

# Epidemiology of Infective Endocarditis in Rural Upstate New York, 2011 - 2016

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## Abstract

**Background:** The epidemiology of infective endocarditis (IE) depends on a number of host factors whose prevalence can vary globally. The usual patient population affected by IE is sicker and older, often with many comorbid conditions. The risk is growing in younger populations due to the emerging epidemic of intravenous (IV) drug use. We have performed a temporal trend analysis of various factors of IE in the rural counties covering a major part of central Upstate New York.

**Methods:** We performed a retrospective analysis of electronic medical records of patients who were admitted in a tertiary care hospital in rural Upstate New York and diagnosed with IE from January 1, 2011 to December 31, 2016. Forty-five patients were identified with definite IE and nine with possible IE.

**Results:** Total incidence of IE was 3.5 cases per 100,000 person years in the total population and 4.4 if we consider total population  $\geq$  18 years in the denominator. A significant ( $P = 0.022$ ) increase in incidence of IE from 2011 to 2016 was seen by univariate analysis. Incidence was higher in males ( $P = 0.029$ ) and for those aged 65 or older ( $P = 0.0003$ ). IV drug use among cases is noted to be more prevalent in 2015 and 2016 compared to previous years.

**Conclusion:** In this study of patients in a rural region of New York, an increase in the incidence of IE was seen over the study period with changes in patient characteristics and etiology over this time. We speculate that an increase in IV drug use could be a leading factor in the recent and future increased incidence of IE in the area.

**Keywords:** Infective endocarditis; Epidemiology; Intravenous drug

use

## Introduction

The epidemiology of infective endocarditis (IE) depends on a number of host factors whose prevalence can vary globally. Yearly incidence is about 3 - 10 per 100,000 people [1]. Several factors have impacted the clinical spectrum of IE including decreased incidence of rheumatic carditis, increased use of intra-cardiac devices, emerging population of high-risk patients (including hemodialysis, intravenous (IV) drug users, and diabetes) as well as improved diagnostic tools and management of IE [2]. The usual patient population affected by IE is sicker and older, often with many comorbid conditions. The risk is growing in younger populations due to the emerging epidemic of IV drug use. We have performed a temporal trend analysis of various factors of IE in the rural counties covering a major part of central Upstate New York.

## Materials and Methods

We performed a retrospective analysis of electronic medical records of patients who were admitted in a tertiary care hospital in rural Upstate New York and diagnosed with IE from January 1, 2011 to December 31, 2016. Five counties of Upstate New York are covered by this tertiary care center: Otsego, Herkimer, Delaware, Chenango and Schoharie Counties. All patients over 18 years of age admitted with diagnosis of IE (ICD-10 codes 133.0) were included in the study. A total of 54 patients were identified and admitted during this time period. For each of these cases, the medical records were thoroughly reviewed to verify possible and definite IE according to the modified Duke's criteria [3]. Forty-five patients were identified with definite IE and nine with possible IE.

Demographic, clinical, laboratory and outcome data were collected using a standardized data collection form with detailed definition of variables. Death information at 6 months was obtained from the electronic medical record. The definitions of community-acquired, nosocomial, and health care-associated infections were described by Correa de Sa et al [4] and we followed the same definitions. This study was approved by

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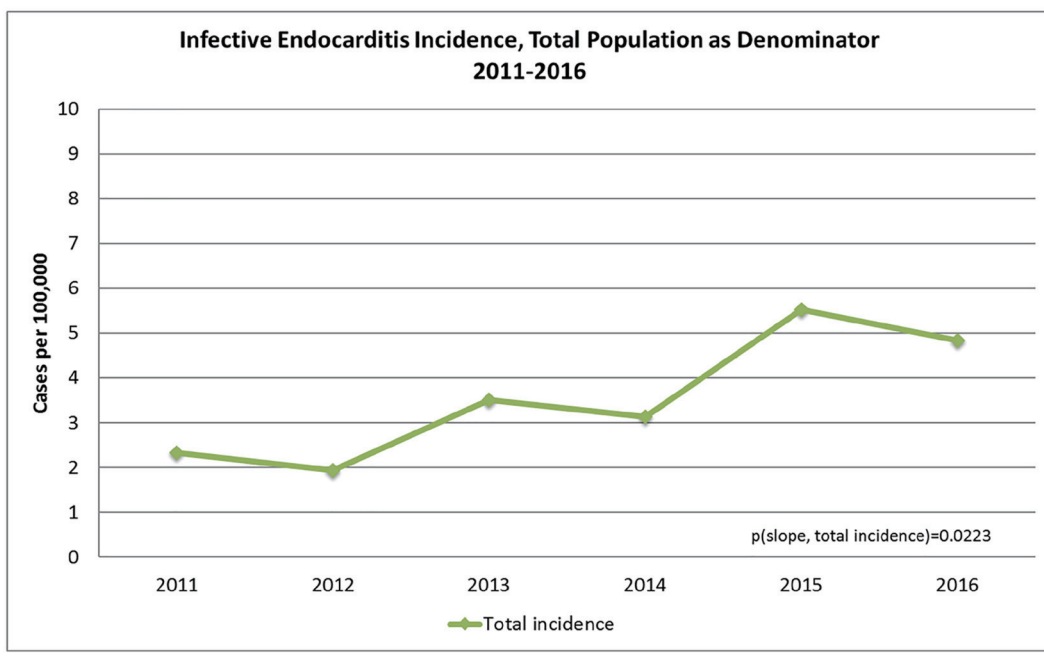


