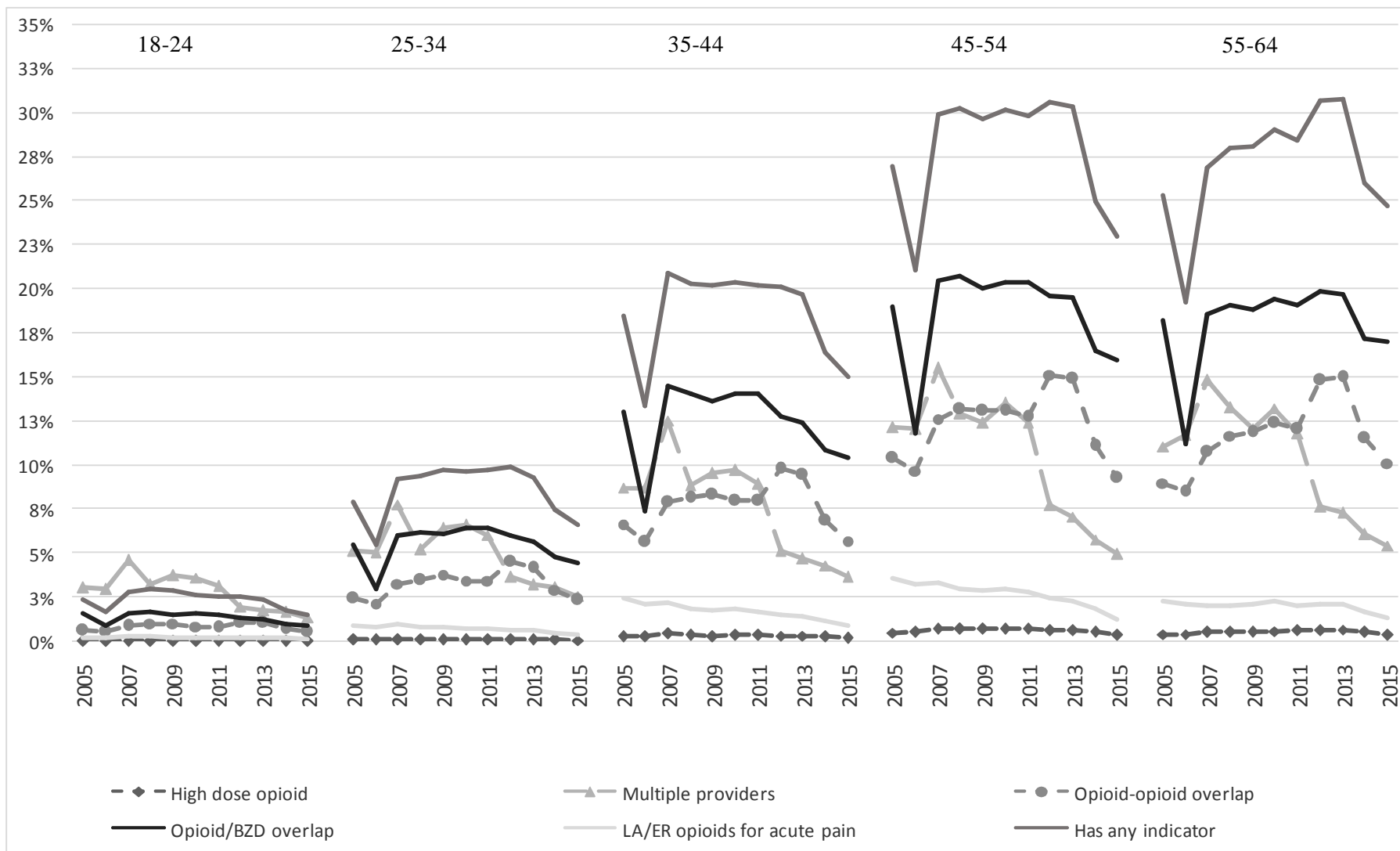
Table A5 (continued). Demographic characteristics of Medicaid population and their opioid drug use, 2005–2015^a

	2012		2013		2014		2015	
	N	%	N	%	N	%	N	%
Age								
18–24	226,472	25.9	211,986	24.2	205,379	21.6	213,216	20.4
25–34	285,018	32.6	287,720	32.8	308,577	32.4	331,449	31.8
35–44	166,591	19.0	171,770	19.6	194,079	20.4	219,491	21.1
45–54	121,202	13.9	123,635	14.1	146,711	15.4	165,245	15.8
55–64	75,411	8.6	80,856	9.2	98,224	10.3	113,279	10.9
Mean	34.3		34.7		35.7		36.1	
Sex								
Male	214,299	24.5	212,194	24.2	252,259	26.5	290,234	27.8
Female	660,395	75.5	663,773	75.8	700,711	73.5	752,446	72.2
Race								
White	530,703	60.7	524,992	59.9	542,683	56.9	576,617	55.3
Black	271,620	31.1	279,017	31.9	294,066	30.9	313,100	30.0
Hispanic	19,273	2.2	19,254	2.2	21,076	2.2	22,084	2.1
Others	53,098	6.1	52,704	6.0	95,145	10.0	130,879	12.6
Number of opioid Rx obtained								
One	328,922	37.6	333,446	38.1	382,484	40.1	434,309	41.7
Two	153,728	17.6	153,447	17.5	168,063	17.6	181,541	17.4
≥Three	392,044	44.8	389,074	44.4	402,423	42.2	426,830	40.9
Mean	5.1		5.0		4.6		4.4	

^a The population included in this study had at least one opioid prescription. Data source was Truven Health MarketScan Multi-State Medicaid data, 2005–2015.

