Meningococcal Disease in Oklahoma, 1988-2004

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Meningococcal Disease Background

- Causes 1,400-2,800 cases of sepsis and meningitis per year in the US (rate: 0.5-1.1/100,000)
- Case-fatality rate is 8-15%
- Severe sequelae occur in 10-20% of survivors
- Incidence in US and Oklahoma has declined >80% since 1955

Neisseria meningitidis

- Gram-negative diplococcal bacteria
- Asymptomatic carriage of the nasopharynx common; ~18% of the population is colonized at any time, median duration 9.6 months
- Invasive disease occurs primarily in the newly colonized
- The most common invasive strains are serogroups B, C, Y, A, and W-135

Meningococcal Disease Clinical Presentation

Two major forms, both of which include fever:

- Meningitis
  - —Inflammation of meninges (outer layer of CNS)
  - —Associated with higher survival rates
- Sepsis (meningococcemia)
  - —Petechial rash, hypotension
  - —Purpura fulminans, disseminated intravascular coagulation (DIC)

Purpura Fulminans

Public Health Importance

- Epidemic potential is small but well-established (0.4% of close contacts develop disease)
- OSDH investigates all cases to assess need for prophylaxis of contacts
- Cases and suspected cases can result in considerable public concern and media interest

Risk Factors

- Infancy
- Deficiency in certain complement components
- Asplenia
- Smoking
- Crowding, including college freshmen living in dormitories
- Poverty
- Preceding illness
- Seasonality
- Black race

Meningococcal Vaccines

Two vaccines currently available, both cover serogroups A,C, Y and W-135

- MPSV4 (Menomune, polysaccharide vaccine)
  - —Licensed since 1981
  - —Indicated for use in persons two years and older
  - —Immunity lasts 3-5 years, 85% protection
- MCV4 (Menactra, conjugate vaccine)
  - —Licensed since 2005
  - —Indicated for use in persons 11-55
  - —Percent efficacy, duration of immunity not yet known

Study Objectives

- Assess trends of meningococcal disease morbidity and mortality in Oklahoma from 1988-2004
- Identify high-risk groups
- Assess whether trends and risk groups known to be important at the national level hold true in Oklahoma

Methods

- Data obtained from OSDH passive surveillance
- Case definition: isolation of *N. meningitidis* from a normally sterile site, or purpura fulminans or positive CSF antigen test in persons with compatible symptoms
- Comparison of urban and rural incidence and mortality
- Sub-analysis of hospital discharge data 2002-2004 used to assess severity indicators, length of stay, and charges

Statistical Analysis

- Rates per 100,000 calculated using bridged-race yearly census estimates
- Odds ratios and 95% confidence intervals
- SAS version 9.1 used for univariate analyses and logistic regression

Meningococcal Disease Oklahoma, 1988-2004

- 545 cases (annual incidence 1.0/100,000)
- 71 (13%) died
- 54% male
- One case of secondary transmission
- One organization-based outbreak

Hospital Discharge Data for MD, Oklahoma, 2002-2004

- 65% diagnosed with meningitis, 35% sepsis
- Average hospital stay was 12 days
- Average hospital charges were $37,724
- 72% discharged home, 19% to post-acute care, 7% died
- Three persons (6.5%) required amputations

