Invasive Meningococcal Disease Risk Factors in Individuals with Commercial and Medicare Insurance in the United States

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Sample Selection	Attrition T	able Ontum												
Sample Selection	Aunuon I	able, Optum	CDIVI-SES/D	UDK	21-25	24 (3.9%)	120 (3.9%)			\$100,000+	133 (21.6%)	852 (27.9%)		
Criterion		Cases Rema	ining Cases E	Excluded	26-30	15 (2.4%)	75 (2.5%)			Unknown	82 (13.3%)	302 (9.9%)		
Unique patients in Optur	m CDM-				31-35	13 (2.1%)	65 (2.1%)			Poverty status				
SES/DODR Jan. 1, 2010	0–Mar. 31,	17,935		0	36-40	21 (3.4%)	105 (3.4%)			Above 400% FPL	533 (86.5%)	2,747 (89.8%)	0.03	0.03
Had -1 emergency dens	artmont				41-45	24 (3.9%)	120 (3.9%)			Below 400% FPL	1 (0.2%)	9 (0.3%)		
or hospitalization claim v	with IMD	952	16,	,983	46-50	28 (4.5%)	140 (4.6%)			Unknown	82 (13.3%)	302 (9.9%)		
diagnosis					51-55	42 (6.8%)	207 (6.8%)			Number of adults in	household			
At least 12 months witho	out IMD	933		19	56-60	39 (6.3%)	200 (6.5%)			Ν	616	3058	0.11	0.02
Continuous anrollment ir					61-65	51 (8.3%)	250 (8.2%)			Mean (SD)	1.5 (1.2)	1.6 (1.3)		
Continuous enrollment in insurance plan ≥12 months before first IMD	676	2	57	66-70	68 (11.0%)	340 (11.1%)			Median (Range)	1.0 (0.0–8.0)	1.0 (0.0–9.0)			
claim					71-75	77 (12.5%)	384 (12.6%)			Interquartile range	1.0–1.0	1.0–2.0		
No evidence of invasive		618	Ę	58	76-80	67 (10.9%)	333 (10.9%)			Number of children	in household			
*Non IMD controls will be					81-85	67 (10.9%)	333 (10.9%)			Ν	616	3058	0.07	0.08
and matched on up to a	1:5 basis	Cases	Cor	ntrols	86-90	37 (6.0%)	174 (5.7%)			Mean (SD)	0.1 (0.6)	0.2 (0.6)		
Matched sample	<u>):</u>	616	3.0	058	Sex					Median (Range)	0.0 (0.0–5.0)	0.0 (0.0–7.0)		
materio a campio					Male	318 (51.6%)	1,587 (51.9%)	0.01	0.9	Interquartile range	0.0–0.0	0.0–0.0		
					Female	298 (48.4%)	1,471 (48.1%)			Resides in state wit	h MenACWY va	ccination mandat	e*	
Eligibility Criteria					Census region					Yes	262 (42.5%)	1,297 (42.4%)	<0.01	0.96
Inclusion Criteria					Northeast	71 (11.5%)	349 (11.4%)	0.04	1	No	354 (57.5%)	1,761 (57.6%)		
Case patients, of all ages	s, must have h n during the ar	ad an IMD diagn	osis code associa cation periods to b	ted with an	Midwest	115 (18.7%)	567 (18.5%)			% of children ≤18 ir	state covered k	y insurance (Sta	te-level)	
in the study sample. IMD) diagnoses we	ere identified by I	nternational Class	ification of	South	269 (43.7%)	1,340 (43.8%)			Ν	285	1409	0.01	0.93
Disease, Ninth Revision,	, Clinical Modif	ication (ICD-9-C	M) diagnosis code	s 0.36.X (for	West	161 (26.1%)	802 (26.2%)			Mean (SD)	93.2 (2.7)	93.2 (2.7)		
Revision, Clinical Modific	cation (ICD-10	-CM) diagnosis c	codes A39.0–A39.4	k, A39.5X,	Census division					Madian (Danga)	93.9 (86.5–	93.8 (86.5–		
A39.8X, or A39.9 (for ser	rvice dates in o	or after October 2	2015). Control patie	ents must	New England	24 (3.9%)	114 (3.7%)	0.04	1	Median (Range)	98.4)	98.4)		
sample. Furthermore, cas	ice of livid duri	ng the study peri I patients must ha	ave been enrolled	in the study in their	Middle Atlantic	47 (7.6%)	235 (7.7%)			Interquartile range	91.3–95.2	91.3–95.2		
health insurance plans fo	or at least 12 m	nonths, without a	ny gaps greater th	an seven	East North Central	65 (10.6%)	321 (10.5%)			% of children ≤18 ir	state with a me	dical home** (Sta	ate-level)	
