A Pilot Study Using Electronic Health Records from Hospital Emergency Departments

to Monitor Drug Use Trends in Overdose Patients in the Baltimore Area,

January 2016-December 2018

May 1, 2019, Revised

Overview and Findings

The University of Maryland Medical System (UMMS) hospitals use the Epic electronic health record (EHR) software to track patient information. This sub-study was designed to use this readily available data to conduct an epidemiologic study of the drugs detected in patients presenting to the emergency department (ED) with a chief complaint and/or diagnosis of overdose or drug-related health problems to better understand patterns in drug use and availability.

UMB sent to CESAR de-identified electronic health record data for 6,607 patients presenting to 4 Baltimore area emergency departments (University of Maryland Baltimore Washington Medical Center (BWMC), University of Maryland Medical Center-Midtown Campus (MTC), University of Maryland Medical Center (UMMC), and University of Maryland St. Joseph Medical Center (SJMC)) from January 2016 through December 2018 (Figure 1). Of these, 2,309 cases (35%) had drug toxicology results (Figure 2). Toxicology screens are typically ordered for suspected drug users, persons with psychiatric illnesses, or persons with an altered mental state. The percentage of patients who had a urinalysis result each quarter ranged from 23-49% (See Appendix A). The hospitals tested for the following 8 drugs: amphetamines, barbiturates, benzodiazepines, cocaine, marijuana, methadone, PCP, and opiates. Each institution's Institutional Review Board for the Protection of Human Subjects (IRB) reviewed the study methodology.

Patients from MTC and UMMC were slightly older and predominantly Black or African-American males, compared to those from BWMC and SJMC (Table 1).

The percentage of specimens testing positive for opiates peaked at 60% in April-June 2016, hit a low of 31% two years later in April-June 2018, and has now rebounded to 36% in October-December 2018 (Figure 3; Appendix B).

Opiates were the drug most often detected, found in 43% of tested specimens, followed by cocaine (37%), benzodiazepines (30%), and marijuana (22%) (Table 2). About half (47%) of the specimens tested positive for multiple drugs. A comparison of the test results from January 2016 through September 2017 with the more recent results from October through December 2018 showed a significant decrease in the percentage of specimens testing positive for opiates (43% vs. 36%, p<.05) and an

increase in the percentage of specimens testing positive for benzodiazepines (29% vs. 37%, p<.05). The percentage of specimens testing positive for opiates in the month of December 2018 (32%) was near the low end of the monthly range over the 36-month period (Figure 4). It is noteworthy that the opiate screen does not detect fentanyl.

While the average number of 8 drugs detected in all positive specimens was 1.93, barbiturate positive specimens contained the highest mean number of drugs of 8 (3.00), and opiate positive specimens contained the lowest (2.26, see Figure 5). Opiate positive specimens were most likely to also test positive for cocaine (51%), benzodiazepines (34%), and marijuana (21%). About one-third (37%) of opiate positive specimens contained 2 or more additional drugs (Table 3).

A comparison of the first and last six months of data collection showed no significant differences in the demographic characteristics of patients testing positive for opiates between the two time periods (Table 4). The decline in the percentage of specimens testing positive for opiates each quarter through April-June 2018 followed by the rebound through October-December 2018 was observed across all four hospitals (Figure 6) and age groups (Figure 7). However, this downward trend continued in patients aged 30 or younger, while a rebound was observed in patients aged 31 or older.

Implications

The decline in the percentage of specimens testing positive for opiates was not expected. The opiate screen used by the hospitals included in the study primarily detects codeine and the heroin metabolite morphine, but not fentanyl or other synthetic opioids. The decline in opiate positives likely does not reflect patterns of use of synthetic opioids, such as fentanyl, which are not detected by the hospital screen. Dr. Dezman completed an additional study using urine point-of-care (POC) fentanyl testing to measure the presence of fentanyl among ED patients seeking care for a drug overdose. Of the patients who underwent both the standard hospital urine drug screen and the POC fentanyl testing, 56% tested positive for fentanyl by POC and negative for opiates by the hospital screen (Dezman et al., 2019). Expanded testing of a small number of newly collected patient specimens may inform us whether the opiate screen used by the hospitals is missing a larger opioid problem.