Figure 1. Total incidence of IE from 2011 to 2016.

the Bassett Institutional Review Board.

Statistical analyses included linear regression and the z-test for comparing incidence rates. For estimating incidence rates, the total population of the above mentioned counties between the years 2011 and 2016 was considered to be at risk, with counts of age-, sex-, and calendar time-specific strata in the denominator enumerated from the collective annual census data of the 6 years (2011 - 2016). All analyses were performed

using the statistical programming language SAS.

**Results**

Total incidence of IE was 3.5 cases per 100,000 person years (Fig. 1) in the total population and 4.4 if we consider total population ≥ 18 years in the denominator. From

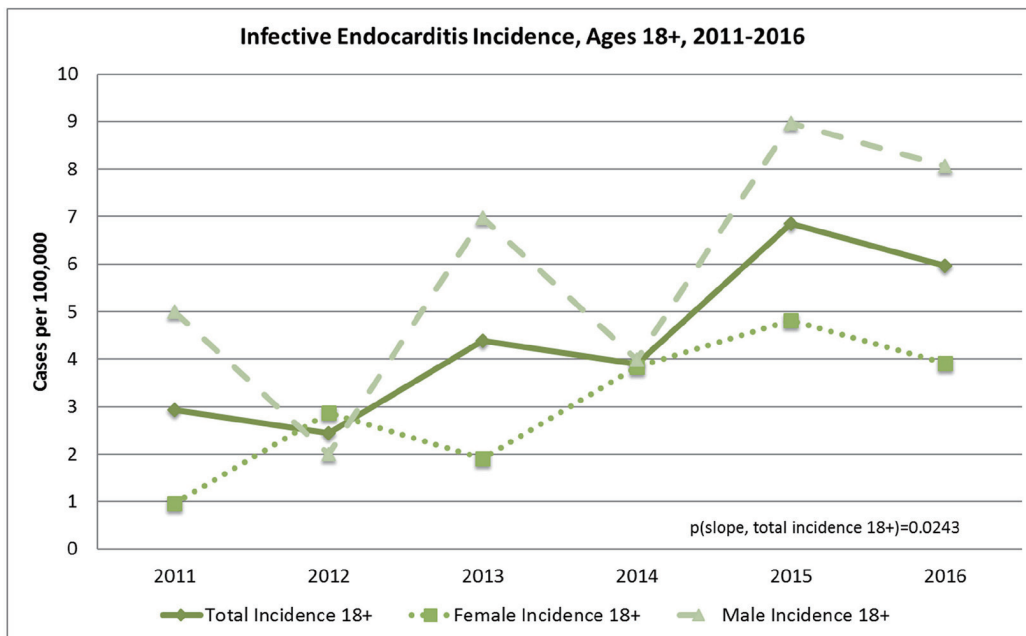
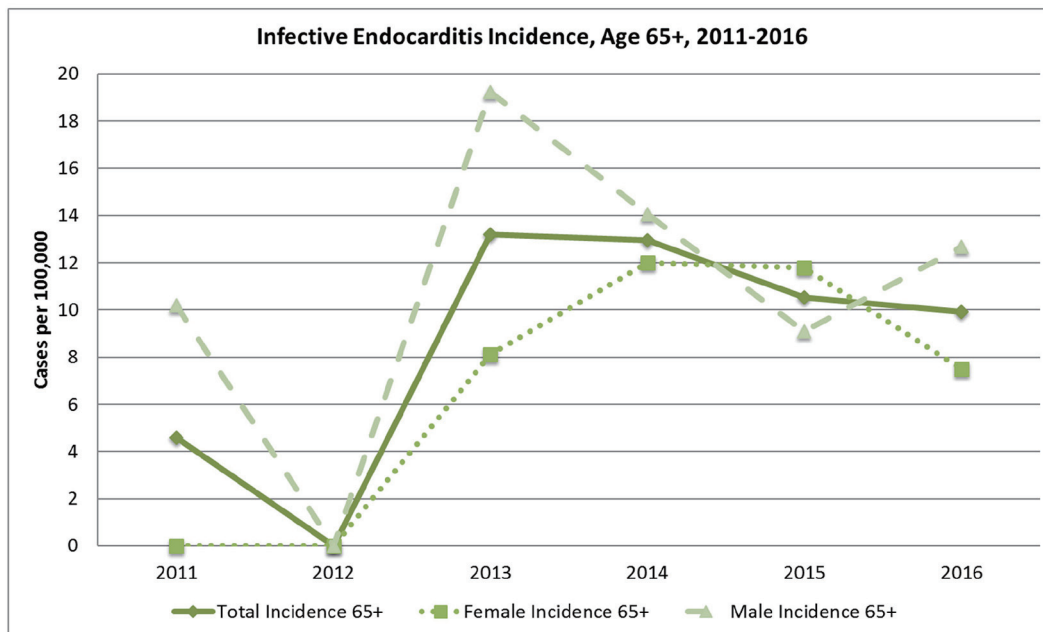