days, prior to their index	date to be incl	luded in the study	y sample.		West North Central	50 (8 1%)	246 (8 0%)			Ν	285	1409	0.01	0.87
Exclusion Criteria					South Atlantic	143 (23 2%)	715 (23.4%)			Mean (SD)	46.8 (4.9)	46.7 (4.9)		
Case patients who had a	anv evidence o	of IMD during thei	r baseline periods	and all	Fast South Central	23 (3 7%)	114 (3.7%)			Median (Range)	47.6 (35.2–	47.6 (35.2–		
patients with evidence of	f invasive pneu	umococcal diseas	se (IPD) at		West South Central	103 (16 7%)	511 (16 7%)			modian (nango)	59.9)	59.9)		
any time during the study excluded because some	y period, were	excluded from th	ne study sample. IF ningitis, coincide w	PD was ith IMD and	Mountain	66 (10.7%)	327 (10.7%)			Interquartile range	42.3–50.6	42.3–50.6		
because IPD and IMD also share some risk factors, including those associated with being immunocompromised, such as HIV. Other infections that may share symptoms and risk factors with IMD, such as streptococcal infection, were not excluded				Dacific	00(10.770)	327 (10.770)			Number of Pediatrie	cians per 10,000	Population (Stat	e-level)		
				Facilit Dece/Ethnicity	95 (15.4 %)	473 (13.376)			N	343	1696	<0.01	0.98	
						21 (5.00/)		0.16	0.02	Mean (SD)	18.0 (4.1)	18.0 (4.0)		
Baseline Demogra	aphic and	Contextual (Characteristic	s of	Asidii	(12, 20/)	134(3.0%)	0.10	0.02	Median (Range)	16.8 (9.9–30.5)	16.8 (9.9–30.5)		
IMD Cases and Non-IMD Controls (Matched Sample), Optum CDM-SES			Diack	02(13.3%)	275(9.0%)			Interquartile range	15.5–19.3	15.5–19.3				
				74(12.0%)	387(12.7%)			Per capita healthca	re expenditures	(State-level)				
					VVNILE	395 (64.1%)	2,087 (08.2%)			Ν	346	1711	0.01	0.8
Baseline	MD Cases	Non-IMD	Standardized	4		34 (5.5%)	155 (5.1%)			Mean (SD)	10,177.6	10,156.7		
Patient	(N=616)	Controls	Difference	p-value	Education level						(1,410.5)	(1,388.4)		
Characteristic		(N=3,058)			Less than 12th Grade	4 (0.6%)	12 (0.4%)	0.23	0.01	Median (Range)	9,982.6 (7.433.2–	9,982.6 (7.433.2–		
Age at index date	- 1 -				High School						4,577.7)	4,577.7)		
N (c =)	616	3058	< 0.01	0.93	Diploma	175 (28.4%)	689 (22.5%)			Interguartile range	9,240.7–	9,234.6-		
Mean (SD)	60.2 (21.7)	60.1 (21.6)			Bachelor Degree	95 (15 4%)	613 (20.0%)			interquartie range	10,547.5	10,521.1		
Median (Range) 66.	5.0 (0.0 - 90.0)	66.0 (0.0 - 90.0)			Plus					Abbreviations: FPL = Fede MenACWY = Meningococo	ral poverty limit; ICU : al A, C, W, and Y ser	= intensive care unit; II ogroup; PCP = primary	/ID = Invasive Menin [,] care provider, SD =	igococcal Disea Standard
Interquartile range	48.0 - 76.0	48.0 - 76.0			Unknown	22 (3.6%)	107 (3.5%)			Deviation. Note: *Mandate receive coordinated. care v	for school/college en vithin a medical home	try by age 16-21. ** Pe	rcentage of children	in the state who
Age category					Household income					,				
0-1	2 (0.3%)	10 (0.3%)	0.06	1	<\$40,000	155 (25.2%)	641 (21.0%)	0.18	<0.01					
2-5	11 (1.8%)	55 (1.8%)			\$40,000-\$49,999	59 (9.6%)	258 (8.4%)							
6-10	5 (0.8%)	22 (0.7%)			\$50,000-\$59,999	42 (6.8%)	236 (7.7%)							
11-15	6 (1.0%)	30 (1.0%)			\$60,000-\$74,999	60 (9.7%)	308 (10.1%)							
16-20	19 (3.1%)	95 (3.1%)			\$75,000-\$99,999	85 (13.8%)	461 (15.1%)							