In the midst of a statewide emergency stemming from an opioid epidemic, Maryland could benefit from further analysis of existing toxicology data to gather more rapid information on the scope and trajectory of the problem. This pilot study could pave the way for Baltimore to acquire a new testing protocol and serve as a model for expansion to other cities across the United States.
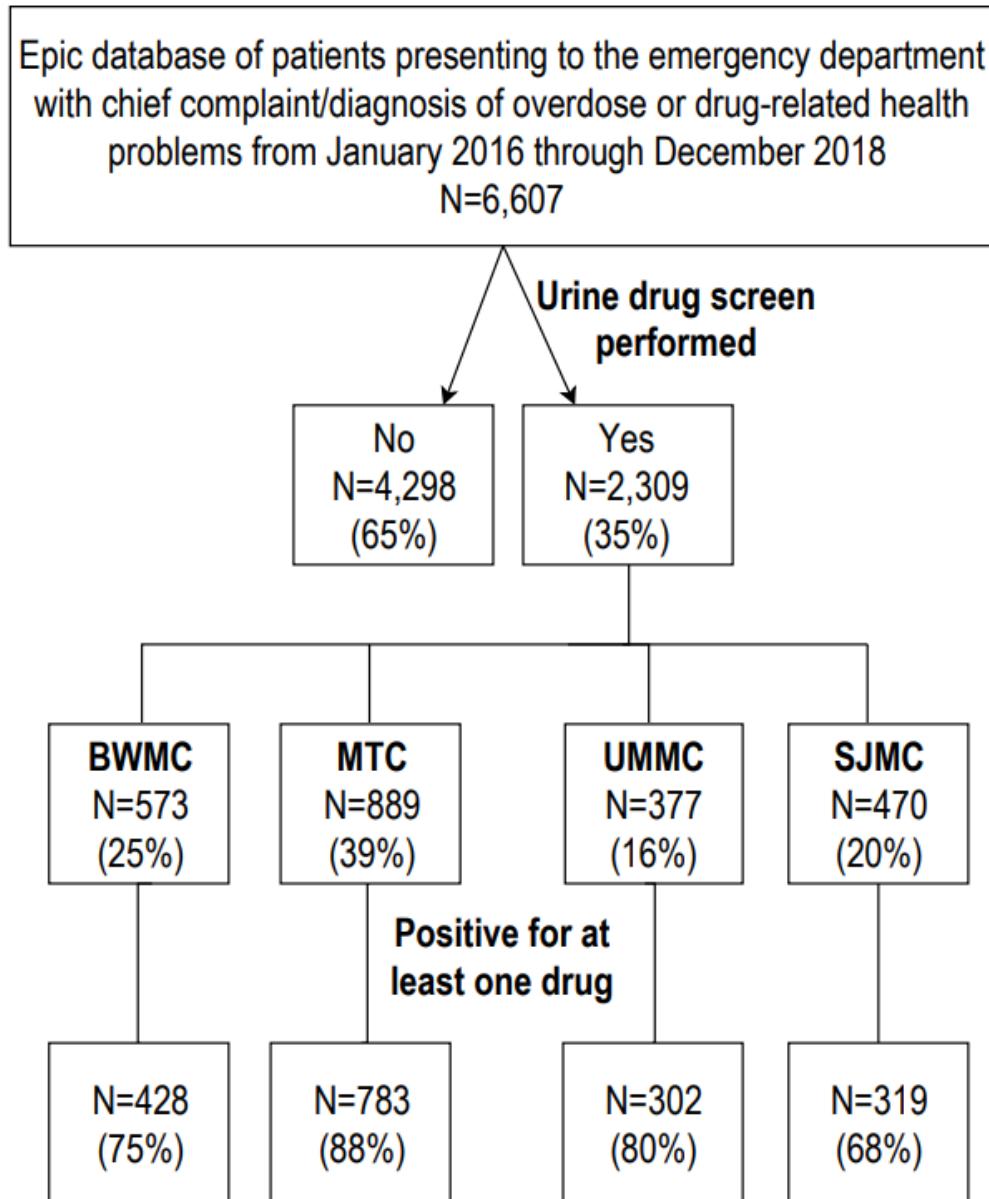
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Figure 1: Hospitals Included in Epic Database

Note: Data obtained from the following hospitals: Top to bottom: SJMC-University of Maryland St. Joseph Medical Center, toxicology results available beginning May 2017; MTC-University of Maryland Medical Center-Midtown Campus; UMMC-University of Maryland Medical Center; BWMC-University of Maryland Baltimore Washington Medical Center.

Figure 2: Cases Included in Epic Database
(N=6,607 specimens collected from ED patients from four hospitals^ from January 2016 through December 2018)

Epic database of patients presenting to the emergency department with chief complaint/diagnosis of overdose or drug-related health problems from January 2016 through December 2018
N=6,607

Urine drug screen performed

No
N=4,298
(65%)

Yes
N=2,309
(35%)

BWMC
N=573
(25%)

MTC
N=889
(39%)

UMMC
N=377
(16%)

SJMC
N=470
(20%)

Positive for at least one drug

N=428
(75%)

N=783
(88%)

N=302
(80%)

N=319
(68%)

Note: ^Data obtained from the following hospitals: BWMC- University of Maryland Baltimore Washington Medical Center, toxicology results available beginning May 2017; MTC- University of Maryland Medical Center- Midtown Campus; UMMC- University of Maryland Medical Center; SJMC- University of Maryland St. Joseph Medical Center.

