



RISK OF INFECTIVE ENDOCARDITIS IN TAIWAN: RETROSPECTIVE COHORT STUDY

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ABSTRACT

Background: The incidence rate of infective endocarditis (IE) in Taiwan is high. Thus, we investigated the incidence and risk factors of IE among Taiwanese patients. **Objective:** In this retrospective cohort study, IE cases from 1998 to 2010 were identified from the National Health Insurance Research Database through the International Classification of Diseases, Ninth Revision, Clinical Modification.

Poisson regression models were used to assess the relative risks (RRs) and 95% confidence intervals (CIs) of IE associated with sex, age, and odds ratios (ORs) of comorbidities. Among 16,924 patients with IE, 108,22 (51.60%) were male and 6,102 (48.40%) were female. **Results:** A total of 59.29% patients were older than 50 years. The annual crude incidence was 4.34–6.86 per 100,000 person-years. Our data also demonstrated that the highest incidence rate was on people aged 70–79 years. The incidence rate of IE was higher in males than in females in the 40- to 49-year-old group (RR = 3.12; 95% CI, 2.84–3.43). Staphylococcal (61.38%) and Streptococcal species (28.44%) were the most common causative pathogens. Males showed more statistically significant comorbidities of hypertension (OR = 5.58; 95% CI, 4.32–7.20), disease of aortic valve (OR = 5.01; 95% CI, 4.13–6.08), acute respiratory failure (OR = 9.23; 95% CI, 7.23–11.78), and drug abuse (OR = 6.39; 95% CI, 3.37–12.13) ($p < 0.0001$) than females. **Conclusions:** The Taiwanese study revealed a high incidence of IE in men and elderly subjects. Staphylococcal species and cardiovascular and infective valve prevention strategies may help reduce the risk of IE.

KEYWORDS: infective endocarditis, incidence, relative risks, age distribution, prospective cohort study.

INTRODUCTION

Infective endocarditis (IE) exacts a high cost from societies worldwide; in the United States alone, 10,000 to 15,000 cases each year have been recorded.^[1] IE is associated with prolonged hospitalization and surgery^[2], and impairs the quality of life.^[3] Notable improvements in IE diagnosis and treatment have been achieved, but in-hospital mortality is still close to 20%.^[4,5] The characteristics of patients with IE vary significantly across countries. Several well-designed epidemiologic studies have reported incidence rates of IE ranging from 2 to 7.60 per 100,000 person-years.^[6-12]

The incidence of IE is related to age, sex, and associated disease. In general, males have higher risk of IE than females, and the incidence rates increase with age.^[13]

Male gender predominated in most case series, and male-to-female ratios ranged from 1.6:1 to 2.5:1.^[13] The problem of IE is evidently linked to cardiovascular system disease, and IE is perceived as a male problem because IE predominantly affects males.^[11,13-15]

Staphylococcus aureus especially related to IE and coagulase-negative Staphylococci especially in prosthetic valve and pacemaker IE^[16-18] are now common etiologies. In-hospital incidence of IE is independently associated with sex, increased multivariate disease, such as hypertension and congestive heart failure^[19], acute respiratory failure^[20], and drug abuse.^[21]

The latest studies found no substantial change in the incidence rates of IE during the recent years.^[16,17] Despite the recent advances in health care and the availability of better diagnostic tools and criteria, the mortality rate of IE remains high, with a mean in-hospital IE mortality rate of 16% (range: 11% to 31%).^[12,22,23]

Untreated IE is generally fatal, and its incidence is increasing. Hence, this population-based study was conducted to understand the incidence and contributing factors of IE in Taiwan. The National Health Insurance (NHI) program, which covers 99.7% of the population in Taiwan, was used to analyze the incidence and epidemiologic characteristics of IE from 1998 to 2010. This study aims to evaluate the incidence rates and associated factors of IE including sex, age, species infection, and comorbidities.

MATERIALS AND METHODS

Data collection: The Taiwanese NHI Bureau (NHIB) provided electronic data containing the patients' sex, date of birth, and classification codes of the diagnosed diseases, as well as data

on health services received and the clinic or hospital code where treatment was obtained or consultation was sought. In 2008, 22.89 million of the country's 22.96 million people (accounting for 99.7% of the island's population) were covered by the NHI program.^[24] More than 1,500 studies have been published in peer-reviewed journals based on the NHI Research Database (NHIRD).

