

Meningococcal Disease Among Men Who Have Sex with Men – United States, January 2012 - June 2015

Temitope A. Folaranmi MBChB MPH MPP

Advisory Committee on Immunization Practices
February 24, 2016

Background

Outbreaks/Clusters of Invasive Meningococcal Disease (IMD) Among Men Who Have Sex with Men (MSM)

- **First reported outbreak occurred in Toronto in 2001**
- **First reported U.S. outbreak occurred in Chicago in 2003**
- **Subsequent clusters/outbreaks have occurred in:**
 - **New York City (2010-2013)**
 - **Los Angeles County (2012-2013)**
 - **Paris (2013)**
 - **Belgium (2013)**
 - **Berlin (2013)**
 - **Chicago (2015)**
- **All outbreaks caused by serogroup C (ST-11 clonal complex)**

Clusters/Outbreaks of Meningococcal Disease Among MSM, United States

	Year	Cases	Deaths (CFR)	HIV+
Chicago	2003	6	3(50%)	unk
New York City	2012-2013	22	6(27%)	15/22(68%)
Los Angeles County	2012-2013	6	3(50%)	1/5*(20%)
Chicago	2015	8**	2(25%)	6/8(75%)

*One unknown HIV status

**Includes one additional case in MN with laboratory evidence of indistinguishable strain

Clusters/Outbreaks of Meningococcal Disease Among MSM, United States

	Year	Cases	Deaths (CFR)	HIV+
Chicago	2003	6	3(50%)	unk
New York City	2012-2013	22	6(27%)	15/22(68%)
Los Angeles County	2012-2013	6	3(50%)	1/5*(20%)
Chicago	2015	8**	2(25%)	6/8(75%)

*One unknown HIV status

**Includes one additional case in MN with laboratory evidence of indistinguishable strain

Clusters/Outbreaks of Meningococcal Disease Among MSM, United States

	Year	Cases	Deaths (CFR)	HIV+
Chicago	2003	6	3(50%)	unk
New York City	2012-2013	22	6(27%)	15/22(68%)
Los Angeles County	2012-2013	6	3(50%)	1/5*(20%)
Chicago	2015	8**	2(25%)	6/8(75%)

*One unknown HIV status

**Includes one additional case in MN with laboratory evidence of indistinguishable strain

Objectives

Objectives

- **Identify IMD cases that occurred among MSM**
- **Describe IMD epidemiology and case characteristics among MSM and non-MSM**
- **Assess rates of IMD and prevalence of known IMD risk factors among MSM**
- **Estimate relative risk of IMD among MSM compared to non-MSM**
- **Estimate relative risk of IMD among HIV infected MSM compared to HIV uninfected MSM**

Methods

IMD Case Reporting in U.S.

- **Meningococcal disease surveillance data reportable in the U.S.**
 - Passive reporting by all U.S. states/territories
 - Includes all cases (confirmed and probable)
- **Intensive investigation conducted by health department**
 - Identifies close contacts, including sex partners
 - Sex of sex partners and HIV status of case-patients not reported

Objectives

- **Identify IMD cases that occurred among MSM**
- Describe IMD epidemiology and case characteristics among MSM and non-MSM
- Assess rates of IMD and prevalence of known IMD risk factors among MSM
- Estimate relative risk of IMD among MSM compared to non-MSM males
- Estimate relative risk of IMD among HIV infected MSM compared to HIV-uninfected MSM

Identification of All Cases Occurring Among MSM

- **Two Epi-X calls for cases posted in May 2013 and June 2015***
 - States reviewed meningococcal cases among men aged 18-64 years occurring during the study period - January 2012 – June 2015
 - Case investigation and risk factor data abstracted
 - Zero report requested if no cases among MSM identified

*100% of state health departments responded to both call for cases

Classification of IMD Cases

- **Cases were classified as:**
 - MSM cases in New York City (MSM-NYC)
 - MSM cases in Los Angeles County (MSM-LAC)
 - MSM cases in Chicago* (MSM-Chicago)
 - MSM sporadic cases (all other MSM cases)# (MSM-Others)
 - Men not known to be MSM (Non-MSM)
- **Not all cases within the three jurisdictions (NYC, Chicago, LAC) are part of a cluster or met the outbreak definition criteria***
 - All cases that occurred within the each jurisdiction during the observation period were grouped together

*Includes cases from the Chicago Metro Area

#Other jurisdictions reporting at least one sporadic case were Arizona, California, Connecticut, the District of Columbia, Delaware, Florida, Illinois, Maryland, Massachusetts, New Jersey, New Mexico, Pennsylvania, South Carolina, Tennessee, Texas, Utah and Minnesota.