						1					1			
Sample Selectio	on Attrition I	able, Optun	n CDM-SES/D	ODR	21-25	24 (3.9%)	120 (3.9%)			\$100,000+	133 (21.6%)	852 (27.9%)		
Criterio	on	Cases Rema	aining Cases I	Excluded	26-30	15 (2.4%)	75 (2.5%)			Unknown	82 (13.3%)	302 (9.9%)		
Unique patients in Op	otum CDM-				31-35	13 (2.1%)	65 (2.1%)			Poverty status				
SES/DODR Jan. 1, 20	010–Mar. 31,	17,935		0	36-40	21 (3.4%)	105 (3.4%)			Above 400% FPL	533 (86.5%)	2,747 (89.8%)	0.03	0.03
ZUZZ	oportmont				41-45	24 (3.9%)	120 (3.9%)			Below 400% FPL	1 (0.2%)	9 (0.3%)		
or hospitalization clair	m with IMD	952	16	5,983	46-50	28 (4.5%)	140 (4.6%)			Unknown	82 (13.3%)	302 (9.9%)		
diagnosis					51-55	42 (6.8%)	207 (6.8%)			Number of adults in	n household			
At least 12 months with	ithout IMD	933		19	56-60	39 (6.3%)	200 (6.5%)			Ν	616	3058	0.11	0.02
					61-65	51 (8.3%)	250 (8.2%)			Mean (SD)	1.5 (1.2)	1.6 (1.3)		
Continuous enrollmen plan ≥12 months befo	ore first IMD	676		257	66-70	68 (11.0%)	340 (11.1%)			Median (Range)	1.0 (0.0–8.0)	1.0 (0.0–9.0)		
claim					71-75	77 (12.5%)	384 (12.6%)			Interquartile range	1.0–1.0	1.0–2.0		
No evidence of invasiv	ive	618		58	76-80	67 (10.9%)	333 (10.9%)			Number of children	in household			
pneumococcal diseas	Se				81-85	67 (10.9%)	333 (10.9%)			Ν	616	3058	0.07	0.08
*Non-IMD controls will and matched on up to	Il be selected	Cases	Со	ntrols	86-90	37 (6.0%)	174 (5.7%)			Mean (SD)	0.1 (0.6)	0.2 (0.6)		
Matched samn		616	3	058	Sex					Median (Range)	0.0 (0.0–5.0)	0.0 (0.0–7.0)		
Matched Samp			Ο,	000	Male	318 (51.6%)	1,587 (51.9%)	0.01	0.9	Interquartile range	0.0–0.0	0.0–0.0		
					Female	298 (48.4%)	1,471 (48.1%)			Resides in state wit	th MenACWY va	ccination manda	te*	
Eligibility Criteri	ia				Census region	, , , , , , , , , , , , , , , , , , ,				Yes	262 (42.5%)	1,297 (42.4%)	<0.01	0.96
Inclusion Criteria					Northeast	71 (11.5%)	349 (11.4%)	0.04	1	No	354 (57.5%)	1,761 (57.6%)		
Case patients, of all ag	ges, must have h	nad an IMD diagi	nosis code associa	ated with an	Midwest	115 (18.7%)	567 (18.5%)			% of children ≤18 ir	state covered	by insurance (Sta	ite-level)	
in the study sample. IN	tion during the ap MD diagnoses we	ere identified by	International Class	sification of	South	269 (43.7%)	1.340 (43.8%)			Ν	285	1409	0.01	0.93
Disease, Ninth Revisio	on, Clinical Modi	fication (ICD-9-C	CM) diagnosis code	es 0.36.X (for	West	161 (26 1%)	802 (26 2%)			Mean (SD)	93.2 (2.7)	93.2 (2.7)		
service dates before C Revision. Clinical Mod	Jctober 2015) or dification (ICD-10	International Cla CM) diagnosis (assification of Dise	ases, Ienth 4. A39.5X.	Census division	101 (2011/0)					93.9 (86.5–	93.8 (86.5–		
A39.8X, or A39.9 (for s	service dates in	or after October	2015). Control pati	ients must	New England	21 (3.9%)	11/ (3.7%)	0.04	1	Median (Range)	98.4)	98.4)		
not have had any evide	lence of IMD duri	ing the study per I natients must h	riod to be included	in the study	Middle Atlantic	27(3.370)	235(7.7%)	0.04		Interquartile range	91.3–95.2	91.3–95.2		
health insurance plans	s for at least 12 r	nonths, without a	any gaps greater th	nan seven	Fact North Control	47 (7.070) 65 (10.6%)	233(1.17)			% of children ≤18 ir	n state with a me	edical home** (St	ate-level)	