Rx: Prescription

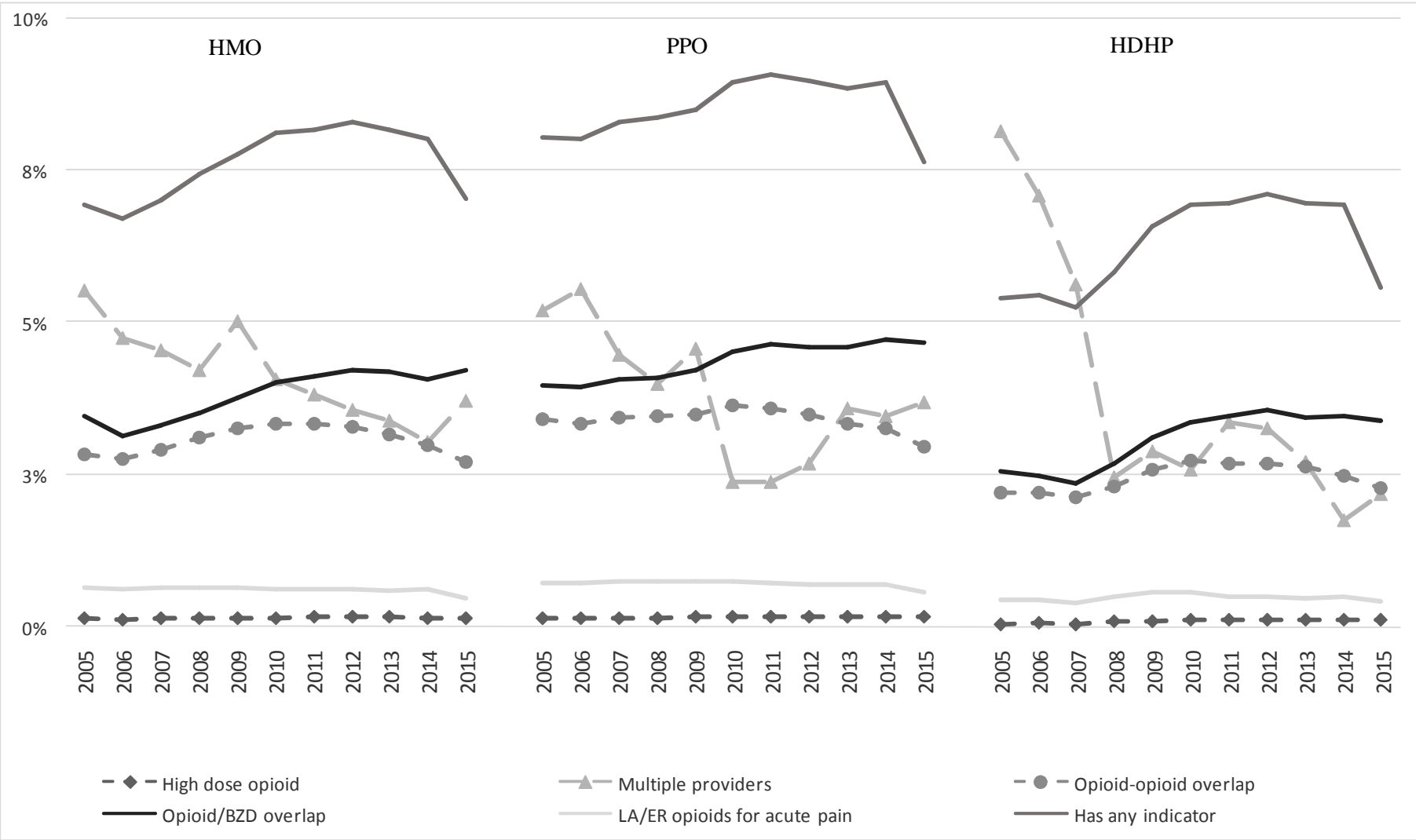
FIGURE A1. Indicators of potentially problematic opioid prescription with ≥ 2 incidents by age among Medicaid enrollees, 2005–2015^a



^a The population included in this study had at least one opioid prescription. The difference in the value in 2015 compared with the baseline year (2005) is statistically significant ($p < 0.001$) for all indicators, except high-dose opioid among 18-24 and 55-64 age groups and opioid-opioid overlap among 25-34 age group ($p < 0.05$). Data source was Truven Health MarketScan Multi-State Medicaid data, 2005–2015.