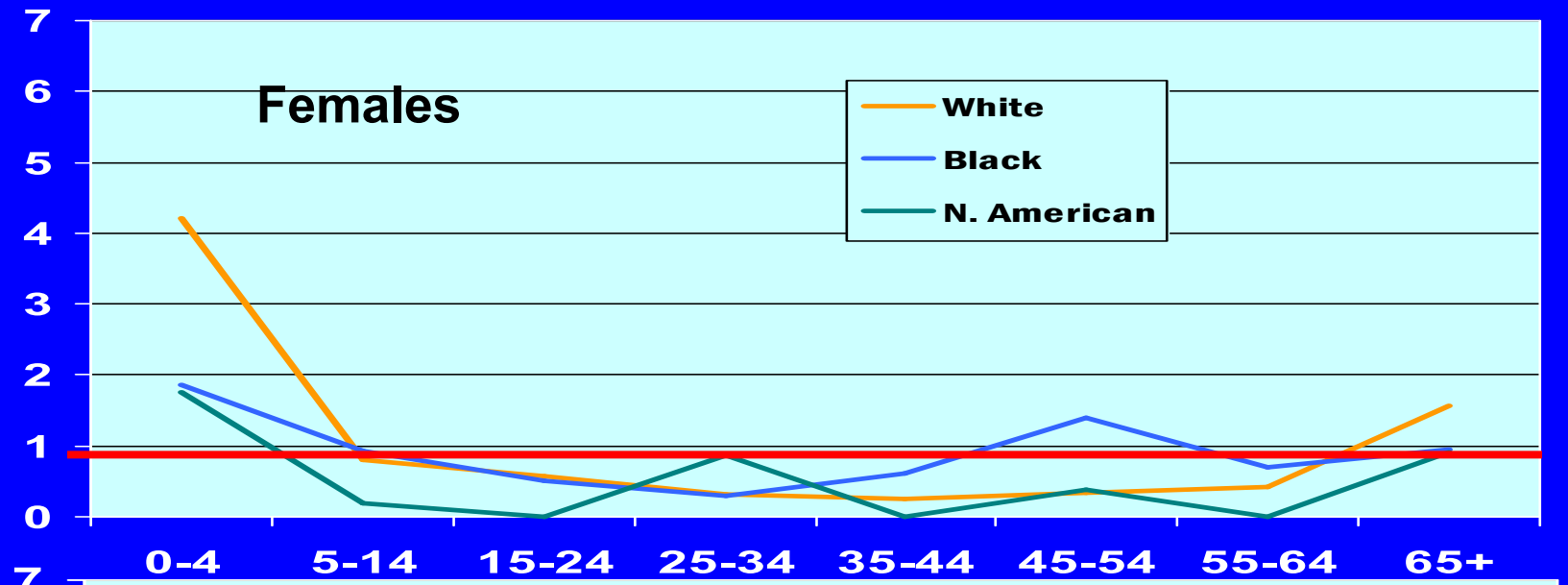
MD Incidence Rate by Age Group and Outcome, Oklahoma, 1988-2004

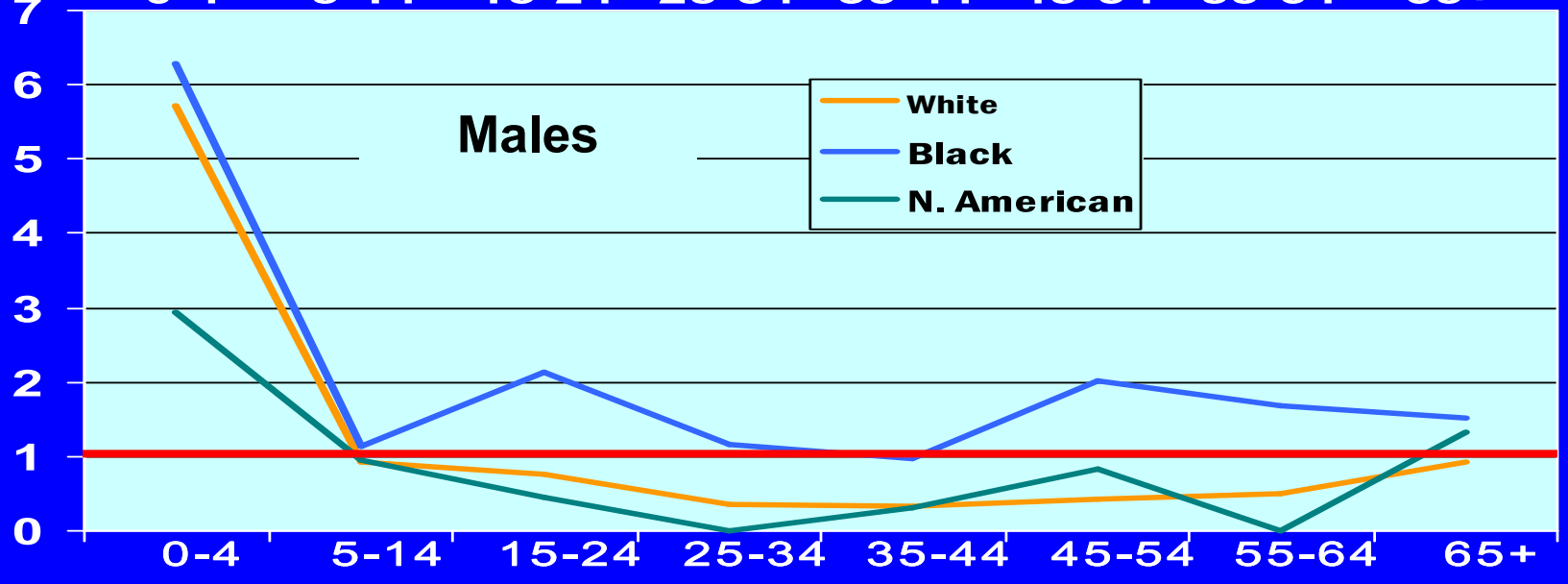
Age in Years	No. of Cases	Rate per 100,000	Case-Fatality Rate (%)
0-1	133	8.4	12.0
2-14	134	1.3	6.7
15-24	60	0.7	11.7
25-39	49	0.4	14.3
40-64	67	0.4	19.4
65+	102	1.4	18.6
Overall	545	1.0	13.0

