Recent Trends in Meningococcal Disease-Related Hospitalization in the United States

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BACKGROUND

- Invasive meningococcal disease (IMD) is a contagious infection caused by the *Neisseria meningitidis* bacteria, which causes swelling of neurologic (e.g., brain, spinal cord) membranes.
  - IMD has a case fatality rate of 10%-15%.[1]
- Increasing attention has been given to gaining a fuller understanding of the scope of the economic burden associated with IMD.
  - Although published data appear to indicate that the burden of IMD is substantial, there are limited data on the magnitude of the burden in specific care settings (e.g., inpatient).
  - Accordingly, we assessed trends in IMD-related hospitalization and aspects of inpatient care (e.g., total charges for an IMD-related hospitalization, patient-level characteristics) in the United States (US).
  - Such information may help decision makers develop sound strategies for addressing this public health concern.

OBJECTIVE

- This study sought to document recent trends in IMD-related hospitalizations in the US.

METHODS

Study Design

- Retrospective database analysis

Data Source

- Discharge data are from the 2004 through 2013 Healthcare Cost & Utilization Project (HCUP) Nationwide Inpatient Sample (NIS).
- The NIS, the largest inpatient care database in the US, is the only national inpatient database with charge information on all patients, regardless of payer.
- The NIS includes many clinical and non-clinical variables for each inpatient stay, including patient demographics, diagnosis codes, length of stay, total charges, admission and discharge status, payer, and hospital-specific characteristics.
- Sampling weights allow for generating nationally representative estimates.

Inclusion Criterion

- A primary diagnosis of IMD (ICD-9-CM codes 036.0x, 036.1x, or 036.9x)

Study Measures and Analytic Methods

- Weighted, descriptive analyses were carried out using the SAS (Version 9.4) statistical software package.
- For each of the 10 years assessed, the following measures were evaluated:
  - Weighted estimates of the rate of IMD-related hospitalizations
  - Per-discharge total charges and length of stay (LOS) for IMD-related hospitalizations
  - Patient- and hospital-level characteristics (e.g., demographics, mortality, hospital region)

RESULTS

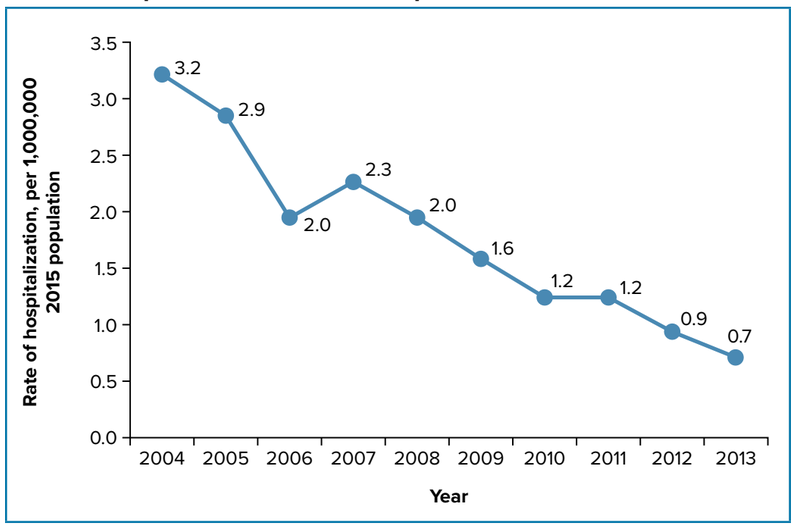
Rates of IMD-Related Hospitalization (Figure 1)

- Across all age groups, the rate of IMD-related hospitalizations decreased substantially between 2004 and 2013, from 3.2/1,000,000 US population in 2004 to 0.7/1,000,000 in 2013:
  - 3.2/1,000,000 US population in 2004
  - 2.9/1,000,000 US population in 2005
  - 2.0/1,000,000 US population in 2006
  - 2.3/1,000,000 US population in 2007
  - 2.0/1,000,000 US population in 2008
  - 1.6/1,000,000 US population in 2009
  - 1.2/1,000,000 US population in 2010
  - 1.2/1,000,000 US population in 2011
  - 0.9/1,000,000 US population in 2012
  - 0.7/1,000,000 US population in 2013

Characteristics of IMD-Related Hospitalizations (Table 1)

- In general, most patients were white, with a similar distribution of males and females.
- In 2004 and 2005, more than 50% of all IMD-related hospitalizations were among patients < 18 years of age, with the proportion in this group falling over time, reaching 27% in 2013.
- Private insurance was the most frequently observed primary payer across all study years.
- In-hospital mortality ranged from 10.6% of all IMD-related hospitalizations in 2006 to 23.7% in 2013.