Test results were obtained for 2,309 (35%) of the 6,607 cases from January 2016 through December 2018.
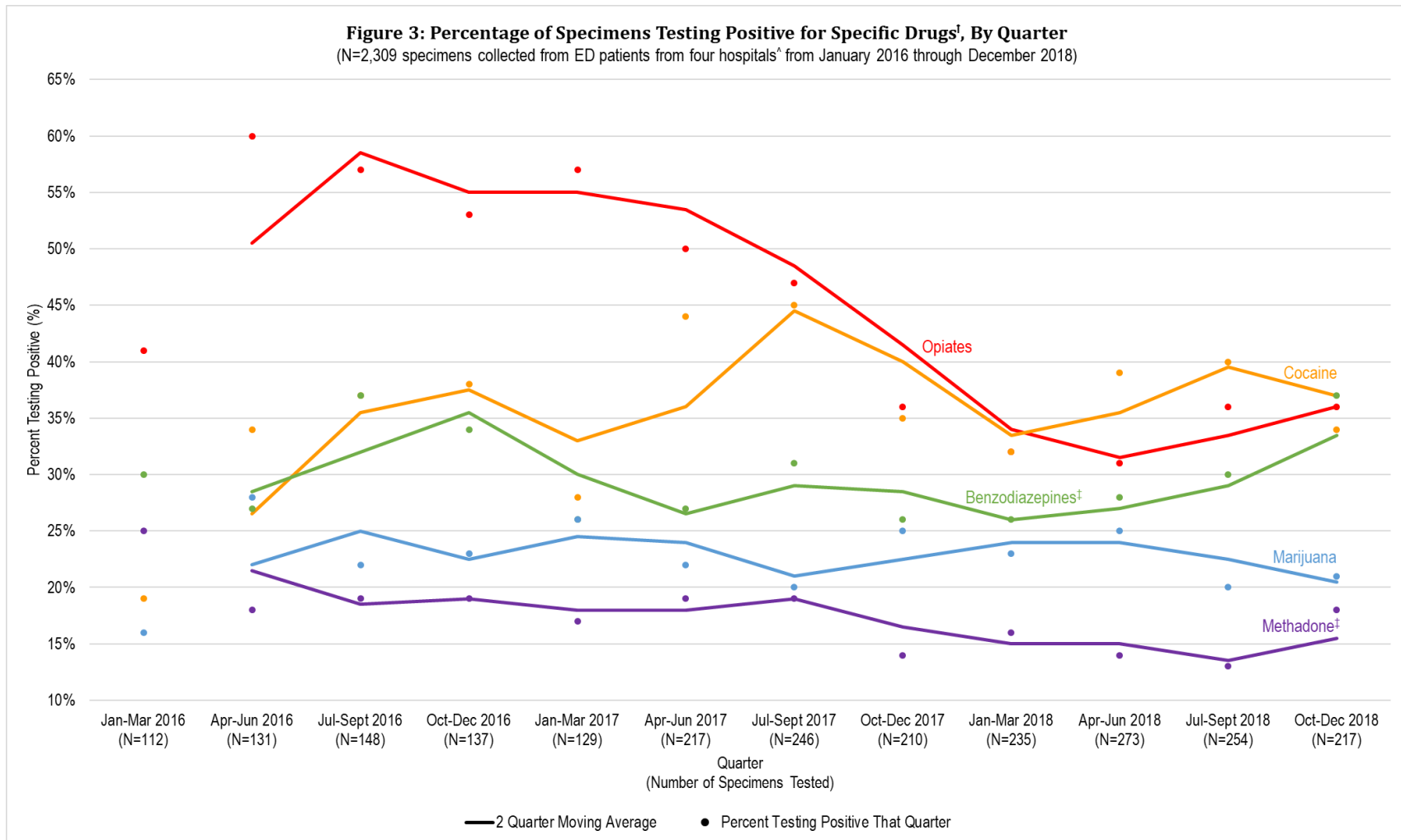
Table 1: Demographics of Emergency Department (ED) Patients, By Hospital
(N=2,309 specimens collected from ED patients from four hospitals from January 2016 through December 2018)

	University of Maryland Baltimore Washington Medical Center^ (N=573) %	University of Maryland Medical Center Midtown Campus (N=889) %	University of Maryland Medical Center (N=377) %	University of Maryland St. Joseph Medical Center (N=470) %
Sex				
Male	52	66	66	48
Female	48	34	34	52
Total:	100%	100%	100%	100%
Age				
<21	7	1	0	9
21-30	26	12	21	32
31-40	24	15	21	19
41-50	15	25	18	15
51-60	17	35	26	15
61+	11	12	14	10
Total:	100%	100%	100%	100%
Mean Age (SD)	39.9 (14.9)	47.6 (12.5)	44.9 (14.2)	38.6 (15.8)
Race[†]				
White	73	20	33	73
Black or African American	23	79	65	22
American Indian or Alaskan Native	<1	<1	0	<1
Asian	2	<1	<1	2
Other	2	<1	1	3
Total:	100%	100%	100%	100%

Notes: ^University of Maryland Baltimore Washington Medical Center toxicology results available beginning May 2017.
[†]N's vary slightly due to missing data.

Patients from University of Maryland Medical Center Midtown Campus and University of Maryland Medical Center are slightly older and predominantly Black or African American males.

Figure 3: Percentage of Specimens Testing Positive for Specific Drugs[†], By Quarter
(N=2,309 specimens collected from ED patients from four hospitals[^] from January 2016 through December 2018)

Notes: [†]Amphetamines, Barbiturates, and PCP results not shown because less than 10% tested positive each quarter.
[^]Data obtained from the following hospitals: BWMC- University of Maryland Baltimore Washington Medical Center, toxicology results available beginning May 2017; MTC- University of Maryland Medical Center- Midtown Campus; UMMC- University of Maryland Medical Center; SJMC- University of Maryland St. Joseph Medical Center.
[‡]N's vary slightly because not all specimens were tested each quarter.