The NHIB collects data from the NHI program and sorts these data into data files each year. The data include data of registration files and original claims for reimbursement. These data files were de-identified by scrambling the identification codes of both patients and medical facilities. The files were then sent to the National Health Research Institutes (NHRI) to form the original files of the NHIRD. NHIRD is one of the largest nationwide, population-based data sets in the world.

IE cases from 1998 to 2010 were collected from the Taiwanese NHIB, and one million patients were used for this longitudinal study. The members of the general population included in this study were 10,886 men and 6,102 women. IE cases from 1998 to 2010 were identified from the NHIRD through the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM). The codes were converted into ICD-9-CM for data analysis. The average sex and age-specific incidences during the target period were further compared and analyzed. The index date for each participant was the first IE diagnosis date. We identified the study endpoint as the first diagnosis of IE from inpatient claims or hospitalization records from 1998 to 2010. An IE case was defined as a diagnosis of acute and subacute bacterial endocarditis (ICD-9-CM 421.0), acute and subacute IE in diseases classified elsewhere (ICD-9-CM 421.1), and unspecified acute endocarditis (ICD-9-CM 421.9) as well as endocarditis with unspecified valve and unspecified cause (ICD-9-CM 424.9). Eleven Infective Endocarditic of Species Infection of *Staphylococcus* species (ICD-9-CM 038.10, 038.11, 038.19, 041.10, 041.11, 041.19), *Streptococcus* species (ICD-9-CM 041.00, 041.01, 041.02, 041.03, 041.04, 041.05, 041.09), *Salmonella* species (ICD-9-CM 003.1), *Escherichia coli* infection (ICD-9-CM 038.42), *Salmonella* species (ICD-9-CM 003.1), *Pseudomonas* species (ICD-9-CM 038.43, 041.7), *Klebsiella pneumoniae* (ICD-9-CM 041.3), and Candidal endocarditis (ICD-9-CM 112.81) were determined. The disease categories used to analyze co-morbid conditions were hypertension (401.0, 401.1, 401.9), diabetes mellitus (250.00–250.90), drug abuse (304.20–304.23, 305.70–305.73, 965.01), disease of mitral valve (424.0), disease of aortic valve (424.1), disease of tricuspid valve (424.2), disease of

pulmonary valve (424.3), prosthetic heart valve (V43.3), heart failure (428.0–428.4, 428.9), ischemic stroke (433.0–434.9, 436, 437.1), intracerebral hemorrhage (430–432.9), cardiac device in situ (V45.0–9), unspecified anomaly of heart (746.89), systemic lupus erythematosus (SLE) (710.0), shock (785.50), and acute respiratory failure (518.81). These categories were based on the ICD-9-CM classification [25]. Access to the NHIRD has been approved by the NHRI Review Committee. All patients' data were encrypted using the same encryption algorithm to cross-link the data while protecting the privacy of the patients. This study protocol was approved by the institutional review board of China Medical University Hospital (CMUH103-REC1-088).

Statistical analyses

The annual incidence of IE was calculated by dividing the number of new cases during a period by the number of people at risk in the population at the beginning of the study. The 13-year cumulative IE incidence refers to the number of new cases divided by the size of the population at risk from 1998 to 2010. Poisson regression models were used to assess the relative risks (RRs) and 95% confidence intervals (CIs) of IE incidence associated with sex, age, and odds ratios (ORs) for the occurrence of comorbidities. P-values < 0.05 were considered statistically significant.

RESULTS

Table 1. Demographic Characteristics of Infective Endocarditis (n = 16988, 1998 to 2010) by Sex and Age