Figure 2. Incidence of IE in population 18 years and older from 2011 to 2016.



**Figure 3.** Incidence of IE in population 65 years and older from 2011 to 2016.

a univariate analysis there was significant ( $P = 0.022$ ) increase in incidence of IE from 2011 to 2016. Using the z-test for comparing incidence rates, incidence was higher in males ( $P = 0.029$ ) and for those aged 65 or older ( $P = 0.0003$ ) (Figs. 2 and 3). IV drug use among cases is noted to be more prevalent in 2015 and 2016 compared to previous years (Table 1). Other common predisposing conditions include previous IE (22.2%), history of cardiac surgery (29.6%) and implantable intra-cardiac device (14.8%). There was just one case of rheumatic carditis and no cases of mitral valve prolapse.

Clinical characteristics are summarized in Table 2. Comorbidities associated with IE include diabetes 38.8%, distant infections 22.2%, pre-existing valvular heart disease 28.8%, heart failure 20.4%, atrial fibrillation 24.07% and renal insufficiency 24.1% with 12.9% dialysis-dependent population. Infection site of acquisition was predominantly community-acquired (79.6%), with some additional healthcare-associated cases (16.7%) and only two cases of nosocomial. Of the cases, 72.2% had native valve IE, with 48% having mitral valve involvement and 22.2% having aortic valve involvement. There

were seven cases (12.9%) with prosthetic valve-associated IE. Although involvement of the pulmonary valve is rarely seen, several cases were identified in this small cohort (5.5%;  $n = 3$ ).

Microbiology and clinical outcomes are also summarized in Table 2. Of the 54 cases, 21 (38.3%) were due to *Staphylococcus aureus*, nine (16.6%) were streptococci, nine (16.6%) from enterococcus species, six (11%) were coagulase negative, six (11%) were culture negative and none were due to the HACEK (Hemophilus species, Aggregatibacter species, Cardiobacterium hominis, Eikenella corrodens, and Kingella species) group. Among the staphylococcus, seven cases were methicillin-resistant. Of the 54 cases of IE, 18 patients (33.3%) had indication for surgery. Fifteen (27.7%) patients needed surgery within 6 weeks, but only eight patients underwent surgery in the first 6-week period. Other patients had surgery after 6 weeks' period. Patients who did not have surgery ( $n = 6$ ) were either deemed too high risk or refused the procedure. In-hospital death rate was 5.5% and 6-month mortality was 9.2%. Median length of stay was calculated 11 days.