MD Incidence Rates by Race/Sex and Outcome, Oklahoma, 1988-2004

Race/Sex Group	No. of Cases	Rate per 100,000	Case-Fatality Rate (%)
White Females	207	0.9	14.0
White Males	218	1.0	11.9
Black Females	18	0.8	16.7
Black Males	43	2.0	16.3
Native American Females	11	0.4	27.3
Native American Males	19	0.8	0.0
Overall	545	1.0	13.0

Rates of MD by Sex, Race, and Age

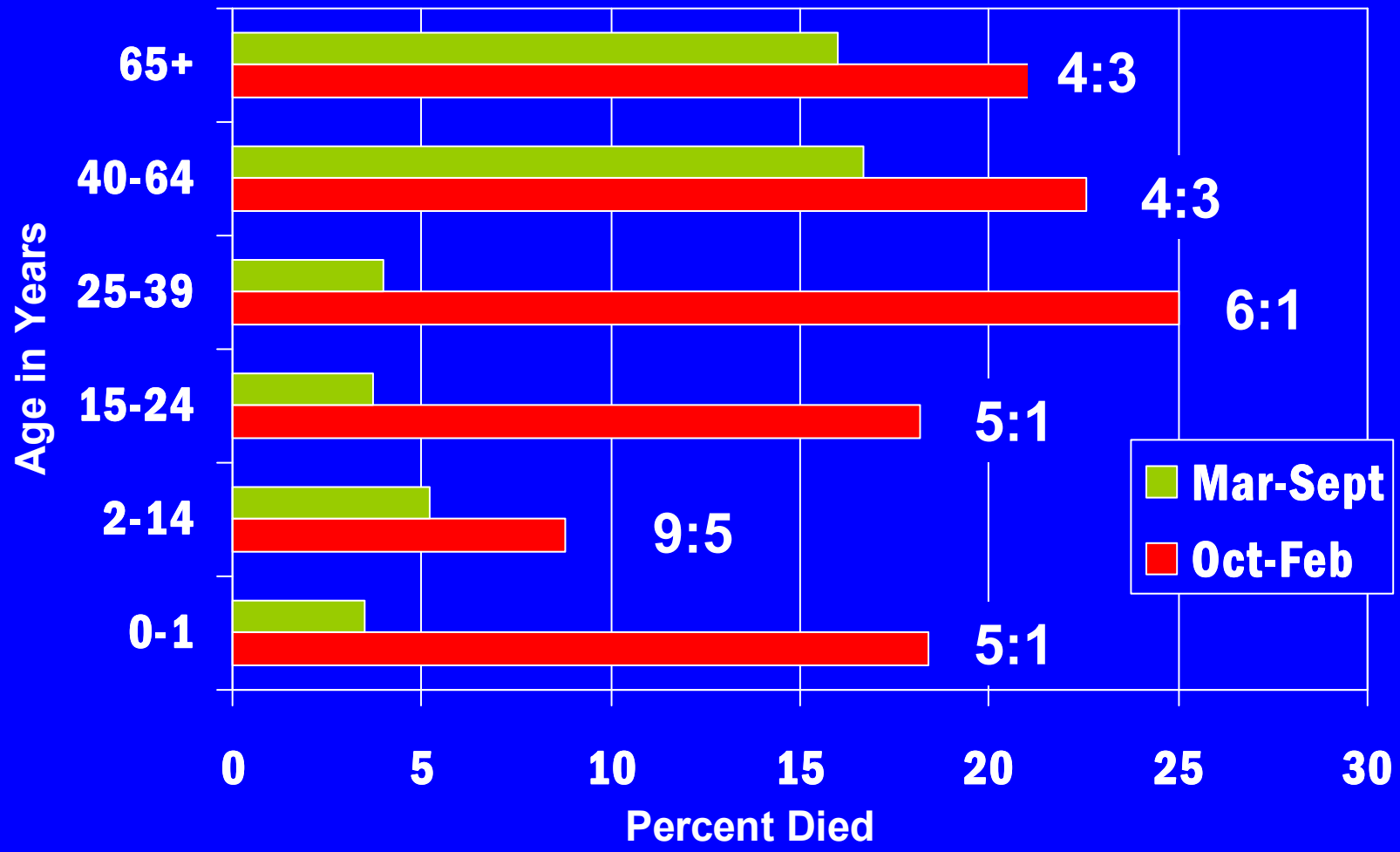




MD Incidence by Age, Specimen Source, and Outcome, Oklahoma, 1988-2004

- 54.5% had a positive culture from blood, 45.5% from cerebrospinal fluid (CSF) only or CSF and blood
- Persons less than 65 were seven times more likely to have meningitis as compared to persons over 65
- Persons with meningococcemia were 60% more likely to die than persons with meningitis

Case-Fatality Rate by Age and Season of Onset, Oklahoma, 1988-2004



Vaccine Preventable MD, Oklahoma, 1988-2004

MPSV4 (Menomune)

	Serogroup in vaccine	Serogroup not in vaccine	
2 or Older	190	75	265
<2	31	48	79
	221	123	344

55% vaccine preventable

MCV4 (Menactra)

	Serogroup in vaccine	Serogroup not in vaccine	
11-55	91	32	123
<11, >55	130	91	221
	221	123	344

27% vaccine preventable

Univariate Analysis of Factors Predicting Death in those with MD

Variable	Odds Ratio	95% CI
Age (> 39 years)	1.54	0.96-2.46
Season (March-September)	1.83	1.15-2.91
Race (Non-White)	1.12	0.60-2.11
Sex (Female)	1.34	0.85-2.10
Residence (Rural)	1.38	0.69-2.83
Isolate Source (Blood)	1.35	0.84-2.18

Logistic Regression Analysis of Factors Predicting Death in those with MD

Variable	Adjusted Odds Ratio	95% CI
Age (x10 years)	1.12	1.002-1.019
Season Oct-Feb	2.62	1.50-4.67
Isolate Source Blood	1.7	0.94-3.02

Conclusion

- State-based analyses are useful to determine trends.
- Children under two years and black males in Oklahoma are at higher risk for MD than other age/sex groups
- Persons with sepsis were more likely to die than those with meningitis, but not after controlling for age and season
- Older age and season of onset are strong predictors of death

Further Research

- Why do children and young adults have higher case-fatality rates in winter months than older adults?
- Why do black women and white men in Oklahoma have nearly the same MD incidence as the overall population, while black men have higher rates?
- What role do factors such as poverty and smoking play in MD in Oklahoma?
- Would targeting eligible high-risk groups improve the cost-benefit ratio of vaccination?