days, prior to their inde	ex date to be inc	luded in the stud	ly sample.		Most North Control	50 (9 10/)	246(9.00%)			Ν	285	1409	0.01	0.87
Evelveise Oriteria						50(0.170)	240(0.0%)			Mean (SD)	46.8 (4.9)	46.7 (4.9)		
Exclusion Criteria	d any avidance a	of IMD during the	vir hacalina nariada	and all		143 (23.2%)	713(23.4%)			Madian (Danga)	47.6 (35.2–	47.6 (35.2–		
patients with evidence	e of invasive pnet	umococcal disea	ase (IPD) at		East South Central	23(3.7%)	(114 (3.7%))			wedian (Range)	59.9)	59.9)		
any time during the stu	udy period, were	excluded from t	he study sample. I	PD was	West South Central	103 (16.7%)	511 (16.7%)			Interquartile range	42.3–50.6	42.3–50.6		
excluded because some of its symptoms, including meningitis, coincide with IMD and because IPD and IMD also share some risk factors including those associated with					Mountain	66 (10.7%)	327 (10.7%)			Number of Pediatrie	cians per 10,000	Population (Stat	e-level)	
being immunocompromised, such as HIV. Other infections that may share symptoms					Pacific	95 (15.4%)	475 (15.5%)			Ν	343	1696	<0.01	0.98
and risk factors with IN	MD, such as stre	ptococcal infection	on, were not exclu	ded.	Race/Ethnicity					Mean (SD)	18.0 (4.1)	18.0 (4.0)		
Racolino Domoc	araphic and	Contoxtual	Characteristic	ee of	Asian	31 (5.0%)	154 (5.0%)	0.16	0.02	Median (Range)	16.8 (9.9–30.5)	16.8 (9.9–30.5)		
IMD Cases and Non-IMD Controls (Matched Sample) Ontum					Black	82 (13.3%)	275 (9.0%)			Interquartile range	15.5–19.3	15.5–19.3		
CDM-SES			Hispanic	74 (12.0%)	387 (12.7%)			Per capita healthca	re expenditures	(State-level)				
					White	395 (64.1%)	2,087 (68.2%)			N	346	1711	0.01	0.8
Baseline		Non-IMD		•	Unknown	34 (5.5%)	155 (5.1%)			Maan (SD)	10,177.6	10,156.7		
Patient	IMD Cases	Controls	Standardize	d p-value	Education level					Mean (SD)	(1,410.5)	(1,388.4)		
Characteristic	(11-010)	(N=3,058)	Difference		Less than 12th	4 (0.6%)	12 (0.4%)	0.23	0.01	Madian (Danaa)	9,982.6	9,982.6		
Age at index date										wedian (Range)	(7,433.2– 4,577.7)	4,577.7)		
Ν	616	3058	<0.01	0.93	Diploma	175 (28.4%)	689 (22.5%)			Intorquartila rango	9,240.7–	9,234.6–		
Mean (SD)	60.2 (21.7)	60.1 (21.6)			Bachelor Degree					Interquartile range	10,547.5	10,521.1		
Median (Range)	66.0 (0.0 - 90.0)	66.0 (0.0 - 90.0)		Plus	Ⴘ Ⴢ(IჂ.4%)	ບ I 3 (∠U.U%)			Abbreviations: $FPL = FederMenACW/Y = Meningeococy$	eral poverty limit; ICU	= intensive care unit; I	MD = Invasive Menir	ngococcal Disea
Interquartile range	48.0 - 76.0	48.0 - 76.0			Unknown	22 (3.6%)	107 (3.5%)			Deviation. Note: *Mandate	for school/college er	ntry by age 16-21. ** Pe	ercentage of children	in the state who
Age category					Household income					receive coordinated, care	within a metrical nom	σ.		
0-1	2 (0.3%)	10 (0.3%)	0.06	1	<\$40,000	155 (25.2%)	641 (21.0%)	0.18	<0.01					
2-5	11 (1.8%)	55 (1.8%)			\$40,000-\$49,999	59 (9.6%)	258 (8.4%)							
6-10	5 (0.8%)	22 (0.7%)			\$50,000-\$59,999	42 (6.8%)	236 (7.7%)							
11-15	6 (1.0%)	30 (1.0%)			\$60,000-\$74,999	60 (9.7%)	308 (10.1%)							
16-20	19 (3.1%)	95 (3.1%)			\$75,000-\$99,999	85 (13.8%)	461 (15.1%)							
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Abbreviations