Variable	Acute and subacute bacterial endocarditis (ICD-9-CM 421.0)		Acute and subacute infective endocarditis in diseases classified elsewhere (ICD-9-CM 421.1)		Unspecified acute endocarditis (ICD-9-CM 421.9)		Unspecified valve and unspecified cause (ICD-9-CM 424.9)		Total		
	Male N (%)	Female N (%)	Male N (%)	Female N (%)	Male N (%)	Female N (%)	Male N (%)	Female N (%)	Male N (%)	Female N (%)	Total N (%)
≤ 18	386(3.74)	356(6.31)	1(2.56)	1(5.00)	17(6.72)	13(7.98)	1(0.37)	1(0.36)	405(3.72)	371(6.08)	776(4.57)
19–29	1053(10.20)	660(11.70)	1(2.56)	0(0.00)	29(11.46)	20(12.27)	3(1.11)	0(0.00)	1086(9.98)	680(11.14)	1766(10.40)
30–39	1526(14.78)	522(9.25)	4(10.26)	2(10.00)	34(13.44)	18(11.04)	2(0.74)	5(1.81)	1566(14.39)	547(8.96)	2113(12.44)
40–49	1664(16.12)	516(9.15)	4(10.26)	1(5.00)	29(11.46)	16(9.82)	15(5.54)	15(5.42)	1712(15.73)	548(8.98)	2260(13.30)
50–59	1601(15.51)	718(12.73)	6(15.38)	1(5.00)	40(15.81)	17(10.43)	27(9.96)	32(11.55)	1674(15.38)	768(12.59)	2442(14.37)
60–69	1489(14.42)	919(16.29)	5(12.82)	5(25.00)	31(12.58)	31(19.02)	62(22.88)	74(26.71)	1587(14.58)	1029(16.86)	2616(15.40)
70–79	1675(16.23)	1136(20.13)	14(35.90)	5(25.00)	47(18.58)	31(19.02)	120(44.28)	92(33.21)	1856(17.05)	1264(20.71)	3120(18.37)
≥ 80	929(9.00)	815(14.45)	4(10.26)	5(25.00)	26(10.28)	17(10.43)	41(15.13)	58(20.94)	1000(9.19)	895(14.67)	1895(11.15)
Total	10323(100)	5642(100)	39(100)	20(100)	253(100)	163(100)	271(100)	277(100)	10886(100)	6102(100)	16988(100)

N (%): N, number of infective endocarditis, with percentages in parentheses

Table 2. Percentage of Infective Endocarditis of Species Infection, 1998–2010

Variable	ICD-9-CM	N (%)
Staphylococcus species	038.10, 038.11, 038.19, 041.10, 041.11, 041.19	1418 (61.38%)
Streptococcus species infection	041.00, 041.01, 041.02, 041.03, 041.04, 041.05, 041.09	657 (28.44%)
Septicemia from Salmonella species	003.1	85 (3.68%)
Escherichia coli infection	038.42	56 (2.42%)
Septicemia from Pseudomonas species	038.43, 041.7	56 (2.42%)
Septicemia from Klebsiella pneumoniae	041.3	33 (1.43%)
Candidal endocarditis	112.81	5 (0.23%)
Denominator (Number of occurrences):2310		
N (%): N, number of infective endocarditis, with percentages in parentheses		

Table 3. Incidence and Relative Risks (RR) for Sex and Age-specific of Infective Endocarditis, 1998–2010

Age	Rate	RR(95% CI) ^a	p-value	Sex		RR (95% CI)	p-value
				Male Rate	Female Rate		
≤ 18	12.15	1 (reference)	0.0005	405 (2.38)	371 (2.18)	1.09 (0.95- 1.26)	0.0005
19–29	42.87	0.93 (0.85–1.00)	0.0005	1086 (6.39)	680 (4.00)	1.60 (1.46- 1.75)	0.0005
30–39	55.11	1.03 (0.95–1.11)	0.0005	1566 (9.22)	547 (3.22)	2.86 (2.60 - 3.16)	0.0005
40–49	69.22	1.15 (1.04–1.08)	0.0005	1711 (10.07)	548 (3.23)	3.12 (2.84- 3.43)	0.0005
50–59	139.89	1.22 (1.14–1.29)	0.0005	1674 (9.86)	768 (4.52)	2.18 (2.01 - 2.37)	0.0005
60–69	187.00	1.26 (1.19–1.34)	0.0005	1586 (9.34)	1029 (6.06)	1.54 (1.43- 1.67)	0.0005
70–79	356.24	1.30 (1.22–1.37)	0.0005	1855 (10.92)	1264 (7.44)	1.47(1.37 - 1.58)	0.0005
≥ 80	712.82	1.45 (1.37–1.52)	0.0005	999 (5.88)	895 (5.27)	1.12 (1.02 - 1.22)	0.0005

^a RR (95% CI) values are derived from Poisson regression model with adjusted sex and age.