Figure 1. Rate of IMD-Related Hospitalization in the US, 2004-2013 per 1,000,000 2015 Population



LOS and Total Charge (Figures 2 and 3)

- The mean LOS across all IMD-related hospitalizations increased by > 2 full days, from 7.2 days in 2004 to 9.5 days in 2013, an increase of 32%.
- Among all IMD-related hospitalizations, the mean total charge (in 2015 US dollars) increased by more than 148%, from $46,453 in 2004 to $115,427 in 2015.

Figure 2. Mean LOS of IMD-Related Hospitalizations in the US, 2004-2013

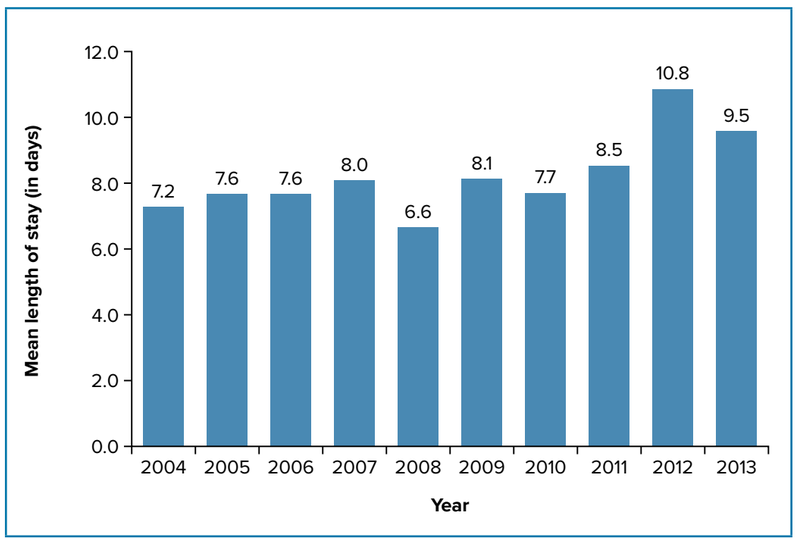


Figure 3. Mean Charge (in 2015 Dollars) per IMD-Related Hospitalization in the US, 2004-2013

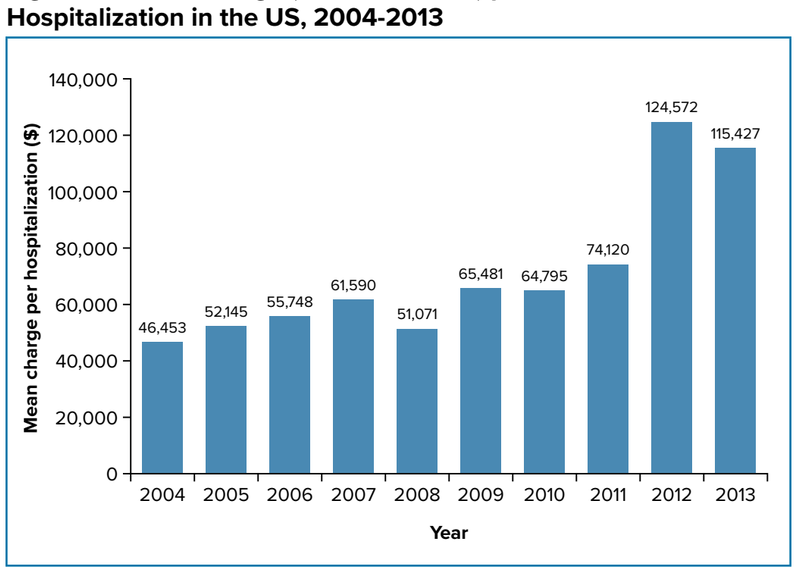


Table 1. The Distribution of Key Characteristics Among IMD-Related Hospitalizations in the US by Year

