

Supplemental Online Content

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This supplemental material has been provided by the authors to give readers additional information about their work.

eTable 1. Patient- and Visit-Level Characteristics Comparing All Patients With and Without Behavioral Flags Excluding Sickle Cell Related Chief Concerns and Frequent Utilizing Patients

	Flag	No flag	
	All Patients, N (%)	All Patients, N (%)	P Value
Total Patients	522 (0.3%)	194,192 (99.7)	
Total Visits	1184 (0.3%)	382,658 (99.7)	
Age			P=.000
	<i>18-24</i>	54 (10.3)	55,829 (14.6)
	<i>25-34</i>	132 (25.3)	81,953 (21.4)
	<i>35-44</i>	133 (25.5)	53,872 (14.2)
	<i>45-54</i>	100 (19.2)	53,230 (13.9)
	<i>55-64</i>	78 (14.9)	59,886 (15.7)
	<i>65 and older</i>	25 (4.8)	77,888 (20.4)
Gender			P=.000
	<i>Male</i>	289 (55.4)	157,900 (41.3)
	<i>Female</i>	233 (44.6)	224,756 (58.7)
Race			P=.000
	<i>Black (Includes Hispanic/Latinx)</i>	355 (68.0)	250,091 (65.4)
	<i>White (includes Hispanic/Latinx)</i>	167 (32.0)	132,567 (34.6)
Insurance status			P=.000
	<i>Commercial</i>	69 (5.8)	40,846 (10.7)
	<i>Managed care</i>	60 (5.1)	88,539 (23.1)
	<i>Medicaid</i>	750 (63.3)	132,206 (34.6)
	<i>Medicare</i>	240 (20.3)	98,452 (25.7)
	<i>Self-pay</i>	65 (5.5)	22,607 (5.9)
Emergency Severity Index (ESI) Level			
	<i>ESI Level 1 (most acute)</i>	7 (.6)	2,532 (.7)
	<i>ESI Level 2</i>	288 (25.0)	86,544 (23.2)
	<i>ESI Level 3</i>	595 (51.7)	193,311 (51.9)
	<i>ESI Level 4</i>	188 (16.4)	78,767 (21.1)
	<i>ESI Level 5 (least acute)</i>	53 (4.6)	9,511 (2.6)
	<i>Psych</i>	19 (1.7)	2,029 (.5)
Emergency Department			
	<i>Hospital #1 (Tertiary Referral Center)</i>	412 (34.8)	157,520 (41.1)
	<i>Hospital #2</i>	454 (38.3)	99,400 (26.0)
	<i>Hospital #3 (Level 1 Trauma Center)</i>	318 (26.9)	125,738 (32.9)
Insurance status			
	<i>Commercial</i>	69 (5.8)	40,846 (10.7)
	<i>Managed care</i>	60 (5.1)	88,539 (23.1)
	<i>Medicaid</i>	750 (63.3)	132,206 (34.6)