Table 4. Incidence Rate^a and 13-year Cumulative Incidence^b of Infective Endocarditis (1998 to 2010) by Year and Age Group

Year/Age	≤ 18	19-29	30-39	40-49	50-59	60-69	70-79	≥80	Total
Incidence Rate									
1998	1.28	2.57	3.07	4.41	8.70	18.02	39.24	49.65	6.07
1999	1.35	2.98	2.76	4.29	6.85	10.49	18.04	21.30	4.34
2000	1.81	2.63	3.32	3.30	7.00	12.54	19.25	24.88	4.66
2001	1.19	3.61	4.34	4.01	6.44	14.53	19.90	29.33	5.20
2002	1.20	4.35	4.15	4.61	7.50	13.65	23.30	32.58	5.74
2003	0.73	4.27	5.33	4.89	6.67	12.03	24.28	27.87	5.71
2004	0.97	5.45	5.88	5.47	8.68	13.75	24.79	35.47	6.74
2005	1.08	4.80	5.61	5.70	8.12	14.58	24.93	41.88	6.86
2006	0.81	3.32	5.10	5.37	7.37	13.17	25.04	37.31	6.22
2007	0.66	3.00	5.12	5.55	7.42	14.24	20.41	37.48	6.13
2008	0.79	2.43	4.71	5.06	8.38	13.72	23.09	35.68	6.22
2009	0.81	1.76	3.70	4.82	7.25	11.76	21.89	39.12	5.77
2010	0.75	1.69	3.56	4.51	6.47	10.71	19.46	34.55	5.38
Mean	1.03	3.30	4.36	4.77	7.45	13.32	23.36	34.39	5.77
13-year Cumulative Incidence									
	12.15	42.87	55.11	69.22	139.89	187.00	356.24	712.82	77.56

^a Annual incidence (per 100,000 person-years) is the number of new cases of infective endocarditis divided by the size of the population at risk in each year.

^b 13-year cumulative incidence is the number of new cases of infective endocarditis divided by the size of the population at risk from 1998 to 2010.

Table 5. Comorbidities and Possible Causes of Infective Endocarditis in Inpatient, 1998–2010

System	Inpatient							Total(16988) N (%)
	ICD-9 code ^a	Male (10882) N (%)	Female (6102) N (%)		<i>p</i> -value	Total(16988) N (%)		
Cardiovascular	428.0–428.4, 428.9	Heart failure	1063 (9.77)	652 (10.69)	0.06 (0.05–0.07)	<0.0001	1715 (10.10)	4666/16988 (27.47)
	401.0, 401.1, 401.9	Hypertension	913 (8.39)	653 (10.70)	5.58 (4.32–7.20)	<0.0001	1566 (9.22)	
	433.0–434.9, 436, 437.1	Ischemic stroke	413 (3.80)	242 (3.97)	2.20 (1.82–2.67)	<0.0001	655 (3.86)	
	V45.0–9	Cardiac device in situ	218 (2.00)	157 (2.57)	1.50 (1.19–1.88)	0.0005	375 (2.21)	
	430–432.9	Intracerebral hemorrhage	207 (1.90)	119 (1.95)	1.93 (1.51–2.47)	<0.0001	326 (1.92)	
	746.89	Unspecified anomaly of	16 (0.14)	13 (0.21)	1.27 (0.58–2.81)	0.55	29 (0.17)	

		heart						
Infective valves	424.0	Disease of mitral valve	1021 (9.39)	565 (9.26)	1.90 (1.71–2.11)	<0.0001	1586 (9.34)	2996/16988 (17.64)
	424.1	Disease of aortic valve	609 (5.60)	237 (3.88)	5.01 (4.13–6.08)	<0.0001	846 (4.98)	
	V43.3	Prosthetic heart valve	172 (1.58)	128 (2.10)	1.42 (1.10–1.81)	0.006	300 (1.77)	
	424.2	Disease of tricuspid valve	142 (1.30)	68 (1.11)	2.27 (1.67–3.07)	<0.0001	210 (1.24)	
	424.3	Disease of pulmonary valve	31 (0.28)	23 (0.38)	1.50 (0.80–2.82)	0.20	54 (0.32)	
Respiratory failure	518.81	Acute Respiratory failure	904 (8.30)	505 (8.28)	9.23 (7.23–11.78)	<0.0001	1409 (8.29)	1409/16988 (8.29)
Diabetes mellitus	250.00–250.90	Diabetes mellitus	742 (6.81)	554 (9.08)	2.32 (1.92–2.80)	<0.0001	1296 (7.62)	1296/16988 (7.62)
Drug abuse	304.20–304.23, 305.70–305.73, 965.01	Drug abuse	60 (0.54)	19 (0.31)	6.39 (3.37–12.13)	<0.0001	79 (0.46)	79/16988 (0.46)
Immune	710.0	SLE	12 (0.11)	40 (0.66)	0.20 (0.10–0.42)	<0.0001	52 (0.31)	52/16988 (0.31)
Shock	785.50	Shock	29 (0.26)	16 (0.26)	2.14 (1.08–4.26)	0.03	45 (0.26)	45/16988 (0.26)