The percentage of specimens testing positive for opiates peaked at 60% in April-June 2016, hit a low two years later in April-June 2018, and has now rebounded to 36% in October-December 2018.

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Table 2: Drugs Detected in Specimens from Emergency Department (ED) Patients from Four Hospitals, By Two Time Periods

(N=2,309 specimens collected from ED patients from four hospitals^ from January 2016 through December 2018)

Drugs Detected	January 2016-September 2017 (N=2,092) %	October-December 2018 (N=217) %	January 2016-December 2018 (N=2,309) %
1. Opiates	43*	36*	43
2. Cocaine	37	34	37
3. Benzodiazepines†	29*	37*	30
4. Marijuana	23	21	22
5. Methadone†	17	18	17
6. Amphetamines	4	4	4
7. Barbiturates†	2	<1	2
8. PCP	2	3	2
Number of Drugs in Specimen (of 8):			
0	21	20	21
1	32	35	32
2	26	27	26 ⎤
3	16	13	16 ⎬ 47%
4+	5	5	5 ⎦
Total:	100%	100%	100%
Mean Number of Drugs in Specimen (of 8):			
	1.54	1.50	1.53

Notes: ^Data obtained from the following hospitals: BWMC- University of Maryland Baltimore Washington Medical Center, toxicology results available beginning May 2017; MTC- University of Maryland Medical Center- Midtown Campus; UMMC- University of Maryland Medical Center; SJMC- University of Maryland St. Joseph Medical Center.
*p<.05 based on Chi-Square.
†N's vary slightly due to missing data.

The October-December 2018 quarter showed a significant decrease in the percentage of specimens testing positive for opiates (43% vs. 36%, p<.05) and an increase in the percentage of specimens testing positive for benzodiazepines (29% vs. 37%, p<.05). From January 2016-December 2018, about half (47%) of all specimens tested positive for 2 or more drugs.

Figure 4: Range of the High and Low Monthly Percentages Testing Positive for Each Drug
(N=2,309 specimens collected from ED patients from four hospitals^ from January 2016 through December 2018)

Range of Monthly Percentage Testing Positive   • Percentage Testing Positive in December 2018   *Percentage occurred in multiple months; most recent month indicated