*Outbreak defined as 2-3 cases of same serogroup in <3 months; attack rate >10 / 100,000

Objectives

- Identify IMD cases that occurred among MSM
- **Describe IMD epidemiology and case characteristics among MSM and non-MSM**
- **Assess rates of IMD and prevalence of known IMD risk factors among MSM**
- **Estimate relative risk of IMD among MSM compared to non-MSM**
- **Estimate relative risk of IMD among HIV infected MSM compared to HIV-uninfected MSM**

Denominator Estimation

- **MSM defined as sex with another man in the past five years**

$$\text{MSM Population per Jurisdiction} = \text{Population of Men Aged 18-64 Years} \times \text{MSM Prevalence}$$

- **Male population approximated using 2012 American Community Survey**
 - Yearly survey conducted by the U.S. Census Bureau
 - Estimated men aged 18-64 years: **96,618,006 (Total U.S. Estimate)**

Denominator Estimation

**MSM Population per Jurisdiction =
Population of Men Aged 18-64 Years X **MSM Prevalence****

- **Prevalence Estimates¹**
 - **LAC: 6.8%**
 - **NYC: 7.3%**
 - **Chicago: 6.6%**
 - **Other U.S. jurisdictions: 3.3%**
 - **Overall prevalence of MSM in the U.S.: 3.9%**

1. Jeremy Grey, Kyle Bernstein et al, 2015. Estimating the population sizes of men who have sex with men (MSM) in the U.S. states and counties using data from the American Community Survey. Manuscripts under Review

Denominator Estimation

- Estimate of HIV infected MSM population in each jurisdiction based on 2012 HIV surveillance data for each jurisdiction^{1,2,3,4}

HIV Uninfected MSM Population per Jurisdiction =
(Population of Men Aged 18-64 Years*MSM Prevalence) – Surveillance Estimate
of HIV Infected MSM

‘MSM-Others’ Cases Estimate =
Total U.S. Estimate – (LAC+ NYC + Chicago Estimate)

- HIV status data not available among non-MSM cases

1. <http://www.nyc.gov/html/doh/downloads/pdf/dires/surveillance-report-dec-2013.pdf>

2. https://www.cityofchicago.org/content/dam/city/depts/cdph/HIV_STI/2014HIVSTISurveillanceReport.pdf

3. <http://publichealth.lacounty.gov/wwwfiles/ph/hae/hiv/2012AnnualHIVSurveillanceReport.pdf>

4. <http://www.cdc.gov/hiv/pdf/library/reports/surveillance/cdc-hiv-surveillance-report-vol-25.pdf>

Denominator Estimation

- Estimate of HIV infected MSM population in each jurisdiction based on 2012 HIV surveillance data for each jurisdiction^{1,2,3,4}

HIV Uninfected MSM Population per Jurisdiction =

(Population of Men Aged 18-64 Years*MSM Prevalence) – Surveillance Estimate of HIV Infected MSM

**‘MSM-Others’ Cases Estimate =
Total U.S. Estimate – (LAC+ NYC + Chicago Estimate)**

- HIV status data not available among non-MSM cases

1. <http://www.nyc.gov/html/doh/downloads/pdf/dires/surveillance-report-dec-2013.pdf>

2. https://www.cityofchicago.org/content/dam/city/depts/cdph/HIV_STI/2014HIVSTISurveillanceReport.pdf

3. <http://publichealth.lacounty.gov/wwwfiles/ph/hae/hiv/2012AnnualHIVSurveillanceReport.pdf>

4. <http://www.cdc.gov/hiv/pdf/library/reports/surveillance/cdc-hiv-surveillance-report-vol-25.pdf>

Results

Identified Cases

- **527 meningococcal disease cases among men aged 18-64 years reported to CDC between January 2012 and June 2015**
 - 74(14%) MSM cases from 17 states
 - 453(86%) cases among non-MSM from 47 states and Washington D.C.