IMD invasive meningococcal disease, US United States, aOR adjusted odds ratios, HIV human immunodeficiency virus

References

1. Harrison LH, Pelton SI, Wilder-Smith A, et al. The Global Meningococcal Initiative: recommendations for reducing the global burden of meningococcal disease. Vaccine. 2011;29(18):3363-3371

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Baseline Patient Characteristic	IMD Cases (N=616)	Non-IMD Controls (N=3 058)	Standardized difference	p-value	
Risk factors for IMC		(11-0,000)			
	1 (0 29/)	0(0,0%)	0.06	0.17	
	1 (0.2%)	0 (0.0%)	0.00	0.17	
asplenia	2 (0.3%)	3 (0.10%)	0.05	0.2	
Human immunodeficiency virus	8 (1.3%)	6 (0.2%)	0.13	<0.01	
Complement component deficiencies	1 (0.2%)	1 (0.03%)	0.04	0.31	
Sickle-cell disease	0 (0.0%)	2 (0.07%)	0.04	1	
Number of pediatric	cian/PCP vis	sits			
Ν	616	3058	0.34	<0.01	
Mean (SD)	5.1 (6.1)	3.3 (4.4)			
Median (Range)	3 (0–46)	2 (0–42)			
Interquartile range	1–7	0–4			
Number of other ph	ysician visi	ts		-	
Ν	616	3058	0.32	<0.01	
Mean (SD)	9.0 (12.3)	5.6 (8.9)			
Median (Range)	5 (0–89)	2 (0–102)			
Interquartile range	1–12	0—7			
Number of office vis	sits				
0	35 (5.7%)	430 (14.1%)	0.44	<0.01	
1	33 (5.4%)	223 (7.3%)			
2-3	68 (11.0%)	466 (15.2%)			
4-5	70 (11.4%)	405 (13.2%)			
6-7	55 (8.9%)	296 (9.7%)			
8-9	45 (7.3%)	248 (8.1%)			
10-12	70 (11.4%)	268 (8.8%)			
13-15	43 (7.0%)	185 (6.0%)			
16+	197 (32.0%)	537 (17.6%)			
Number of emerger	ncy departm	nent visits			
Ν	616	3058	0.49	<0.01	
Mean (SD)	1.6 (2.5)	0.5 (1.8)			
Median (Range)	1 (0–28)	0 (0–34)			
Interquartile range	0–2	0—0			
Number of hospital	izations				
Ν	616	3058	0.88	<0.01	
Mean (SD)	1.3 (1.8)	0.2 (0.6)			
Median (Range)	1 (0–13)	0 (0–7)			
Interquartile range	0–2	0—0			
Number of ICU visit	:S				
Ν	616	3058	0.86	<0.01	
Mean (SD)	0.6 (0.9)	0.0 (0.3)			
Median (Range)	0 (0–6)	0 (0–5)			
Interquartile range	0—1	0—0			

Deviation

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Baseline Clinical Characteristics of IMD Cases and Non-IMD Controls (Matched Sample), Optum CDM-SES

Abbreviations: IMD = Invasive Meningococcal; Disease; PCP = primary care provider, SD = Standard

GSK