LA/ER: Long-acting or Extended-release, BZD: Benzodiazepine

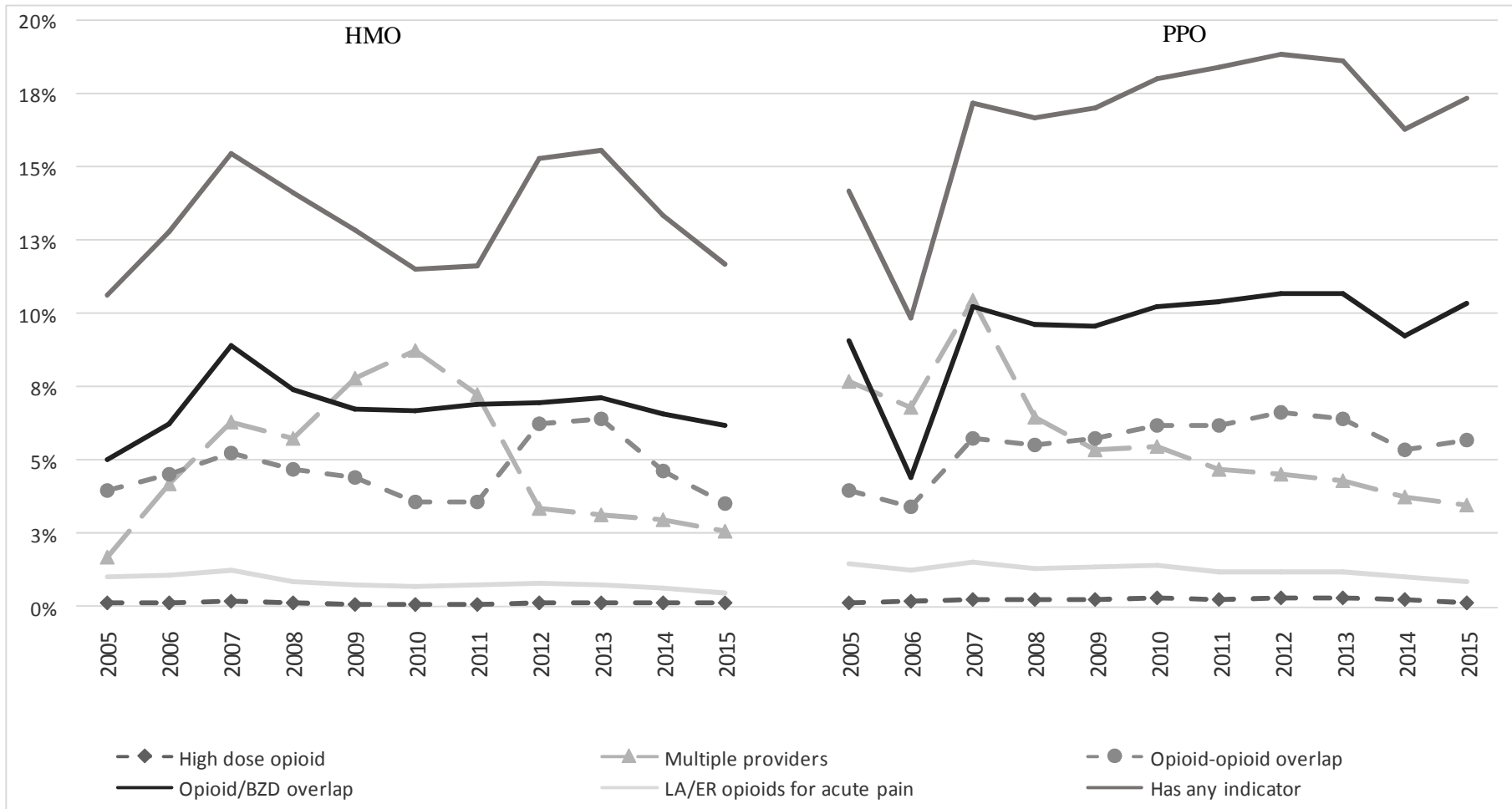
Figure A2: Indicators of potentially problematic opioid prescription with ≥ 2 incidents by plan type among commercially insured enrollees, 2005–2015^a



^a The population included in this study had at least one opioid prescription. The difference in the value in 2015 compared to the baseline year (2005) is statistically significant ($p < 0.001$) for all indicators, except high-dose opioid among HMO group and opioid-opioid overlap among HDHP group. Data source was Truven Health MarketScan Commercial Claims and Encounters data, 2005–2015.

LA/ER: Long acting or extended release, BZD: benzodiazepine

Figure A3. Indicators of potentially problematic opioid prescription with ≥ 2 incidents by plan type among Medicaid enrollees, 2005–2015^a



^a The population included in this study had at least one opioid prescription. The difference in the value in 2015 compared to the baseline year (2005) is statistically significant ($p < 0.001$) for all indicators, except high-dose opioid among both HMO and PPO groups. Data source was Truven Health MarketScan Multi-State Medicaid data, 2005–2015.

LA/ER: Long acting or extended release, BZD: benzodiazepine