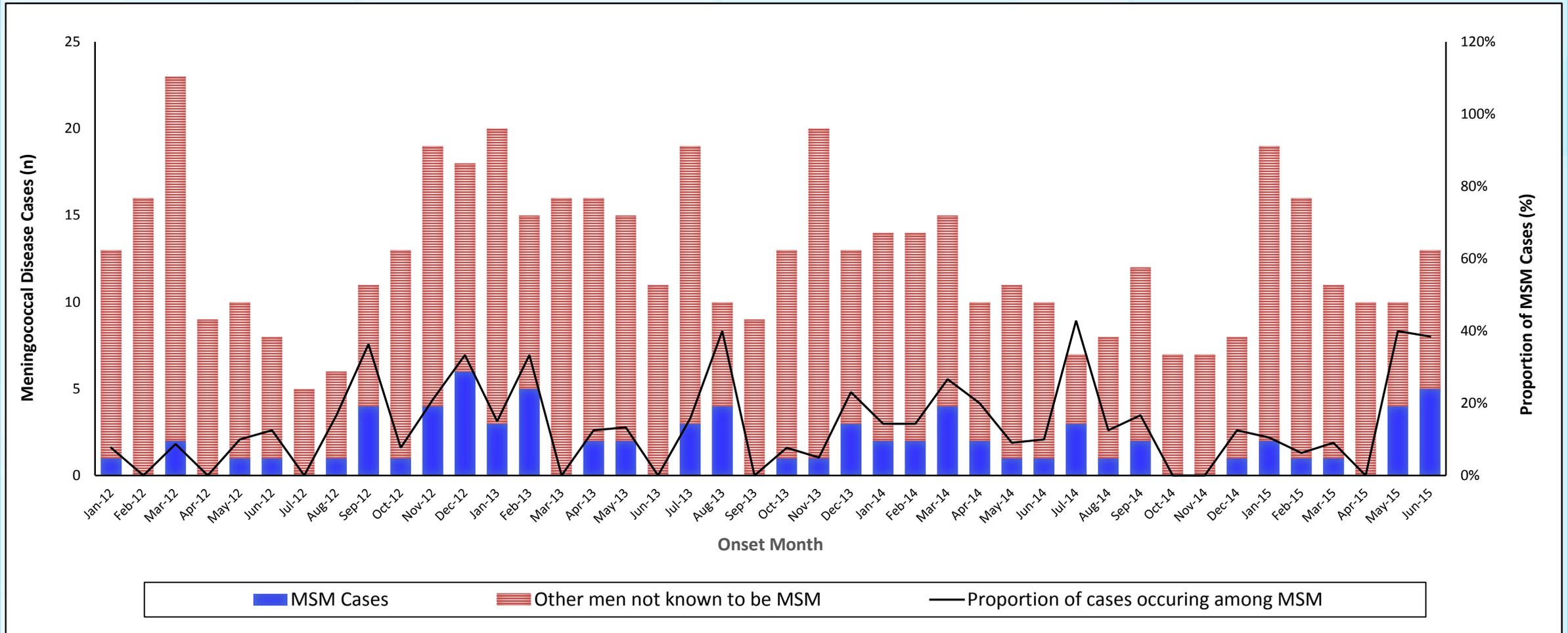
MSM Status by Age Group

Age group (years)	MSM (%)	Non-MSM (%)	Total (%)	p-value
18-25	15(20)	142(31)	157(29)	
26-35	32(43)	99(22)	131(26)	
36-45	14(19)	61(14)	75(16)	< 0.0001
46-55	12(16)	87(19)	99(17)	
56-64	1(1)	64(14)	65(13)	
Total	74(100)	453(100)	527(100)	

MSM Status by Age Group

Age group (years)	MSM (%)	Non-MSM (%)	Total (%)	p-value
18-25	15(20)	142(31)	157(29)	
26-35	32(43)	99(22)	131(26)	
36-45	14(19)	61(14)	75(16)	< 0.0001
46-55	12(16)	87(19)	99(17)	
56-64	1(1)	64(14)	65(13)	
Total	74(100)	453(100)	527(100)	

Meningococcal Disease Among MSM and Other Men Aged 18-64 Years - United States, January 2012 – June 2015



MSM Cases Classification by Jurisdiction

Jurisdiction	MSM Cases		
	Outbreak	Sporadic	Total
NYC	22	1	23
LAC	6	8	14
Chicago*	7	4	11
Others	0	26	26
Total	35	39	74

* Includes cases from the Chicago Metro area

Demographic Characteristics of Cases

	MSM				Non-MSM	<i>p</i> -value
	Others (N=26)	NYC (N=23)	LAC (N=14)	Chicago (N=11)	U.S. (N=453)	
Ethnicity (%)						
Hispanic	8(31)	3(16)	7(50)	2(18)	82(23)*	0.135
Non-Hispanic	18(69)	16(84)	7(50)	9(82)	276(77)*	
Race (%)						
White	17(71)	6(26)	9(69)	5(46)	268(70)#	0.007
Black	5(22)	15(65)	3(23)	6(56)	92(24) #	
Native American	0(0)	0(0)	0(0)	0(0)	6(2) #	
Asian	1(4)	0(0)	1(8)	0(0)	5(1) #	
Others	1(4)	2(9)	0(0)	0(0)	13(3) #	

* N = 358, # N=384

Demographic Characteristics of Cases

	MSM				Non-MSM	<i>p</i> -value
	Others (N=26)	NYC (N=23)	LAC (N=14)	Chicago (N=11)	U.S. (N=453)	
Ethnicity (%)						
Hispanic	8(31)	3(16)	7(50)	2(18)	82(23)*	0.135
Non-Hispanic	18(69)	16(84)	7(50)	9(82)	276(77)*	
Race (%)						
White	17(71)	6(26)	9(69)	5(46)	268(70)#	0.007
Black	5(22)	15(65)	3(23)	6(56)	92(24) #	
Native American	0(0)	0(0)	0(0)	0(0)	6(2) #	
Asian	1(4)	0(0)	1(8)	0(0)	5(1) #	
Others	1(4)	2(9)	0(0)	0(0)	13(3) #	

