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Adult sepsis — A nationwide study of trends and outcomes in a population of 23 million people

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KEYWORDS

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Summary Objectives: To determine the trend of incidence and outcome of sepsis based on a nationwide administrative database.

Methods: We analyzed the incidence and mortality of both emergency department treated and hospital treated sepsis from 2002 through 2012 using the entire health insurance claims data of Taiwan. The national health insurance covers 99% of residents in Taiwan. Sepsis patients were identified using a set of validated ICD-9CM codes conforming to the sepsis-3 definition. The 30-day all-cause mortality was verified by linked death certificate database.

Results: During the 11-year study period, a total of 1,259,578 episodes of sepsis was identified. The mean incidence rate was 639 per 100,000 person-years, increasing from 637.8/100,000 persons in 2002 to 772.1/100,000 persons in 2012 (annual increase: 1.9%). The mortality rate, however, has decreased from 27.8% in 2002 to 22.8% in 2012 (annual decrease: 0.45%). The trend of incidence and mortality did not change after standardization by age and gender using 2002 as the reference standard.

Conclusion: We showed that the incidence of sepsis has increased while the mortality has

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decreased in Taiwan. Despite the decreasing trend in sepsis mortality, the total number of sepsis mortality remains increasing due to the rapid increase in sepsis incidence.

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Introduction

In 2011, sepsis has become the most expensive condition to be treated in the hospital of United States.¹ Although, highly deadly, sepsis is an infectious disease that can be prevented and treated. Understanding its true burden can not only help to arouse public awareness, but also help to guide resource allocation into sepsis prevention and outcome improvement activities. Unfortunately, the estimation of the burden of sepsis is difficult, as sepsis is a hard to define medical condition that involves various clinical manifestations and a broad range of infections and organ dysfunction. The definition of sepsis also underwent three major revisions in the past 15 years, and the latest Third International Consensus Definitions for Sepsis and Septic Shock (sepsis-3 definition) describes sepsis as a life-threatening organ dysfunction cause by a dysregulated host response to infection.^{2–5}

Several past attempts were made to determine the incidence and outcome of sepsis based on survey data. Recent sepsis incidence varies widely from 13 to 1031 episodes per 100,000 person-year with mortality between 20% and 50%.^{6–14} Inconsistent sepsis definition, random variation in survey data, and deflation of hospital mortality may be the major causes for the marked heterogeneity in incidence and outcome. Past incidences and outcome estimations were based on a survey of either the patient registry database or the hospital-discharge record such as the National Inpatient Sample (NIS) database of the United States. These survey data require weighting of the selected sample, which is often complicated by the inaccuracy in the determination of the hospital service population due to the heterogeneity of service population across different participating hospitals. In addition, in-hospital mortality often deviates from the 30-day mortality as hospitals find ways to reduce in-hospital mortality when they participate in hospital mortality reduction programs.¹⁵

As the definition of sepsis changes, the population incidence of sepsis may also need an updated evaluation by a true nationwide longitudinal database that includes both outpatient and inpatient data. Thus, we proposed to estimate the trends and outcome of sepsis using the entire national health claims database of Taiwan between 2002 and 2012, where all patients can be longitudinally tracked for an outcome using linked national death certificate database after hospital discharge. To the best of our knowledge, this is the first study using both a nationwide database and the latest sepsis-3 definition, in determining the true burden of sepsis at the population level.

Methods

Study cohort

We analyzed the entire National Health Insurance claims database of Taiwan between 2002 January 1 and December 31, 2012. The database was developed as part of the National Health Informatics Project (NHIP) sponsored by the Ministry of Health and Welfare of Taiwan. The database contains information for nearly the entire 23 million residents of Taiwan, as the National Health Insurance of Taiwan is a government operated, mandatory health insurance system with 99.7% coverage rate. The insurance plan guarantees unfettered access to outpatient or inpatient medical care, and partial reimbursement of prescribed drug.^{16–18} More than 95% of Taiwanese population are Han Chinese, and the second largest ethnic group is of Austronesian Ancestry (~2%).¹⁹ Since this is an anonymized electronic database study, patient consent is not required. Our study was approved by the institutional review board of National Taiwan University Hospital.

Case selection and definitions

Conforming to sepsis-3, sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection.³ The coding system used and validated previously by Angus DC et al., agreed with the sepsis-3 definition, and was used in this study.⁸ Operationally, we identified cases with sepsis by selecting all cases with ICD-9-CM codes for both a bacterial or fungal infectious process (Appendix 1) and a diagnosis of acute organ dysfunction (Appendix 2) in the hospital or emergency department records. Acute organs/systems dysfunction used for this study was: cardiovascular/shock, respiratory, central nervous system, hematologic, hepatic, renal and metabolic system dysfunction. We did not include gastrointestinal failure because it is difficult to define by ICD-9 code. Index date was defined as the first day of emergency department visit or hospital admission of sepsis. The following information was collected for analysis: demographic, presence of pre-existing comorbidity, and outcome. The comorbidity information was based on ICD-9CM codes used and validated by Gangne et al., and obtained in the one year period prior to the index sepsis hospitalization.²⁰ Other information was abstracted from the index hospitalization claims records. We defined the mortality as the 30-day all-cause mortality verified by a linked national death certificate database.

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