Note: ^Data obtained from the following hospitals: BWMC- University of Maryland Baltimore Washington Medical Center, toxicology results available beginning May 2017; MTC- University of Maryland Medical Center- Midtown Campus; UMMC- University of Maryland Medical Center; SJMC- University of Maryland St. Joseph Medical Center.
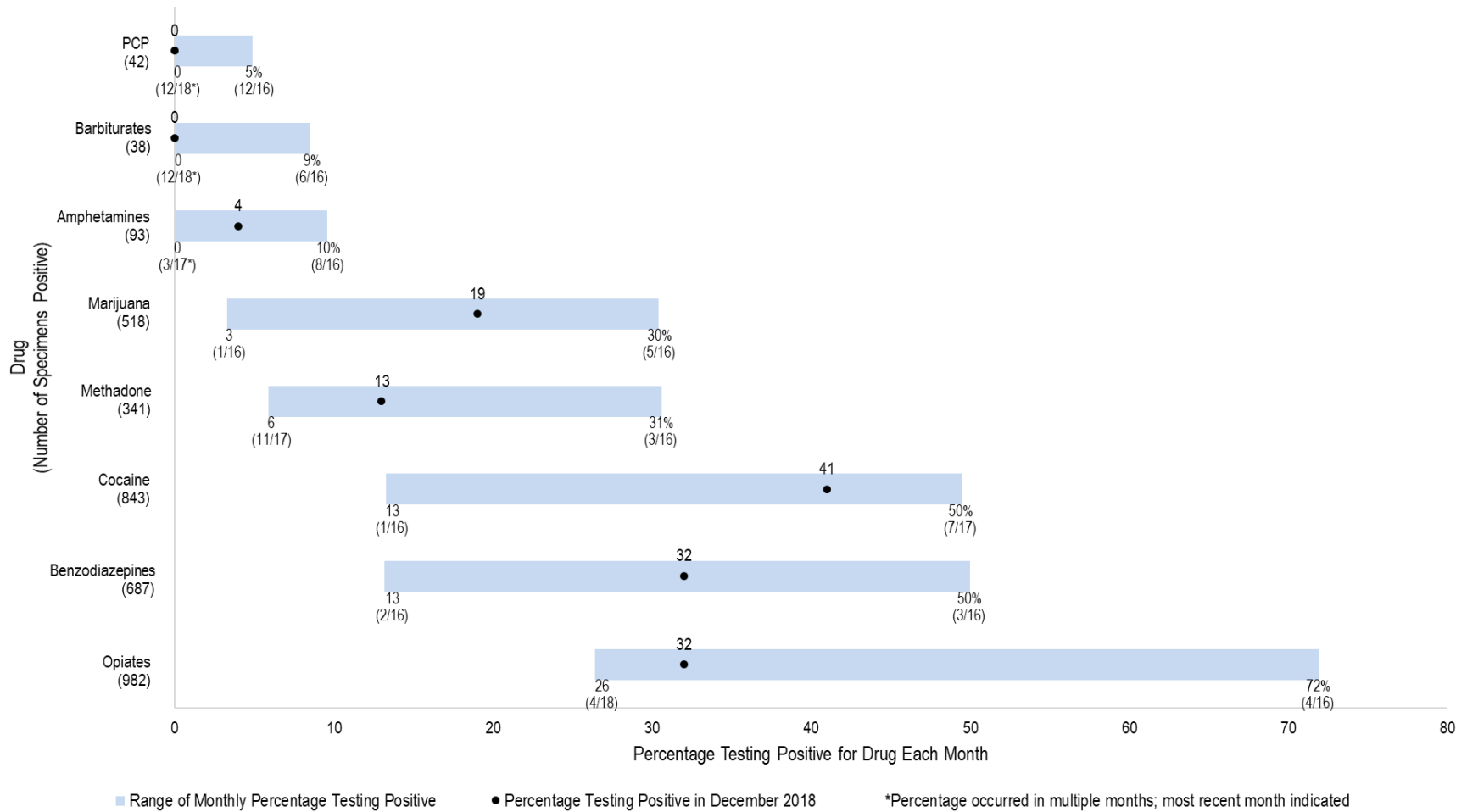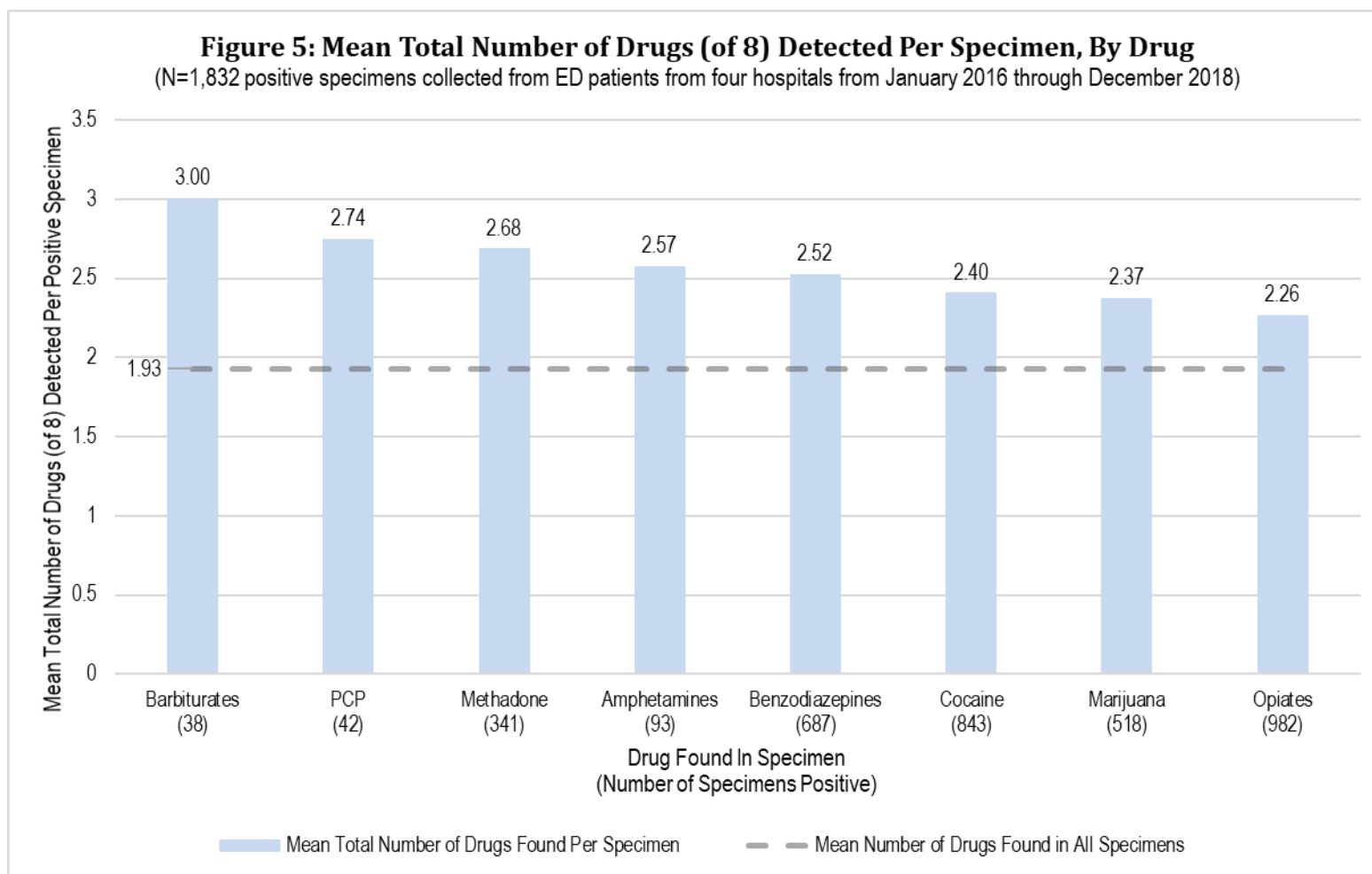
The percentage of specimens testing positive for opiates (32% in December 2018) was near the low end of the monthly range since data collection started in January 2016.