* N = 358, # N=384

Clinical Characteristics of Cases

	MSM				Non-MSM	<i>p</i> -value
	Others (N=26)	NYC (N=23)	LAC (N=14)	Chicago (N=11)	U.S. (N=453)	
Type of infection*(%)						
Bacteremia†	14(54)	12(52)	2(14)	5(46)	93(21)	-
Meningitis	13(50)	14(61)	5(36)	5(46)	86(19)	
Other	6(23)	4(17)	2(14)	2(18)	57(13)	
Unknown	2(8)	0	5(36)	1(9)	260(57)	
Outcome (%)						
Deaths(CFR)	10(39)	6(26)	5(36)	3(27)	90(24)**	0.126

*Categories are not mutually exclusive; sum of percentages may exceed 100%. 10% of all MSM cases had both meningitis and bacteremia or either of them and another clinical presentation such as septic shock or pneumonia

**383 cases with known outcome

† Includes meningococemia.

Clinical Characteristics of Cases

	MSM				Non-MSM	<i>p</i> -value
	Others (N=26)	NYC (N=23)	LAC (N=14)	Chicago (N=11)	U.S. (N=453)	
Type of infection*(%)						
Bacteremia†	14(54)	12(52)	2(14)	5(46)	93(21)	-
Meningitis	13(50)	14(61)	5(36)	5(46)	86(19)	
Other	6(23)	4(17)	2(14)	2(18)	57(13)	
Unknown	2(8)	0	5(36)	1(9)	260(57)	
Outcome (%)						
Deaths(CFR)	10(39)	6(26)	5(36)	3(27)	90(24)**	0.126

*Categories are not mutually exclusive; sum of percentages may exceed 100%. 10% of all MSM cases had both meningitis and bacteremia or either of them and another clinical presentation such as septic shock or pneumonia

**383 cases with known outcome

† Includes meningococemia.

Serogroup Characteristics of Cases

Serogroup	MSM				Non-MSM
	Others (N=26)	NYC (N=23)	LAC (N=14)	Chicago (N=11)	U.S. (N=453)
A	0(0)	0(0)	0(0)	0(0)	1(0.2)
B	1(4)	1(4)	3(21)	0(0)	125(28)
C	19(73)	22(96)	10(71)	11(100)	98(22)
W	2(8)	0(0)	0(0)	0(0)	51(11)
Y	2(8)	0(0)	1(7)	0(0)	75(17)
Z	0(0)	0(0)	0(0)	0(0)	1(0.2)
Non-groupable	0(0)	0(0)	0(0)	0(0)	23(6)
Other	1(4)	0(0)	0(0)	0(0)	7(2)
Unknown	1(4)	0(0)	0(0)	0(0)	72(16)

Serogroup Characteristics of Cases

Serogroup	MSM				Non-MSM
	Others (N=26)	NYC (N=23)	LAC (N=14)	Chicago (N=11)	U.S. (N=453)
A	0(0)	0(0)	0(0)	0(0)	1(0.2)
B	1(4)	1(4)	3(21)	0(0)	125(28)
C	19(73)	22(96)	10(71)	11(100)	98(22)
W	2(8)	0(0)	0(0)	0(0)	51(11)
Y	2(8)	0(0)	1(7)	0(0)	75(17)
Z	0(0)	0(0)	0(0)	0(0)	1(0.2)
Non-groupable	0(0)	0(0)	0(0)	0(0)	23(6)
Other	1(4)	0(0)	0(0)	0(0)	7(2)
Unknown	1(4)	0(0)	0(0)	0(0)	72(16)

HIV Status of Case-Patients

	MSM				Non-MSM
	Others (N=26)	NYC (N=23)	LAC (N=14)	Chicago (N=11)	U.S. (N=453)
HIV Status(%)					
Infected	12(46)	15(65)	5(36)	6(54)	Data not available
Uninfected	6(23)	8(35)	7(50)	5(46)	
Unknown	8(31)	-	2(14)	-	

- **59% (N=63) of all MSM cases with known HIV status are HIV infected**
- **58% (N=56) of serogroup C, W, or Y MSM cases with known HIV status are HIV infected**

Mortality Outcomes

- **Among all men, serogroup C cases were 1.5 times more likely to have a fatal outcome ($p < 0.0001$)**
- **No significant association between fatal outcome and MSM status ($p = 0.128$)**
 - Outcome data was unknown in 15% of the non-MSM case patients
- **Among MSM, no significant association between fatal outcome and HIV status ($p = 0.558$)**
 - Among serogroup C, W, and Y MSM cases, no significant association between HIV status and mortality outcome ($p = 0.827$)