Acknowledgements

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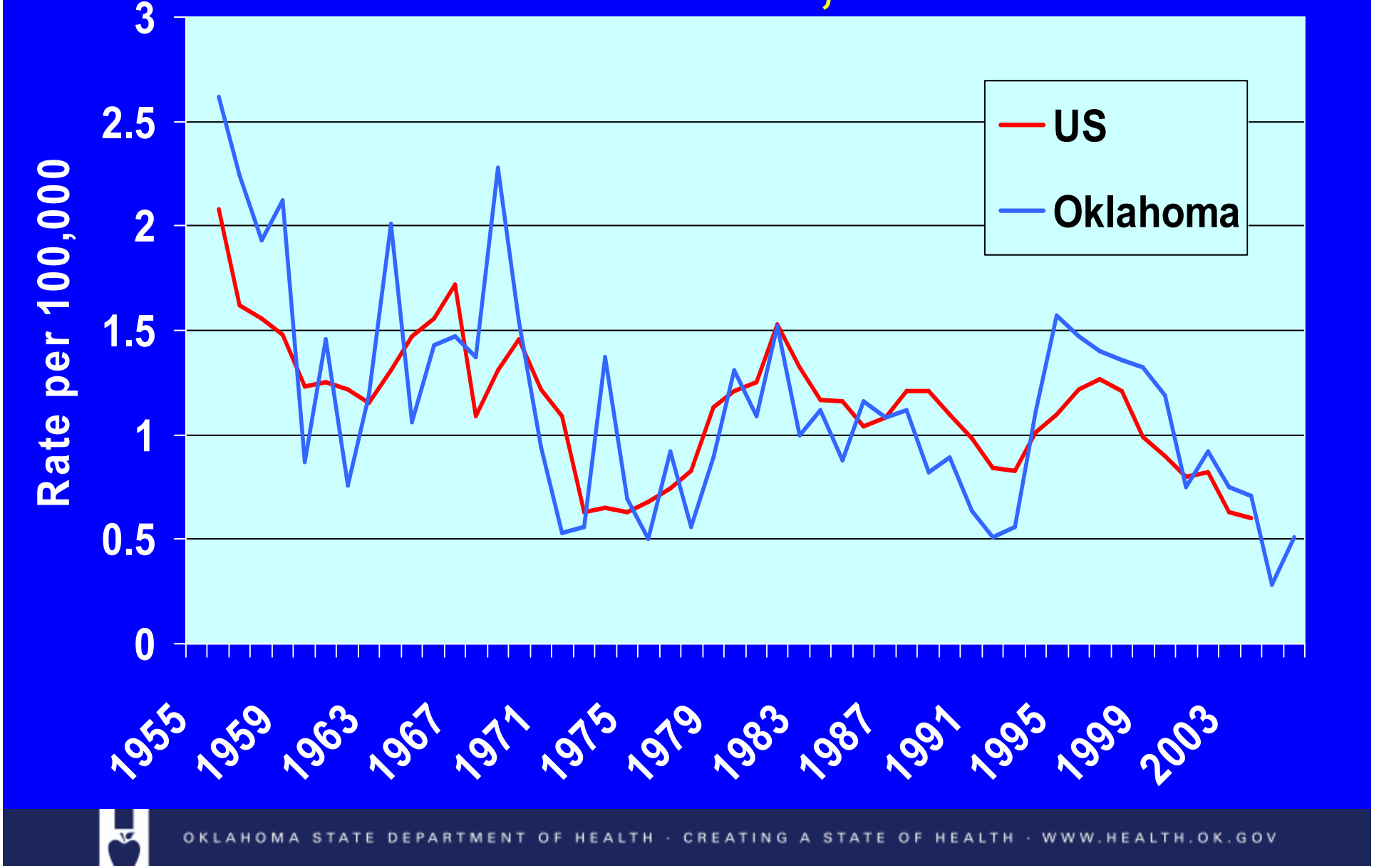
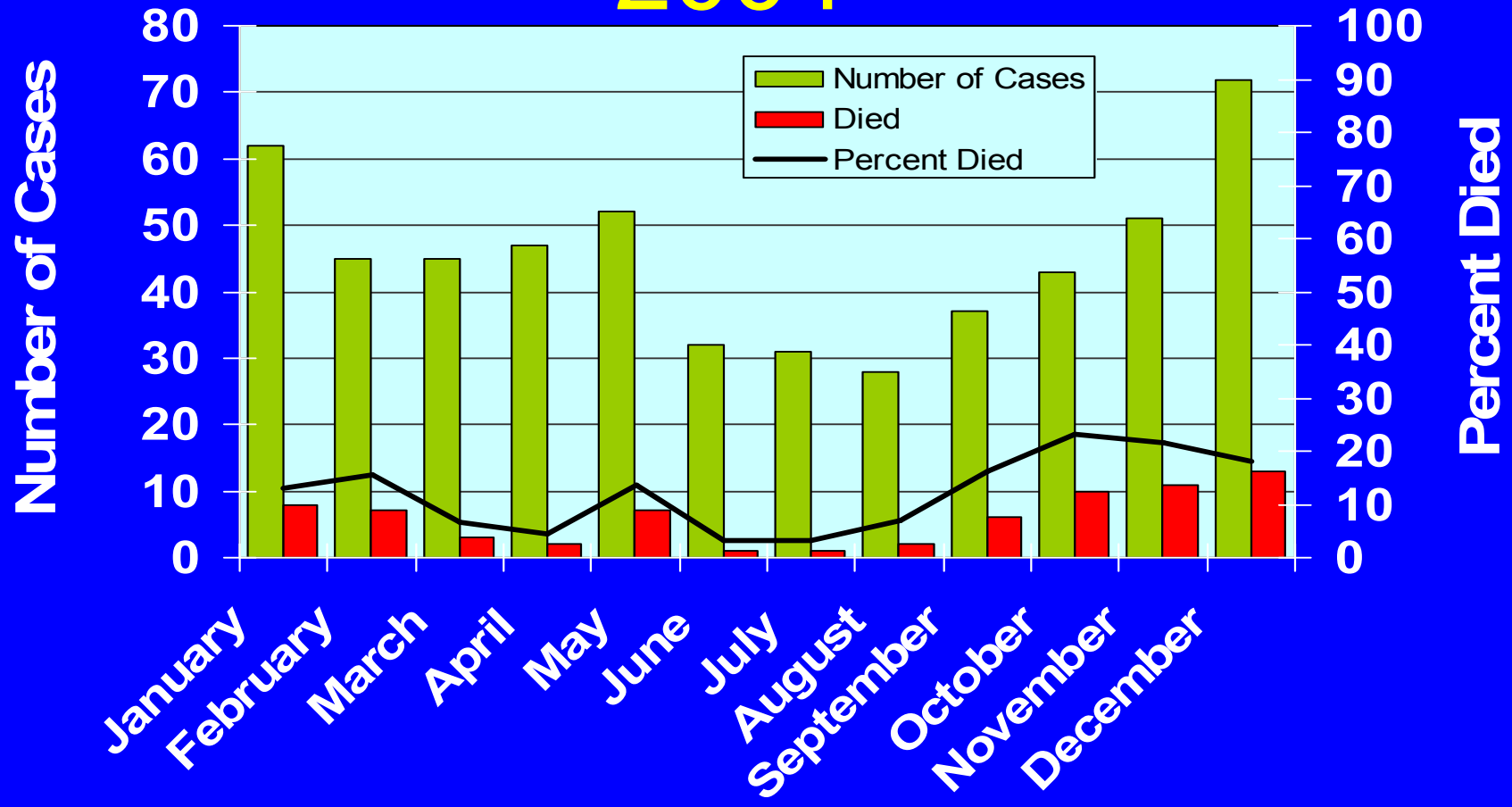
Discussion