Figure 5: Mean Total Number of Drugs (of 8) Detected Per Specimen, By Drug
(N=1,832 positive specimens collected from ED patients from four hospitals from January 2016 through December 2018)

Notes: ^Data obtained from the following hospitals: BWMC- University of Maryland Baltimore Washington Medical Center, toxicology results available beginning May 2017; MTC- University of Maryland Medical Center- Midtown Campus; UMMC- University of Maryland Medical Center; SJMC- University of Maryland St. Joseph Medical Center.
†N's vary slightly due to missing data.

Specimens containing barbiturates contained the highest mean number of drugs of 8 (3.00), and specimens containing opiates had the lowest (2.26).
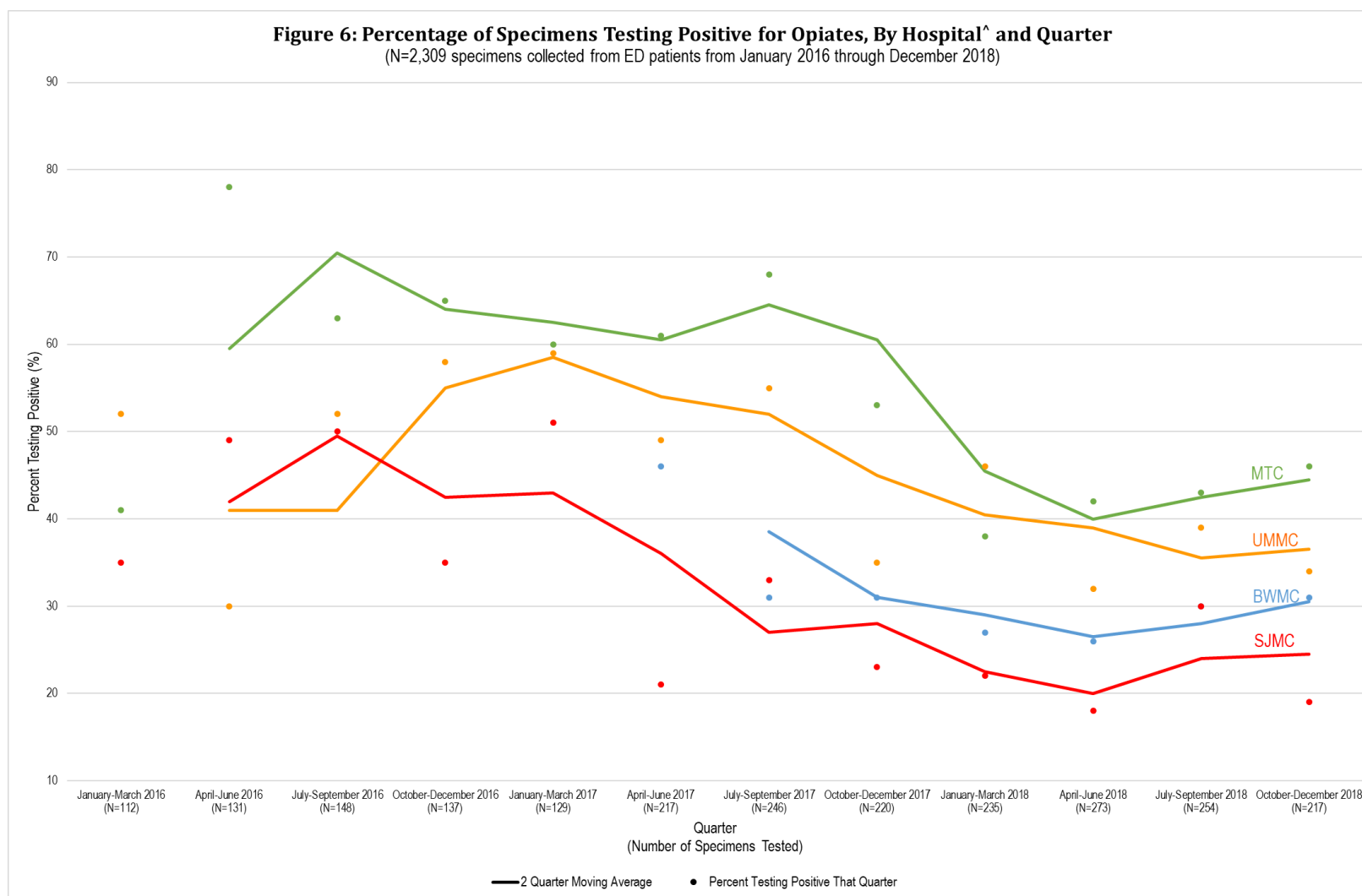
Table 3: Other Drugs Detected in Opiate Positive Urine Specimens

(N=982 opiate positive specimens collected from ED patients from four hospitals^ from January 2016 through December 2018)

Other Drugs Detected in Opiate Positive Specimens	Percent Positive (N=982) %
1. Cocaine	51
2. Benzodiazepines[†]	(n=981) 34
3. Marijuana	21
4. Methadone[†]	(n=860) 17
5. Amphetamines	3
6. Barbiturates[†]	(n=859) 2
7. PCP	2
Number of Other Drugs in Opiate Positive Specimens (of 7):	
0	24
1	39
2	26 ⎤ 37%
3+	11 ⎦
Total:	100%

Notes: ^Data obtained from the following hospitals: BWMC- University of Maryland Baltimore Washington Medical Center, toxicology results available beginning May 2017; MTC- University of Maryland Medical Center- Midtown Campus; UMMC- University of Maryland Medical Center; SJMC- University of Maryland St. Joseph Medical Center.
[†]N's vary slightly due to missing data.