<i>Medicare</i>	240 (20.3)	98,452 (25.7)	
<i>Self-pay</i>	65 (5.5)	22,607 (5.9)	
	Flag	No flag	
	Median (IQR)	Median (IQR)	P Value
WR time (minutes)	20.27 (7.95-77.53)	29.63 (10.43-91.97)	P=.000
Wait to see clinician (minutes)	33.79 (15.87-82.75)	40.07 (18.72-95.60)	P=.000
In-room time (minutes)	222.95 (110.35-386.2)	224.75 (125.08-374.06)	p=.5965
ED LOS (minutes)	277.28 (149-461)	291 (173-466)	p=.0123
	All Patients, N (%)	All Patients, N (%)	P Value
Number of lab orders			
<i>0 lab orders</i>	415 (35.05)	104,287 (27.25)	P=.000
<i>1-3 lab orders</i>	133 (11.23)	46,539 (12.16)	
<i>4 or more lab orders</i>	636 (53.72)	231,832 (60.58)	
Number of medication orders			P=.000
<i>0 medication orders</i>	292 (24.66)	66,012 (17.55)	P=.000
<i>1-3 medication orders</i>	411 (34.71)	141,317 (36.93)	
<i>4 or more medication orders</i>	481 (40.62)	175,329 (45.82)	
Number of imaging orders			P=.000
<i>None</i>	616 (52.03)	152,086 (39.74)	P=.000
<i>X-ray only</i>	266 (22.47)	100,369 (26.23)	
<i>Advanced imaging (CT, US, or MRI)</i>	302 (25.51)	130,203 (34.03)	
Disposition			P=.000
<i>Admit</i>	177 (14.96)	69847 (18.16)	P=.000
<i>Discharge</i>	750 (63.4)	264911 (68.89)	
<i>Left against medical advice or without being seen</i>	200 (16.91)	26492 (6.89)	
<i>Observation</i>	23 (1.94)	16756 (4.36)	
<i>Transfer</i>	20 (1.69)	2951 (.77)	
<i>Triaged</i>	4 (.34)	957 (.25)	
<i>Voided/Other</i>	10 (.84)	2623 (.68)	
Urine Drug Screen (UDS) present	114 (21.84)	12,849 (6.60)	P=.000
Presence of intramuscular medication**	62 (11.87)	15,744 (8.09)	p=.001
Restraints used	1 (.19)	46 (.02)	p=.024
*Non-flag visits for patients who eventually received a behavioral flag during the study period were excluded **excludes tetanus vaccine administration			

eTable 2. Patient- and Visit-Level Characteristics Comparing Black and White Patients with Behavioral Flags Excluding Sickle Cell Related Chief Complaints and Frequent Utilizing Patients

	Black Patients, N (%)	White Patients, N (%)	P Value
# and percent with flag	355 (3.1 flags per 1,000 patients)	167 (2.0 flags per 1,000 patients)	p<.001
	Black Pts with Flag	White Pts with Flag	
	Median (IQR)	Median (IQR)	P Value
Waiting room time, minutes	20.7 (7.8-74.3)	15.9 (7.4-56.1)	p=.048
Wait to see clinician, minutes	33.7 (15.4-78.6)	29.4 (13.9-72.6)	p=.198
In-room time, minutes	224.9 (113.6-401.2)	255.6 (130.7-401.0)	p=.152
Length of stay, minutes	276.9 (144-476)	293.9 (160-439)	p=.883
	N (%)	N (%)	P Value
Number of lab orders			p=.11
<i>0 lab orders</i>	308 (36.9)	107 (30.6)	
<i>1-3 lab orders</i>	90 (10.8)	43 (12.3)	
<i>4 or more lab orders</i>	436 (52.3)	200 (57.1)	
Number of medication orders			p=.14
<i>0 medication orders</i>	219 (26.3)	73 (20.9)	
<i>1-3 medication orders</i>	283 (33.9)	128 (36.6)	
<i>4 or more medication orders</i>	332 (39.8)	149 (42.6)	
Number of imaging orders			p=.18
<i>None</i>	442 (53.0)	174 (49.7)	
<i>X-ray only</i>	192 (23.0)	74 (21.1)	
<i>Advanced imaging (CT, US, or MRI)</i>	200 (24.0)	102 (29.1)	
Disposition			p=.005
<i>Admit</i>	104 (12.5)	73 (20.8)	
<i>Discharge</i>	536 (64.4)	214 (61.1)	
<i>Left against medical advice or without being seen</i>	154 (18.5)	46 (13.1)	
<i>Observation</i>	15 (1.8)	8 (2.3)	
<i>Transfer</i>	14 (1.7)	6 (1.7)	
<i>Triaged</i>	3 (.4)	1 (.3)	
<i>Voided/Other</i>	8 (1.0)	2 (.6)	
Emergency Department			P=.000
<i>Hospital of the University of Pennsylvania</i>	306 (36.7)	106 (30.3)	
<i>Pennsylvania Hospital</i>	268 (32.1)	186 (53.1)	
<i>Penn Presbyterian Medical Center</i>	260 (31.2)	58 (16.6)	
Insurance status			p=.001
<i>Commercial</i>	43 (5.2)	26 (7.4)	
<i>Managed care</i>	29 (3.5)	31 (8.9)	