Reported Behaviors Among MSM Cases

Behaviors	All MSM	
	%	No. of cases assessed (N)
Smoking	33%	63
Recreational drug use ¹	49%	53
Multiple sexual partners/anonymous sex	47%	32
Use of dating “apps” or website	61%	23
Recent travel	21%	68

1. Including marijuana

IMD Annualized Incidence Rates Among MSM and Non-MSM

Category	Cases	Person-Months	Estimated rate per 100,000	Rate Ratio (95%CI)	p-value
Overall Estimates					
Non-MSM	453	3,713,996,151	0.15	Ref	
MSM	74	150,724,089	0.59	4.0(3.6-4.5)	<0.001
MSM-Others					
Non-MSM	414	3,477,603,438	0.14	Ref	
MSM	26	121,617,682	0.26	1.8(1.2-2.7)	<0.001
MSM-NYC					
Non-MSM	19	96,027,210	0.24	Ref	
MSM	23	7,669,550	3.60	23.0(8.3, 27.8)	<0.001
MSM-LAC					
Non-MSM	13	117,904,949	0.13	Ref	
MSM	14	8,684,771	1.93	14.6(6.8-31.1)	<0.001
MSM-Chicago					
Non-MSM	7	32,885,789	0.26	Ref	
MSM	11	2,326,851	5.67	22.2(8.6-57.3)	<0.001

IMD Annualized Incidence Rates Among MSM and Non-MSM

Category	Cases	Person-Months	Estimated rate per 100,000	Rate Ratio (95%CI)	p-value
Overall Estimates					
Non-MSM	453	3,713,996,151	0.15	Ref	
MSM	74	150,724,089	0.59	4.0(3.6-4.5)	<0.001
MSM-Others					
Non-MSM	414	3,477,603,438	0.14	Ref	
MSM	26	121,617,682	0.26	1.8(1.2-2.7)	<0.001
MSM-NYC					
Non-MSM	19	96,027,210	0.24	Ref	
MSM	23	7,669,550	3.60	23.0(8.3, 27.8)	<0.001
MSM-LAC					
Non-MSM	13	117,904,949	0.13	Ref	
MSM	14	8,684,771	1.93	14.6(6.8-31.1)	<0.001
MSM-Chicago					
Non-MSM	7	32,885,789	0.26	Ref	
MSM	11	2,326,851	5.67	22.2(8.6-57.3)	<0.001

IMD Annualized Incidence Rates Among MSM and Non-MSM

Category	Cases	Person-Months	Estimated rate per 100,000	Rate Ratio (95%CI)	p-value
Overall Estimates					
Non-MSM	453	3,713,996,151	0.15	Ref	
MSM	74	150,724,089	0.59	4.0(3.6-4.5)	<0.001
MSM-Others					
Non-MSM	414	3,477,603,438	0.14	Ref	
MSM	26	121,617,682	0.26	1.8(1.2-2.7)	<0.001
MSM-NYC					
Non-MSM	19	96,027,210	0.24	Ref	
MSM	23	7,669,550	3.60	23.0(8.3, 27.8)	<0.001
MSM-LAC					
Non-MSM	13	117,904,949	0.13	Ref	
MSM	14	8,684,771	1.93	14.6(6.8-31.1)	<0.001
MSM-Chicago					
Non-MSM	7	32,885,789	0.26	Ref	
MSM	11	2,326,851	5.67	22.2(8.6-57.3)	<0.001

IMD Annualized Incidence Rates Among MSM and Non-MSM

Category	Cases	Person-Months	Estimated rate per 100,000	Rate Ratio (95%CI)	p-value
Overall Estimates					
Non-MSM	453	3,713,996,151	0.15	Ref	
MSM	74	150,724,089	0.59	4.0(3.6-4.5)	<0.001
MSM-Others					
Non-MSM	414	3,477,603,438	0.14	Ref	
MSM	26	121,617,682	0.26	1.8(1.2-2.7)	<0.001
MSM-NYC					
Non-MSM	19	96,027,210	0.24	Ref	
MSM	23	7,669,550	3.60	23.0(8.3, 27.8)	<0.001
MSM-LAC					
Non-MSM	13	117,904,949	0.13	Ref	
MSM	14	8,684,771	1.93	14.6(6.8-31.1)	<0.001
MSM-Chicago					
Non-MSM	7	32,885,789	0.26	Ref	
MSM	11	2,326,851	5.67	22.2(8.6-57.3)	<0.001