	2004		2005		2006		2007		2008		2009		2010		2011		2012		2013	
Total (n, %)	**915**	**100.0**	**817**	**100.0**	**565**	**100.0**	**669**	**100.0**	**572**	**100.0**	**475**	**100.0**	**372**	**100.0**	**372**	**100.0**	**285**	**100.0**	**220**	**100.0**
Sex (n, %)																				
Male	442	48.3	458	56.0	271	48.0	355	53.0	244	42.7	242	50.9	195	52.5	211	56.7	130	45.6	115	52.3
Female	445	48.6	360	44.0	281	49.7	300	44.9	318	55.6	229	48.2	172	46.3	161	43.3	155	54.4	105	47.7
Unknown/missing sex	29	3.1	0	0.0	13	2.4	14	2.1	10	1.7	4	0.9	4	1.2	0	0.0	0	0.0	0	0.0
Age (n, %)																				
< 18	501	54.8	448	54.9	219	38.7	244	36.4	232	40.6	114	24.0	118	31.8	128	34.3	90	31.6	60	27.3
18-29	155	16.9	128	15.6	138	24.4	169	25.3	151	26.5	103	21.7	67	18.0	79	21.2	45	15.8	60	27.3
30-39	53	5.8	75	9.2	56	10.0	14	2.0	68	11.9	41	8.5	26	7.0	33	8.9	20	7.0	10	4.6
40-49	61	6.6	48	5.9	35	6.1	56	8.3	39	6.8	58	12.3	42	11.2	34	9.0	40	14.0	35	15.9
50-59	42	4.5	58	7.1	59	10.5	109	16.3	20	3.5	64	13.4	41	11.1	33	8.9	35	12.3	10	4.6
≤ 60	100	10.9	60	7.3	54	9.5	69	10.3	61	10.7	92	19.3	78	21.0	65	17.5	55	19.3	45	20.5
Unknown/missing age	4	0.5	0	0.0	5	0.8	9	1.4	0	0.0	4	0.9	0	0.0	0	0.0	0	0.0	0	0.0
Race/ethnicity (n, %)																				
White	405	44.2	304	37.2	222	39.3	270	40.4	281	49.2	291	61.2	244	65.6	216	57.9	145	50.9	140	63.6
Black	50	5.4	86	10.5	38	6.7	52	7.8	71	12.4	54	11.4	35	9.5	32	8.6	35	12.3	25	11.4
Hispanic	140	15.4	89	10.9	86	15.2	67	10.0	63	11.0	45	9.4	30	8.0	45	12.1	55	19.3	40	18.2
Other/unknown/missing race/ethnicity	320	35.0	338	41.4	219	38.8	280	41.7	157	27.4	85	18.0	63	16.9	79	21.4	50	17.5	15	6.8
Hospital region (n, %)																				
Northeast	154	16.8	138	16.9	87	15.5	78	11.7	88	15.4	72	15.2	48	12.8	74	20.0	10	3.5	5	2.3
Midwest	240	26.2	137	16.8	126	22.3	140	20.9	148	26.0	106	22.3	89	23.9	94	25.2	40	14.0	40	18.2
South	294	32.1	271	33.2	168	29.7	243	36.3	196	34.3	163	34.4	124	33.4	129	34.6	40	14.0	25	11.4
West	228	24.9	271	33.1	184	32.5	208	31.1	139	24.3	134	28.2	111	29.8	75	20.3	0	0.0	10	4.6
Unknown/missing hospital region	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	195	68.4	140	63.6
Primary payer (n, %)																				
Medicare	71	7.8	54	6.6	34	6.0	49	7.4	60	10.5	83	17.4	59	15.9	0	0.0	55	19.3	35	15.9
Medicaid	328	35.8	277	33.9	159	28.1	162	24.2	152	26.5	138	29.0	109	29.4	13	3.4	85	29.8	55	25.0
Private insurance	424	46.4	382	46.7	277	49.0	355	53.1	269	47.0	183	38.6	142	38.2	5	1.3	105	36.8	85	38.6
Other/unknown/missing primary payer	92	10.1	104	12.8	95	17.0	103	15.4	91	16.0	71	15.0	62	16.5	354	95.3	40	14.0	45	20.5
Died during hospitalization? (n, %)	**130**	**14.3**	**115**	**14.1**	**60**	**10.6**	**79**	**11.8**	**95**	**16.7**	**64**	**13.5**	**47**	**12.7**	**55**	**14.8**	**35**	**12.8**	**50**	**23.7**

CONCLUSIONS

- IMD-related hospitalization rates in the US declined precipitously during the study period (overall, –78%), but the total charge burden per stay increased substantially during this same period (+148%), with LOS increasing substantially as well (+32%).
  - Uptake of meningococcal vaccination during the study period, particularly among adolescents, likely contributed to the decrease in IMD incidence over time.
  - While per-stay charges have increased over time, the reduction in the number of hospitalizations during the study period has resulted in total IMD-related inpatient charges decreasing by ~37%, from $39.6 million in 2004 to $24.8 million in 2013.
- Generally, in-hospital mortality rates were consistent with published estimates,[1] but there was a noticeable increase in 2013.
- Further research is warranted to better understand factors that may influence the observed growth in rates of IMD-related hospitalization in the US, as well as the substantial increase in the direct economic burden of inpatient stays for these events.
  - Such research may help in planning optimal resource allocation both in inpatient settings and across the entire continuum of care.

LIMITATIONS

- Patient discharges were identified based upon diagnosis codes that, if recorded inaccurately, may cause misidentification of IMD.
- Due to changes in data collection procedures during the study period, some measures were not consistently reported (e.g., hospital region, primary payer), resulting in inflated counts of unknown/missing data.

REFERENCES

1. Centers for Disease Control and Prevention. Epidemiology and prevention of vaccine-preventable diseases. 13th ed. Hamborsky J, Kroger A, Wolfe S, editors. Washington, DC: Public Health Foundation; 2015.

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