<i>Medicaid</i>	548 (65.7)	202 (57.7)	p=.07
<i>Medicare</i>	166 (19.9)	74 (21.1)	
<i>Self-pay</i>	48 (5.8)	17 (4.9)	
Emergency Severity Index (ESI) Level			
<i>ESI Level 1 (most acute)</i>	3 (.4)	4 (1.1)	
<i>ESI Level 2</i>	202 (24.2)	86 (24.6)	
<i>ESI Level 3</i>	407 (48.8)	188 (53.7)	
<i>ESI Level 4</i>	142 (17.0)	46 (13.1)	
<i>ESI Level 5 (least acute)</i>	44 (5.3)	9 (2.6)	
<i>Psych</i>	11 (1.3)	8 (2.3)	
<i>Unknown</i>	25 (3.0)	9 (2.6)	

eTable 3. Patient- and Visit-Level Characteristics Comparing All Patients and High Utilizing Patients and Sickle Cell Related Concerns

Patient Characteristics Comparing All Comers and High Utilizers				
	All Comers	All Comers (Excluding Many Visitors)	Many Visitors (>18 visits)	
	All Patients, N (%)	All Patients, N (%)	All Patients, N (%)	P Value
Total Patients	195,601	194,719	881	
Total Visits	420,007	385,773	34,234	
Age				
18-24	31,497 (16.1)	31,431 (16.14)	66 (7.49)	p<.01
25-34	43,577 (22.28)	43,382 (22.28)	195 (22.13)	
35-44	28,397 (14.52)	28,231 (14.5)	166 (18.84)	
45-54	26,714 (13.66)	26,540 (13.63)	174 (19.75)	
55-64	28,818 (14.73)	28,663 (14.72)	155 (17.59)	
65 and older	36,598 (18.71)	36,473 (18.73)	125 (14.19)	
Gender				
Female	110,890 (56.69)	110,436 (56.72)	454 (51.53)	p<.01
Male	84,710 (43.31)	84,283 (43.28)	427 (48.47)	
Race				
Black (Includes Hispanic/Latinx)	113,638 (58.1)	112,908 (57.98)	730 (82.86)	p<.01
White (includes Hispanic/Latinx)	81,963 (41.9)	81,812 (42.02)	151 (17.14)	
Patient Characteristics Comparing All Comers and Chief Complaint Related to Sickle Cell				
	All Comers	All Comers, Excluding Sickle Cell Chief Complaint	Sickle Cell Chief Complaint	
	All Patients, N (%)	All Patients, N (%)	All Patients, N (%)	P Value
Total Patients	195,601	195,101	500	
Total Visits	420,007	412,784	7,223	
Age				
18-24	31,497 (16.1)	31,358 (16.1)	139 (27.8)	p<.01
25-34	43,577 (22.28)	43,361 (22.22)	216 (43.20)	
35-44	28,397 (14.52)	28,312 (14.51)	85 (17)	
45-54	26,714 (13.66)	26,677 (13.67)	37 (7.4)	
55-64	28,818 (14.73)	28,800 (14.76)	18 (3.6)	
65 and older	36,598 (18.71)	36,593 (18.76)	5 (1)	
Gender				
Female	110,890 (56.69)	110,607 (56.7)	283 (56.6)	p=.63
Male	84,710 (43.31)	84,493 (43.3)	217 (43.4)	
Race				
Black (Includes Hispanic/Latinx)	113,638 (58.1)	113,145 (58)	493 (98.6)	p<.01
White (includes Hispanic/Latinx)	81,963 (41.9)	81,956 (42)	7 (1.4)	