IMD Annualized Incidence Rates Among HIV Infected and HIV Uninfected MSM

Category	Cases	Person-Months	Estimated rate per 100,000	Rate Ratio (95% CI)	p-value
Overall Estimates¹					
MSM without HIV infection	26	131,637,089	0.24	Ref	
MSM with HIV infection	38	19,087,000	2.33	10.1(6.1-16.6)	<0.001
MSM-Others²					
MSM without HIV infection	6	106,114,922	0.07	Ref	
MSM with HIV infection	12	15,502,760	0.93	13.7(5.1-36.5)	<0.001
MSM-NYC					
MSM without HIV infection	8	6,003,876	1.61	Ref	
MSM with HIV infection	15	1,665,640	10.61	6.8(2.9-15.9)	<0.001
MSM-LAC					
MSM without HIV infection	7	7,293,574	1.15	Ref	
MSM with HIV infection	5	1,391,240	4.31	5.2(1.8-15.0)	<0.001
MSM-Chicago					
MSM without HIV infection	5	1,799,491	3.33	Ref	
MSM with HIV infection	6	527,360	13.65	4.1(1.25-13.42)	0.025

1. Only able to abstract HIV status data from 63 out of 74 cases

2 Only able to abstract HIV status data from 18 out of 26 cases.

IMD Annualized Incidence Rates Among HIV Infected and HIV Uninfected MSM

Category	Cases	Person-Months	Estimated rate per 100,000	Rate Ratio (95% CI)	p-value
Overall Estimates¹					
MSM without HIV infection	26	131,637,089	0.24	Ref	
MSM with HIV infection	38	19,087,000	2.33	10.1(6.1-16.6)	<0.001
MSM-Others²					
MSM without HIV infection	6	106,114,922	0.07	Ref	
MSM with HIV infection	12	15,502,760	0.93	13.7(5.1-36.5)	<0.001
MSM-NYC					
MSM without HIV infection	8	6,003,876	1.61	Ref	
MSM with HIV infection	15	1,665,640	10.61	6.8(2.9-15.9)	<0.001
MSM-LAC					
MSM without HIV infection	7	7,293,574	1.15	Ref	
MSM with HIV infection	5	1,391,240	4.31	5.2(1.8-15.0)	<0.001
MSM-Chicago					
MSM without HIV infection	5	1,799,491	3.33	Ref	
MSM with HIV infection	6	527,360	13.65	4.1(1.25-13.42)	0.025

1. Only able to abstract HIV status data from 63 out of 74 cases

2 Only able to abstract HIV status data from 18 out of 26 cases.

IMD Annualized Incidence Rates Among HIV Infected and HIV Uninfected MSM

Category	Cases	Person-Months	Estimated rate per 100,000	Rate Ratio (95% CI)	p-value
Overall Estimates¹					
MSM without HIV infection	26	131,637,089	0.24	Ref	
MSM with HIV infection	38	19,087,000	2.33	9.8(5.9-16.2)	<0.001
MSM-Others²					
MSM without HIV infection	6	106,114,922	0.07	Ref	
MSM with HIV infection	12	15,502,760	0.93	13.7(5.1-36.5)	<0.001
MSM-NYC					
MSM without HIV infection	8	6,003,876	1.61	Ref	
MSM with HIV infection	15	1,665,640	10.61	6.8(2.9-15.9)	<0.001
MSM-LAC					
MSM without HIV infection	7	7,293,574	1.15	Ref	
MSM with HIV infection	5	1,391,240	4.31	5.2(1.8-15.0)	<0.001
MSM-Chicago					
MSM without HIV infection	5	1,799,491	3.33	Ref	
MSM with HIV infection	6	527,360	13.65	4.1(1.25-13.42)	0.025

1. Only able to abstract HIV status data from 63 out of 74 cases

2 Only able to abstract HIV status data from 18 out of 26 cases.

IMD Annualized Incidence Rates Among HIV Infected MSM and Other Men*

Category	Cases	Person-Months	Estimated rate per 100,000	Rate Ratio (95% CI)	p-value
Overall Estimates					
Other Men	479	3,845,633,240	0.15	Ref	
MSM with HIV infection	38	19,087,000	2.39	16.0(11.5-22.4)	<0.001
MSM-Others					
Other Men	414	3,583,718,360	0.15	Ref	
MSM with HIV infection	12	15,502,760	0.93	6.7(3.8-11.9)	<0.001
MSM-NYC					
Other Men	27	102,031,080	0.31	Ref	
MSM with HIV infection	15	1,665,640	10.81	34.0(18.1-64.0)	<0.001
MSM-LAC					
Other Men	20	125,198,520	0.19	Ref	
MSM with HIV infection	5	1,391,240	4.31	22.5(8.44-59.9)	<0.001
MSM-Chicago					
Other Men	13	34,685,280	0.45	Ref	
MSM with HIV infection	6	527,360	11.38	30.4(11.5-79.9)	<0.001