Cocaine was most likely to be found in opiate positive specimens (51%), followed by benzodiazepines (34%), and marijuana (21%). About one-third (37%) of opiate positive specimens contained 2 or more additional drugs.

Figure 6: Percentage of Specimens Testing Positive for Opiates, By Hospital^ and Quarter
(N=2,309 specimens collected from ED patients from January 2016 through December 2018)

Notes: ^Data obtained from the following hospitals: BWMC- University of Maryland Baltimore Washington Medical Center, toxicology results available beginning May 2017; MTC- University of Maryland Medical Center- Midtown Campus; UMMC- University of Maryland Medical Center; SJMC- University of Maryland St. Joseph Medical Center.

The decline in the percentage of specimens testing positive for opiates each quarter through April-June 2018 followed by the rebound through October-December 2018 was observed across all four hospitals.

Table 4: Demographics of Emergency Department (ED) Patients Testing Positive for Opiates, By Two Time Periods
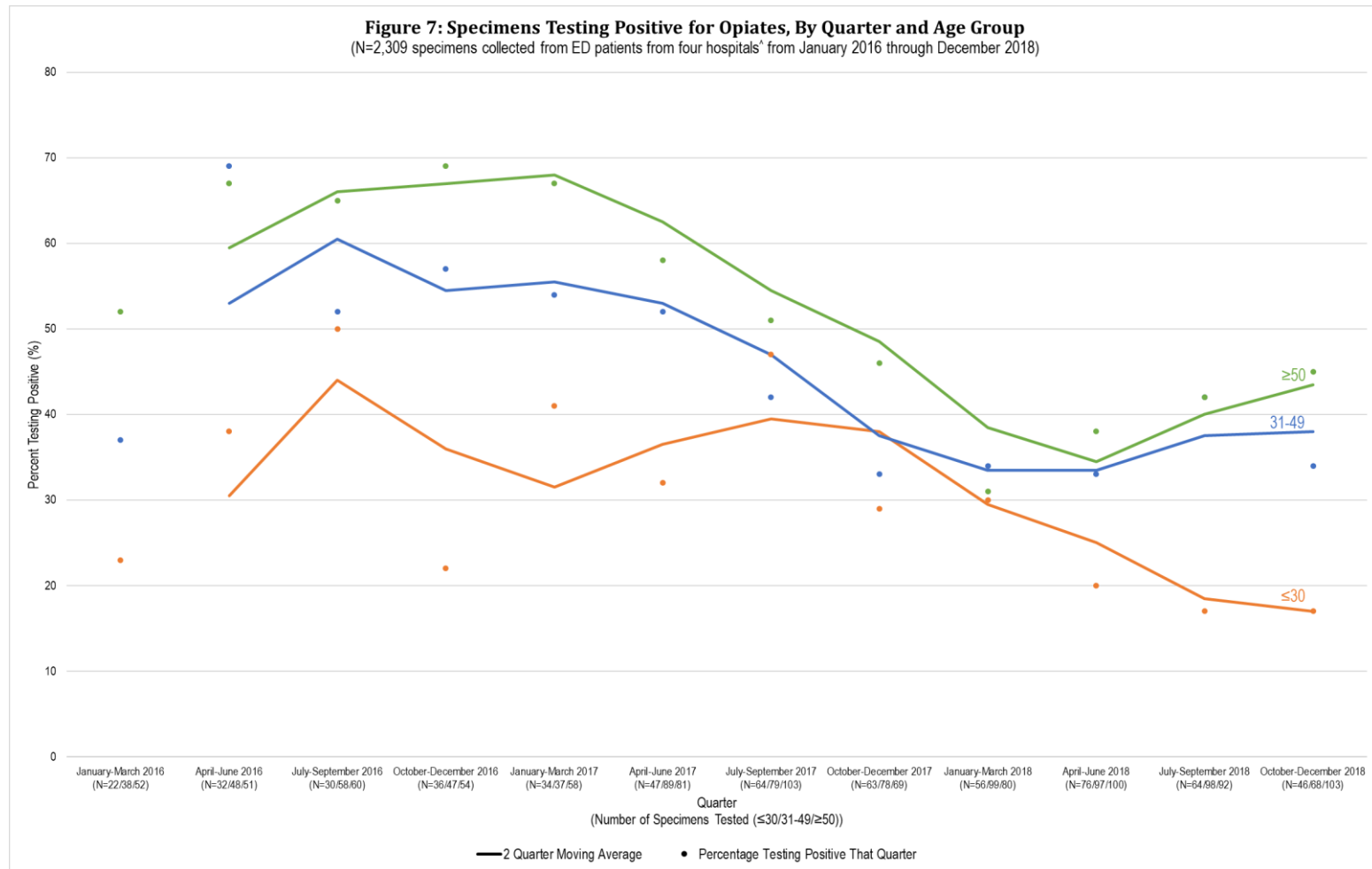
(N=293 opiate positive specimens collected from ED patients from four hospitals^)