Visit-Level Characteristics Comparing All Comers and High Utilizers				
	All Comers (N, %)	All Comers Excluding Many Visitors (N, %)	Many Visitors (N, %)	P Value
# and percent with flag	683 (3.5 flags per 1,000 patients)	526 (2.7 flags per 1,000 patients)	157 (178 flags per 1,000 patients)	p<.01
	Median (IQR)	Median (IQR)	Median (IQR)	P Value
Waiting room time, minutes	29.23 (10.3-91.77)	29.55 (10.42-91.92)	25.63 (9.47-89.53)	p<.01
Wait to see clinician, minutes	40.03 (18.67-96)	40.05 (18.7-95.6)	40 (18.25-101.4)	p=.09
In-room time, minutes	226.2 (125.28-376.49)	225.37 (125.42-374.98)	235.43 (123.25-394.08)	p<.01
Length of stay, minutes	292 (172-467)	292 (173-466.01)	292 (160.22-477)	p<.01
	N (%)	N (%)	N (%)	P Value
Number of lab orders				
0 lab orders	117,051 (27.87)	105,302 (27.30)	11,749 (34.32)	p<.01
1-3 lab orders	50,774 (12.09)	46,930 (12.17)	3,844 (11.23)	
4 or more lab orders	252,182 (60.04)	233,541 (60.54)	18,641 (54.45)	
Number of medication orders				
0 medication orders	74,393 (17.71)	66,767 (17.31)	7,626 (22.28)	p<.01
1-3 medication orders	153,400 (36.52)	142,370 (36.91)	11,030 (32.22)	
4 or more medication orders	192,214 (45.76)	176,636 (45.79)	15,578 (45.5)	
Number of imaging orders				
None	172,939 (41.18)	153,675 (39.85)	19,264 (56.27)	p<.01
X-ray only	110,308 (26.27)	101,554 (26.33)	8,754 (25.57)	
Advanced imaging (CT, US, or MRI)	136,662 (32.55)	130,448 (33.82)	6,214 (18.15)	
Disposition				
Admit	76,054 (18.11)	70,037 (18.15)	6,017 (17.58)	p<.01
Discharge	288,439 (68.67)	265,694 (68.87)	22,745 (66.44)	
Left against medical advice or without being seen	30,287 (7.21)	26,697 (6.92)	3,590 (10.49)	
Observation	18,052 (4.3)	16,780 (4.35)	1,272 (3.72)	
Transfer	3,157 (.75)	2,971 (.77)	186 (.54)	
Triage	1,029 (.24)	961 (.25)	68 (.20)	
Voided/Other	2,989 (.71)	2,633 (.68)	356 (1.04)	
Emergency Department				
Hopsital of the University of Pennsylvania	171,447 (40.82)	158,554 (41.1)	12,893 (37.66)	p<.01
Pennsylvania Hospital	112,009 (26.67)	100,529 (26.06)	11,480 (33.53)	
Penn Presbyterian Medical Center	136,551 (32.51)	126,690 (32.84)	9,861 (28.8)	
Insurance status				
Commercial	42,505 (10.12)	41,039 (10.64)	1,462 (4.27)	p<.01
Managed care	90,477 (21.54)	88,730 (23)	1,747 (5.1)	
Medicaid	154,918 (36.89)	134,112 (34.77)	20,806 (60.78)	
Medicare	108,912 (25.93)	99,125 (25.7)	9,787 (28.59)	
Self-pay	23,190 (5.52)	22,759 (5.9)	431 (1.26)	
Emergency Severity Index (ESI) Level				
ESI Level 1 (most acute)	2,626 (.64)	2,545 (.68)	81 (.24)	p<.01
ESI Level 2	94,185 (23.03)	87,300 (23.24)	6,885 (20.66)	
ESI Level 3	212,692 (52)	194,884 (51.87)	17,808 (53.43)	
ESI Level 4	84,437 (20.64)	79,236 (21.09)	5,201 (15.6)	
ESI Level 5 (least acute)	12,653 (3.09)	9,650 (2.57)	3,003 (9.01)	
Psych	2,445 (.6)	2,092 (.56)	353 (1.06)	