* Other men – All non-MSM and HIV uninfected MSM combined

IMD Annualized Incidence Rates Among HIV Infected MSM and Other Men*

Category	Cases	Person-Months	Estimated rate per 100,000	Rate Ratio (95% CI)	p-value
Overall Estimates					
Other Men	479	3,845,633,240	0.15	Ref	
MSM with HIV infection	38	19,087,000	2.39	16.0(11.5-22.4)	<0.001
MSM-Others					
Other Men	414	3,583,718,360	0.15	Ref	
MSM with HIV infection	12	15,502,760	0.93	6.7(3.8-11.9)	<0.001
MSM-NYC					
Other Men	27	102,031,080	0.31	Ref	
MSM with HIV infection	15	1,665,640	10.81	34.0(18.1-64.0)	<0.001
MSM-LAC					
Other Men	20	125,198,520	0.19	Ref	
MSM with HIV infection	5	1,391,240	4.31	22.5(8.44-59.9)	<0.001
MSM-Chicago					
Other Men	13	34,685,280	0.45	Ref	
MSM with HIV infection	6	527,360	11.38	30.4(11.5-79.9)	<0.001

* Other men – All non-MSM and HIV uninfected MSM combined

IMD Annualized Incidence Rates Among HIV Infected MSM and Other Men*

Category	Cases	Person-Months	Estimated rate per 100,000	Rate Ratio (95% CI)	p-value
Overall Estimates					
Other Men	479	3,845,633,240	0.15	Ref	
MSM with HIV infection	38	19,087,000	2.39	16.0(11.5-22.4)	<0.001
MSM-Others					
Other Men	414	3,583,718,360	0.15	Ref	
MSM with HIV infection	12	15,502,760	0.93	6.7(3.8-11.9)	<0.001
MSM-NYC					
Other Men	27	102,031,080	0.31	Ref	
MSM with HIV infection	15	1,665,640	10.81	34.0(18.1-64.0)	<0.001
MSM-LAC					
Other Men	20	125,198,520	0.19	Ref	
MSM with HIV infection	5	1,391,240	4.31	22.5(8.44-59.9)	<0.001
MSM-Chicago					
Other Men	13	34,685,280	0.45	Ref	
MSM with HIV infection	6	527,360	11.38	30.4(11.5-79.9)	<0.001

* Other men – All non-MSM and HIV uninfected MSM combined

IMD Annualized Incidence Rates Among HIV Infected MSM and Other Men*

Category	Cases	Person-Months	Estimated rate per 100,000	Rate Ratio (95% CI)	p-value
Overall Estimates					
Other Men	479	3,845,633,240	0.15	Ref	
MSM with HIV infection	38	19,087,000	2.39	16.0(11.5-22.4)	<0.001
MSM-Others					
Other Men	414	3,583,718,360	0.15	Ref	
MSM with HIV infection	12	15,502,760	0.93	6.7(3.8-11.9)	<0.001
MSM-NYC					
Other Men	27	102,031,080	0.31	Ref	
MSM with HIV infection	15	1,665,640	10.81	34.0(18.1-64.0)	<0.001
MSM-LAC					
Other Men	20	125,198,520	0.19	Ref	
MSM with HIV infection	5	1,391,240	4.31	22.5(8.44-59.9)	<0.001
MSM-Chicago					
Other Men	13	34,685,280	0.45	Ref	
MSM with HIV infection	6	527,360	11.38	30.4(11.5-79.9)	<0.001

* Other men – All non-MSM and HIV uninfected MSM combined

Relative Risk of IMD among MSM with Serogroup C, W, and Y Infections

Comparison	Relative Risk		
	Overall	MSM-Others	Clustered MSM cases (NYC, LAC and Chicago)
MSM compared to non-MSM	7.4	3.3	21.3-38.9
HIV infected MSM compared to HIV uninfected MSM	9.2	10.3	1.8-7.7
HIV infected MSM compared to other men	25.7	6.7	12.9-48.4
HIV uninfected MSM compared to non-MSM	3.0	0.97	9.3-22.8

Relative Risk of IMD among MSM with Serogroup C, W, and Y Infections

Comparison	Relative Risk		
	Overall	MSM-Others	Clustered MSM cases (NYC, LAC and Chicago)
MSM compared to non-MSM	7.4	3.3	21.3-38.9
HIV infected MSM compared to HIV uninfected MSM	9.2	10.3	1.8-7.7
HIV infected MSM compared to other men	25.7	6.7	12.9-48.4
HIV uninfected MSM compared to non-MSM	3.0	0.97	9.3-22.8