	January-June 2016 (N=125) %	July-December 2018 (N=168) %
Sex		
Male	76	66
Female	24	34
Total:	100%	100%
Age		
<21	<1	2
21-30	13	9
31-40	17	17
41-50	22	23
51-60	34	32
61+	14	17
Total:	100%	100%
Mean Age (SD)	46.8 (12.7)	48.1 (13.1)
Race[†]		
Black or African American	59	57
White	39	43
Asian	2	0
Total:	100%	100%

Notes: ^Data obtained from the following hospitals: BWMC- University of Maryland Baltimore Washington Medical Center, toxicology results available beginning May 2017; MTC- University of Maryland Medical Center- Midtown Campus; UMMC- University of Maryland Medical Center; SJMC- University of Maryland St. Joseph Medical Center.
[†]N's vary slightly due to missing data.

There were no significant differences in the demographic characteristics of patients testing positive for opiates between the first and last six months of data collection.

Figure 7: Specimens Testing Positive for Opiates, By Quarter and Age Group
(N=2,309 specimens collected from ED patients from four hospitals^ from January 2016 through December 2018)

Quarter
(Number of Specimens Tested (≤30/31-49/≥50))

2 Quarter Moving Average   • Percentage Testing Positive That Quarter

Notes: ^Data obtained from the following hospitals: BWMC- University of Maryland Baltimore Washington Medical Center, toxicology results available beginning May 2017; MTC- University of Maryland Medical Center- Midtown Campus; UMMC- University of Maryland Medical Center; SJMC- University of Maryland St. Joseph Medical Center.

The decline in the percentage of specimens testing positive for opiates each quarter through April-June 2018 was observed across age groups. However, this downward trend continued in patients aged 30 or younger, while a rebound was observed in patients aged 31 or older.

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Appendix A: Percentage of Cases with a Urine Toxicology Result, By Quarter

(N=6,607 cases from ED patients from four hospitals^ from January 2016 through December 2018)

Quarter	Total Cases (N)	Cases Tested f	Percentage of Cases Tested %
January-March 2016	388	112	29
April-June 2016	544	131	24
July-September 2016	603	148	25
October-December 2016	547	137	25
January-March 2017	559	129	23
April-June 2017	735	217	30
July-September 2017	565	246	44
October-December 2017	516	210	41
January-March 2018	510	235	46
April-June 2018	622	273	44
July-September 2018	524	254	49
October-December 2018	494	217	44
Total:	**6607**	**2309**	**35**

Notes: ^Data obtained from the following hospitals: BWMC- University of Maryland Baltimore Washington Medical Center, toxicology results available beginning May 2017; MTC- University of Maryland Medical Center- Midtown Campus; UMMC- University of Maryland Medical Center; SJMC- University of Maryland St. Joseph Medical Center.

The percentage of patients who had a urinalysis result ranged from 23-49%. The percentage has increased since April-June 2017.

Appendix B: Drugs Detected in Specimens from Emergency Department (ED) Patients, By Quarter

(N=2,309 specimens collected from ED patients from four hospitals^ from January 2016 through December 2018)

Quarter (N of specimens tested)	Opiates %	Cocaine %	Benzodiazepines† (N) %	Marijuana %	Methadone† (N) %	Amphetamines %	Barbiturates† (N) %	PCP %
January-March 2016 (112)	41	19 L	30	16 L	(96) 25 H	3	(96) 2	<1
April-June 2016 (131)	60 H	34	(128) 27	28 H	(114) 18	2	(111) 5 H	2
July-September 2016 (148)	57	37	37 H	22	(127) 19	5	(127) 2	0 L
October-December 2016 (137)	53	38	(135) 34	23	(119) 19	4	(117) 2	2
January-March 2017 (129)	57	28	26	26	(109) 17	<1 L	(109) 0 L	<1
April-June 2017 (217)	50	44	27	22	(182) 19	3	(182) 3	2
July-September 2017 (246)	47	45 H	31	20	(236) 19	4	(237) 2	2
October-December 2017 (210)	36	35	26 L	25	(193) 14	5	(193) 2	2
January-March 2018 (235)	32	32	26	23	(210) 16	3	(210) 3	<1
April-June 2018 (273)	31 L	39	(271) 28	25	(244) 14	6	(241) 1	3 H
July-September 2018 (254)	36	40	30	20	(226) 13 L	6 H	(225) <1	2
October-December 2018 (217)	36	34	37	21	(192) 18	4	(191) <1	3

Notes: ^Data obtained from the following hospitals: BWMC- University of Maryland Baltimore Washington Medical Center, toxicology results available beginning May 2017; MTC- University of Maryland Medical Center- Midtown Campus; UMMC- University of Maryland Medical Center; SJMC- University of Maryland St. Joseph Medical Center.

†N's vary slightly due to missing data.

H: Highest quarter.

L: Lowest quarter.