**Table 1.** Incidence of IE From 2011 to 2016 in IV Drug Users

Year of admission	Number of cases diagnosed with IE	Number of cases with reported IV drug use	Percentage (%) of cases using IV drugs
2011	6	1	16.7
2012	5	1	20
2013	9	1	11.1
2014	8	0	0
2015	14	6	42.9
2016	12	4	33.3

**Table 2.** Characteristics of Patients

Variables	IE, 2011 - 2016, n = 54
<b>Demographics</b>	
Age, median years (range)	61.5 (21 - 93)
Female gender	19 (35%)
Race (Caucasian)	54 (100%)
<b>Diagnosis</b>	
Definite IE	45 (85%)
Possible IE	9 (14%)
<b>Comorbidities</b>	
Diabetes mellitus	21 (38.8%)
HIV	1 (1.85%)
Neoplasm	6 (11.1%)
Other immunosuppressed states	2 (3.7%)
Valvular heart disease	15 (28.8%)
Heart failure	11 (20.4%)
Bicuspid aortic valve	1 (1.85%)
Atrial fibrillation	13 (24.07%)
Distant infections	12 (22.2%)
Pulmonary disease	11 (20.37%)
Renal insufficiency	13 (24.1%)
Dialysis dependent	7 (12.9%)
<b>Predisposing factor</b>	
Rheumatic heart disease	1 (1.85%)
Mitral valve prolapse	0
IV drug use	13 (24.1%)
Previous cardiac surgery	16 (29.6%)
Congenital heart disease	1 (2.38 %)
Previous IE	12 (22.2%)
Implantable intra-cardiac device	8 (14.8%)
Central venous line	6 (11.1%)
<b>Affected valve</b>	
Native valve	39 (72.2%)
Prosthetic valve	7 (12.9%)
Lead infection	8 (14.8%)
Aortic	12 (22.2%)
Mitral	26 (48%)
Tricuspid	7 (12.9%)
Pulmonary	3 (5.5%)
<b>Site of acquisition</b>	
Community acquired	43 (79.6%)
Nosocomial	2 (3.7%)
Healthcare associated	9 (16.7%)
<b>Causative organism</b>	
<i>S. aureus</i>	21 (38.3%)
MSSA	14 (66.6%)
MRSA	7 (33.3%)
Coagulase negative Staph	6 (11%)
Streptococcus species	9 (16.6%)
Enterococcus	9(16.6%)
Culture negative	6 (11%)
Others	3 (5.5%)
<b>Outcomes</b>	
Median length of stay	11
In-hospital death	3 (5.5%)
6-month mortality	5 (9.2%)
Valve surgery indicated (within 6 weeks)	15 (27.7%)
Valve surgery indicated (6 week to 1 year)	3 (5.5%)
Valve surgery performed (within 6 weeks)	8 (14.8%)
Valve surgery performed (6 week to 1 year)	4 (7.4%)

## Discussion

Understanding the epidemiologic trends of IE is important in its prevention, diagnosis and treatment. Our study period is after changes in the prevention of IE guidelines that were revised in 2007, so our time trends are not likely to be affected by this transition. The overall incidence of IE in the area appeared to be similar to that of the United States [5, 6]. A significant increase in IE was observed within the community during the study period. An increase in IV drug use among cases is also observed in the last 2 years of study period, which reflects an important behavioral pattern in this and other rural communities [7-9]. *Staphylococcus aureus* has become the predominant causative organism in the developed world. This can be attributed to the increase in risk factors in the population including older age, diabetes, end-stage renal disease, intra-cardiac device, increased use of invasive procedures and IV drug use [10]. It remained the predominant pathogen in community-acquired and healthcare-related endocarditis and can lead to an aggressive form of disease [11]. There is a general decreasing trend in nosocomial endocarditis in the United States and similar results are seen in our study. This decrease coincided with coordinated efforts to reduce hospital-acquired infections through evidence-based consensus guidelines, bundled interventions, and public reporting [12, 13]. We observed a lower proportion of patients undergoing surgery, in-hospital and 6-month mortality as compared to other studies [1, 5].

Our study has several limitations. Although the tertiary care hospital in this study is the major hospital located within the five county rural regions, referral bias is possible if some IE patients were admitted to hospitals in other nearby counties [14, 15]. There are no standard codes to identify skilled home nursing care and wound care, which are normally included in the definition of health care-associated infection; consequently, the number of health care-associated infections could have been underestimated. The population is predominantly Caucasian, rural middle to low socioeconomic class which may make our study less generalizable to more urban and racially diverse populations. Information regarding death was acquired from the electronic medical record and was not confirmed by the state health department. This may have resulted in underestimation of mortality.

## Conclusion

In this study of patients in a rural region of New York, an increase in the incidence of IE was seen over the study period with changes in patient characteristics and etiology over this time. In general, male gender and older age were associated with increased IE risk. We speculate that an increase in IV drug use could be a leading factor in the recent and future increased incidence of IE in the area.

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## Competing Interests

The authors declare that they have no competing interests.

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