Visit-Level Characteristics Comparing All Comers versus Chief Complaint of Sickle Cell				
	All Comers, N (%)	All Comers Excluding Sickle Cell, N (%)	Chief Complaint of Sickle Cell, N (%)	P Value
# and percent with flag	683 (3.5 flags per 1,000 patients)	638 (3.3 flags per 1,000 patients)	45 (90 flags per 1,000 patients)	p<.01
	Median (IQR)	Median (IQR)	Median (IQR)	P Value
Waiting room time, minutes	29.23 (10.33-91.77)	29.38 (10.35-92.08)	21.97 (9.75-76.32)	p<.01
Wait to see clinician, minutes	40.03 (18.67-96)	40.1 (18.7-96.12)	36.88 (17.18-89.18)	p<.01
In-room time, minutes	226.2 (125.28-376.49)	224.75 (123.95-375.68)	283.67 (200.07-408.35)	p<.01
Length of stay, minutes	292 (172-467)	291 (171-467)	330 (228.67-490)	p<.01
	N (%)	N (%)	N (%)	P Value
Number of lab orders				
0 lab orders	117,051 (27.87)	116,276 (28.17)	775 (10.73)	p<.01
1-3 lab orders	50,774 (12.09)	50,339 (12.19)	435 (6.02)	
4 or more lab orders	252,182 (60.04)	246,169 (59.64)	6,013 (83.25)	
Number of medication orders				
0 medication orders	74,393 (17.71)	74,171 (17.97)	222 (3.07)	p<.01
1-3 medication orders	153,400 (36.52)	152,614 (36.97)	786 (10.88)	
4 or more medication orders	192,214 (45.76)	185,999 (45.06)	6,215 (86.04)	
Number of imaging orders				
None	172,939 (41.18)	169,327 (41.03)	3,612 (50.01)	p<.01
X-ray only	110,308 (26.27)	107,351 (26.01)	2,957 (40.94)	
Advanced imaging (CT, US, or MRI)	136,662 (32.55)	136,008 (32.96)	654 (9.05)	
Disposition				
Admit	76,054 (18.11)	72,786 (17.63)	3,268 (45.24)	p<.01
Discharge	288,439 (68.67)	284,842 (69.01)	3,597 (49.8)	
Left against medical advice or without being seen	30,287 (7.21)	29,996 (7.27)	291 (4.03)	
Observation	18,052 (4.3)	18,016 (4.36)	36 (.5)	
Transfer	3,157 (.75)	3,141 (.76)	16 (.22)	
Triage	1,029 (.24)	1,023 (.25)	6 (.08)	
Voided/Other	2,989 (.71)	2,980 (.72)	9 (.12)	
Emergency Department				
Hopsital of the University of Pennsylvania	171,447 (40.82)	169,743 (41.12)	1,704 (23.59)	p<.01
Pennsylvania Hospital	112,009 (26.67)	107,628 (26.07)	4,381 (60.65)	
Penn Presbyterian Medical Center	136,551 (32.51)	135,413 (32.8)	1,138 (15.76)	
Insurance status				
Commercial	42,505 (10.12)	42,160 (10.21)	342 (4.73)	p<.01
Managed care	90,477 (21.54)	89,538 (21.69)	939 (13)	
Medicaid	154,918 (36.89)	150,526 (36.47)	4,392 (60.81)	
Medicare	108,912 (25.93)	107,442 (26.03)	1,470 (20.35)	
Self-pay	23,190 (5.52)	23,110 (5.6)	80 (1.11)	
Emergency Severity Index (ESI) Level				
ESI Level 1 (most acute)	2,626 (.64)	2,626 (.65)	0 (0)	p<.01
ESI Level 2	94,185 (23.03)	92,871 (23.11)	1,314 (18.2)	
ESI Level 3	212,692 (52)	206,797 (51.47)	5,895 (81.65)	
ESI Level 4	84,437 (20.64)	84,427 (21.01)	10 (.14)	
ESI Level 5 (least acute)	12,653 (3.09)	12,652 (3.15)	1 (.01)	
Psych	2,445 (.6)	2,445 (.61)	0 (0)	