Relative Risk of IMD among MSM with Serogroup C, W, and Y Infections

Comparison	Relative Risk		
	Overall	MSM-Others	Clustered MSM cases (NYC, LAC and Chicago)
MSM compared to non-MSM	7.4	3.3	21.3-38.9
HIV infected MSM compared to HIV uninfected MSM	9.2	10.3	1.8-7.7
HIV infected MSM compared to other men	25.7	6.7	12.9-48.4
HIV uninfected MSM compared to non-MSM	3.0	0.97	9.3-22.8

Relative Risk of IMD among MSM with Serogroup C, W, and Y Infections

Comparison	Relative Risk		
	Overall	MSM-Others	Clustered MSM cases (NYC, LAC and Chicago)
MSM compared to non-MSM	7.4	3.3	21.3-38.9
HIV infected MSM compared to HIV uninfected MSM	9.2	10.3	1.8-7.7
HIV infected MSM compared to other men	25.7	6.7	12.9-48.4
HIV uninfected MSM compared to non-MSM	3.0	0.97	9.3-22.8

Relative Risk of IMD among MSM with Serogroup C, W, and Y Infections

Comparison	Relative Risk		
	Overall	MSM-Others	Clustered MSM cases (NYC, LAC and Chicago)
MSM compared to non-MSM	7.4	3.3	21.3-38.9
HIV infected MSM compared to HIV uninfected MSM	9.2	10.3	1.8-7.7
HIV infected MSM compared to other men	25.7	6.7	12.9-48.4
HIV uninfected MSM compared to non-MSM	3.0	0.97	9.3-22.8

Discussion

IMD Risk Among MSM

- **MSM had higher incidence in both outbreak and non-outbreak settings compared to the non-MSM population (RR 1.8 - 23.0)**
- **Serogroup C accounted for majority of MSM cases**
 - Consistent with previous outbreaks among MSM
 - Reason for this occurrence remain unclear

IMD Risk Among HIV Infected MSM

- **High HIV prevalence among MSM with IMD (59%)**
 - Compared to general HIV prevalence of 19%¹ among MSM in the U.S.
- **Unclear why no significant association observed between HIV status and case fatality among the MSM cases**
 - May be related to access to HIV care, care seeking behavior, etc.
 - Data not stratified by viral load or CD4 count status
- **Being MSM combined with HIV infection conferred a higher risk for meningococcal disease than being MSM alone**
- **HIV infection seems to be responsible for most of the increased risk observed among MSM-Others**

1. Prevalence and Awareness of HIV Infection Among Men Who Have Sex With Men --- 21 Cities, United States, 2008. Morbidity and Mortality Weekly Report (MMWR). 2010;59(37):1201-7

High Risk Behaviors among MSM with IMD

- **High prevalence of recreational drug use among MSM with IMD (48%)**
 - Recreational drug use prevalence of 10%¹ among U.S. adults
- **High prevalence of smoking among MSM with IMD (30%)**
 - 18%² prevalence among U.S. individuals 12 years and older
- **Reasons for increased IMD risk in outbreak settings are unclear**
 - May include increased number of contacts and/or higher-risk behaviors
 - MSM with these behaviors may also be at increased risk of being infected with HIV

1. Jamal A, Agaku I, O'Connor E, King B, Kenemer J, Neff L. Current Cigarette Smoking Among Adults — United States, 2005–2013. (MMWR). 2014;63(47):1108-12

2. Center for Behavioral Health Statistics and Quality. Behavioral health trends in the United States: Results from the 2014 National Survey on Drug Use and Health. 2015.

Limitations

- **Ascertainment of MSM status during case investigations still a challenge**
 - Misclassification of MSM status – may underestimate our rate
 - IMD risk may vary depending on accuracy of denominator estimate
- **CDC recommended that health departments routinely assess MSM and HIV status for cases that occur in men aged ≥ 16 years**
 - Remains unclear how broadly and completely this recommendation has been implemented
- **Given the lack of a proper control population, assessment of risk factors is difficult**
 - Missing/incomplete data

Key Messages

- **In our analysis, MSM had increased incidence in both outbreak and non-outbreak settings compared to the general population, however the overall incidence is low**
 - Increases with HIV infection and is higher among serogroups C, W, and Y infections
- **Most MSM case-patients are in the older age-groups and would not have been part of the current adolescent vaccination program**

Acknowledgements

- **Kyle Bernstein**
- **Amy Blain**
- **Virginia Bowen**
- **Jeremy Grey**
- **Hajime Kamiya**
- **Cecilia Kretz**
- **Jennifer Liang**
- **Jessica MacNeil**
- **Stacey Martin**
- **Sarah Meyer**
- **Lara Misegades**
- **Monica Patton**
- **Manisha Patel**
- **Adam Retchless**
- **Xin Wang**
- **Melissa Whaley**
- **New York City Department of Health and Mental Hygiene**
- **Los Angeles County Department of Public Health**
- **California Department of Public Health**
- **Chicago Department of Public Health**
- **Other State and Local Health Departments**