^a The International Classification of Diseases, Ninth Revision, Clinical Modification was used to code and classify morbidity data from the inpatient records.

OR: Odds ratios

N (%): N, number of infective endocarditis, with percentages in parentheses

Table 1 shows that during the 13-year period (1998 to 2010), 16,988 people from the general population were diagnosed with IE. The majority of cases or 64.08% (n = 10886) involved men, whereas 35.92% (n = 6102) involved women. The mean age of in-patient cases was 53 years, and the ratio of male-to-female was 1.78. The 70- to 79-year-old group accounted for 18.37% (n = 3120) of the cases, followed by the 60- to 69-year-old group (15.40%, n = 2616), and the 50- to 59-year-old group (14.37%, n = 2442). The ≥ 50-year-old group constituted 59.29% of the total cases (Table 1). Endocarditis in the majority of cases was caused by acute and subacute bacterial endocarditis (n = 15965), followed by unspecified valve and unspecified cause (n = 548), and unspecified acute endocarditis (n = 416).

The frequencies of the causative agents are shown in Table 2. Overall, Staphylococcal (61.38%) and Streptococcal (28.44%) species were the most common isolated microorganisms. Other pathogens included Salmonella (3.68%), E. coli (2.42%), Pseudomonas (2.42%), Klebsiella (1.43%), and Candidal (0.23%) species.

The standardized highest and lowest rates were found in the ≥ 80 - and ≤ 18 -year-old groups, respectively (12.15 vs. 712.82 per 100,000 person-years), with a relative ratio (RR = 1.45, 95% CI, 1.37–1.52). The sex- and age-adjusted RRs of the different age groups are listed in Table 3. The incidence of IE in all age groups was higher in males than in females (all p -values < 0.0005). Annual IE incidences from ≤ 18 -year-old groups to ≥ 80 -year-old groups were significantly higher in males than in females, with male-to-female risk ratios ranging from 1.09 to 3.12 (Table 3).

The annual incidence of IE increased from 6.07 in 1998 to 6.86 per 100,000 person-years in 2005 and decreased to 5.38 per 100,000 person-years in 2010. The mean annual incidence of IE was 5.77 per 100,000 person-years. Our data also demonstrated the maximum percentage of IE in 2005 (6.86 per 100,000 person-years) and the minimum percentage in 1999 (4.34 per 100,000 person-years). Based on the patients' data, the 13-year cumulative incidence of IE was 77.56 per 100,000 person-years. In the 13-year cumulative incidence, the ≥ 80 -year-old group (712.82 per 100,000 person-years) presented the highest incidence, whereas the ≤ 18 -year-old group (12.15 per 100,000 person-years) presented the lowest incidence (Table 4).

The comorbidities and possible causes of IE among the 16,988 inpatients were as follows: cardiovascular system, 4,666 episodes (27.47%); infective valve, 2,996 episodes (17.64%); acute respiratory failure, 1,409 episodes (8.29%); diabetes mellitus, 1,296 episodes (7.62%); drug abuse, 79 episodes (0.46%); SLE, 52 episodes (0.31%), and shock, 45 episodes (0.26%). Among the 16,988 IE cases, male cases were more statistically significant than female cases on hypertension (OR = 5.58, 95% CI, 4.32–7.20), disease of aortic valve (OR = 5.01, 95% CI, 4.13–6.08), acute respiratory failure (OR = 9.23, 95% CI, 7.23–11.78), and drug abuse (OR = 6.39, 95% CI, 3.37–12.13) ($p < 0.0001$).