- 55% of cases were preventable using Menomune
- 27% of cases were preventable using Menactra
- Current vaccine strategy emphasizes college freshmen living in dormitories—is this justified in Oklahoma?

Rates of Meningococcal Disease, US and Oklahoma, 1955-2005



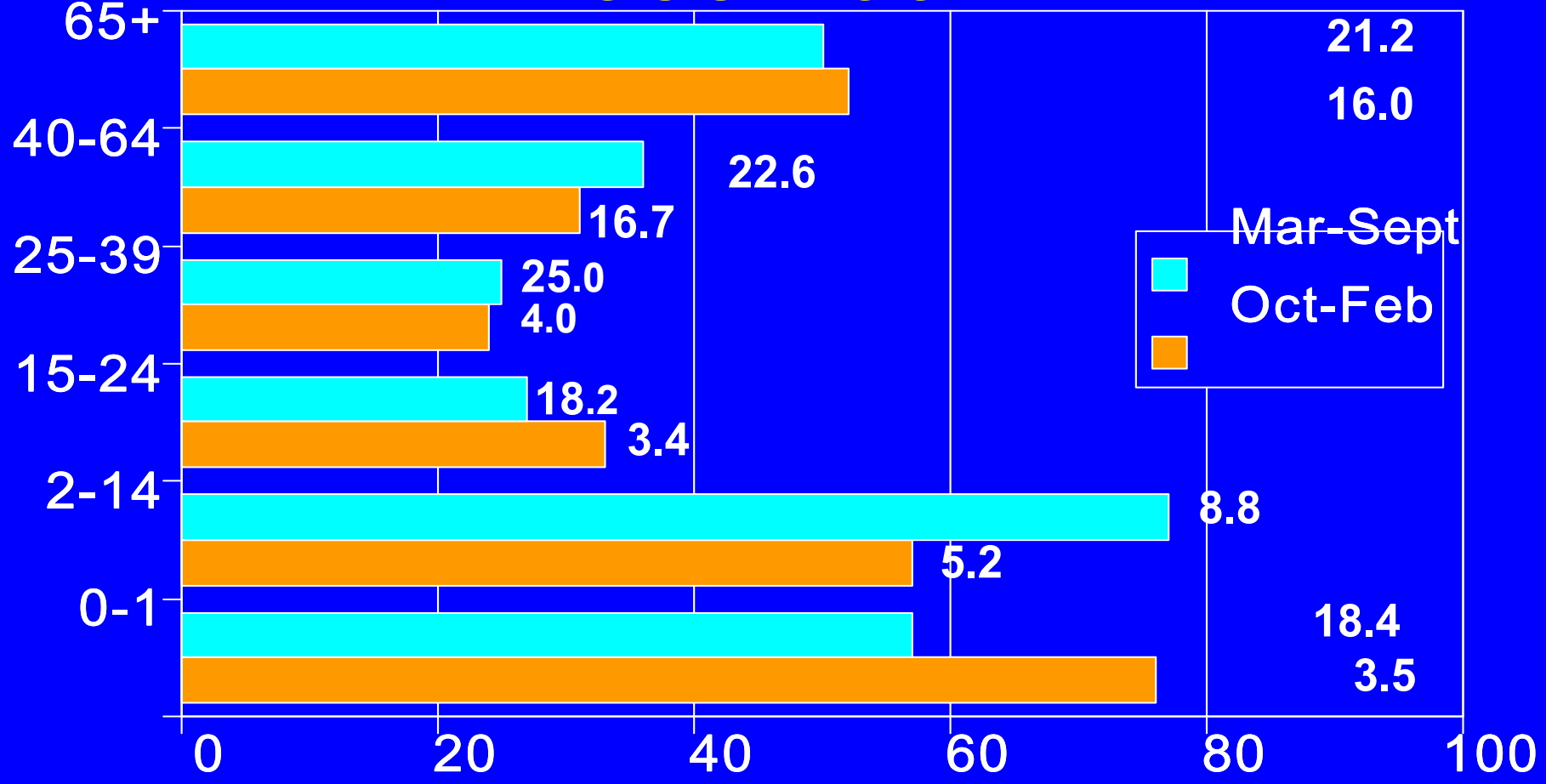
MD by Month of Onset and Outcome, Oklahoma, 1988-2004



MD Incidence by Age, Specimen Source, and Outcome, Oklahoma, 1988-2004

	Blood Only		Cerebrospinal Fluid (CSF) or CSF and Blood	
Age	Number	Case-Fatality Rate	Number	Case-Fatality Rate
0-1	63	12.7	63	11.1
2-14	56	8.9	64	6.3
15-24	19	21.1	38	8.0
25-39	22	27.3	25	4.0
40-64	36	13.9	30	26.7
65+	83	21.7	13	0.0
Total	279	16.5	233	9.9

Death Rates by Age and Season of Onset, Oklahoma, 1988-2004



Incidence of Serogroups B, C and Y, Oklahoma, 1988-2004