DISCUSSION

The present study is the largest 13-year population-based survey to evaluate the incidences of IE in Taiwan. Our findings are consistent with those that state that IE patients are particularly at high risk in relation to infective valve (i.e., mitral valve and aortic valve). Indeed, the

present study supports the notion that IE is associated with older age, the male sex, and Staphylococcal as well as comorbidities of hypertension^[19], acute respiratory failure^[20], drug abuse^[21], and disease of aortic valve.^[26–28]

During the 1980s, incidence of IE per 100,000 persons in Western countries was approximately 1.5 to 6.^[6–9] The mean annual incidence of IE was 5.77 per 100,000 person-years in Taiwan. We observed that the incidence of IE in Taiwan was on a medium scale compared with that in other populations.^[6–9,11,28] The annual incidence of IE increased from 1998 to 2005 and decreased in 2010. Increased effort should be exerted in the prevention and treatment of IE. IE consultations may help establish the correct diagnosis, and thus the appropriate treatment to a severely sick patient can be provided.^[29–31]

The mean age of patients in this study was 53 years^[32], and the highest incidence rates were found in the ≥ 70 - to 79-year-old groups.^[33] The apparent increasing trend in the annual incidence of IE in Taiwan may be attributed to the aging population and increased risk associated with older age. According to literature, we confirm a high incidences associated to IE, particularly in older ages and in subjects with comorbidities.^[2,33] The poor prognosis of conservative therapy of symptomatic aortic valve disease, functional status, and life expectancy in this older age group seem to be positively influenced by aortic valve replacement.^[34]

The results showed males had statistically higher comorbidities than females. In 12% of the studied population, a diagnostic code for congestive heart failure was reported in the year before the onset of IE.^[19] Approximately 5% to 10% of endocarditis cases are right-sided; clinical manifestation on right-sided endocarditis is mainly respiratory, including dyspnea and cough, and differs from left-sided endocarditis, which is more frequently characterized by heart failure.^[20] Injecting drug use (IDU) is a major risk factor for IE. An understanding of the epidemiology of IE and IDU is vital for the delivery of health care for this disease^[21], and for valvular replacement.^[26–28]

The results of a previous study, which were similar to those of other studies, showed that men are more affected than women (male: female ratio is 1.78:1).^[11,13–15,35,36] The problem of IE is evidently linked to men because IE predominantly affects males. Inevitably, IE is perceived as a male problem. However, this result might be similarly attributed to the gender distribution across studies.^[35,36]

Another study demonstrated IE cases in relation to infective valves, including mitral (9.34%), aortic (4.98 %), prosthetic (1.77%), and tricuspid valves (1.24%), as well as disease of pulmonary valve (0.32%). Other studies have reported the ranks and incidence rates for the different infective valves of IE, namely, native (67% to 90%), mitral (13.4% to 45.7%), aortic (24% to 33.2%), prosthetic (7% to 31%), and tricuspid valves (4.5% to 18%); these infective valves accounted for 7% to 25% of cases of IE in most developed countries.^[26–28] An important evolving trend is the emergence of Staphylococcal species as a common cause of IE as identified in recent studies.^[37–40] Our data revealed that Staphylococcus species alone was responsible for approximately 61.38%. As reported recently, Staphylococcal species have overtaken streptococcal organisms as the most frequent causes of native-valve endocarditis.^[41–44] The overall in-hospital mortality rates for both prosthetic valve and native valve IE have remained high.^[26–28]

Diagnosis and management of infectious endocarditis are particularly challenging for the injured patient. The valve replacement for active mitral valve endocarditis has been reported in the IE patient population.^[26–28] The results showed that the etiology of patients with Staphylococcus species infection increased among patients suffering from IE at the hospital.^[45] The prevention of IE may be best achieved by controlling modifiable risk factors. The present study has inherent limitations. The sociodemographic variables, except sex and age, in the 2000 Longitudinal Health Insurance Database were not examined because of the lack of available information on factors such as education, lifestyle status, disease severity, in-hospital mortality, and surgical treatment.

This study demonstrates that the mean annual incidence of IE was 5.77 per 100,000 person-years. The incidence of IE, which increased with age, is higher in males. In addition, Staphylococcal species were the most common causative pathogens (61.38%). Our findings provide strong evidence that IE incidence rates increased mainly with cardiovascular system and infective valves. Consultation service strategies and decision making in treatment were correlated with improved patient care.

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