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# Spatial clusters of AIDS in Indonesia



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Available online 28 January 2017

## KEYWORDS

AIDS;  
Indonesia;  
GIS;  
Cluster analysis

## Abstract

**Objective:** This study seeks to determine whether distinctive clusters of case rates, number of new cases, treatment types, and other socio-demographic characteristics exist among provinces in Indonesia. Hierarchical Agglomerative and k-means clustering techniques are used to empirically derive the patterns of AIDS among Indonesian provinces by forming clusters of provinces with similar characteristics.

**Methods:** Cluster analysis is used to segment the Indonesian provinces in terms of how their rates of medical care and number of new cases of AIDS vary with respect to the socio-economic characteristics and sustainable health system of the province. Data from the 2011 *Statistik Indonesia* (2014–2015) and the 2006 Governance and Decentralization Survey were used.

**Results:** Cluster analysis yielded three distinct clusters: the high incidence rates and moderately high case rates cluster, the low case and incidence rates cluster, and the high case and incidence rates cluster.

**Conclusion:** Addressing the socioeconomic, demographic, and health inequalities that exist among the provinces should be a priority. Preventive interventions should consider provincial poverty and illiteracy rates, the population and its density, the type of self-treatment sought, the unmet need for healthcare services, the density of medical professionals, as well as the number of opportunistic infections.

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## Introduction

During the early 1980s, Asia countries seemed to have little cause for concern with regards to the Acquired Immune Deficiency Syndrome (AIDS) [1]. Prior to 1988, the reported AIDS cases were mainly concentrated among hemophiliacs

and men who had sex with other men and tests conducted among these individuals suggest that the infection levels of the human immunodeficiency virus (HIV) rarely exceeded one percent of any group [11,13]. The early political and social responses to the disease often focused on marginalized populations like homosexuals and IV drug users [8]. Even during the early 21st century, AIDS-related deaths in Southeast Asia (23 per 1000 persons) is only nearly 50 percent of that of the World average [17].

During the mid-1980s, HIV cases in Indonesia were concentrated among sex workers, homosexual men, and transvestites [26]. The prevalence of HIV in Indonesia throughout

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most of the 1990s was low with minimal increases in the rate of infection [7]. In a trajectory that mirrors Thailand and India, Indonesia experienced a surge in the number of HIV infection and AIDS cases. This increase could largely be attributed to unprotected/unsafe sex and injection drug use [26].

The growing number of HIV and AIDS cases was addressed in numerous ways. Following the identification of an HIV positive foreign tourist in Bali in 1987, the Indonesian government initiated a systematic sentinel surveillance of sex workers in Jakarta and Surabaya the following year [7]. A year later, the Indonesia's Ministry of Health established the National AIDS Committee which was comprised of multi-sectorial and non-governmental organization (NGO) representatives. The Indonesian government has shown increased commitment to HIV and AIDS prevention and reduction, particularly following the Asian Economic Crisis. With financial assistance from the United State (USAID), Australia (AusAID), United Kingdom (DFID), and Germany (KfW), the Setani Commitment was implemented to target provinces with the highest rates of HIV and AIDS (e.g. DKI Jakarta, Riau, Bali, East Java, West Java, and Papua) [20,26]. To date, AIDS prevention efforts focused primarily on encouraging condom use, harm reduction, antiretroviral (ARV) treatment, and promoting other types of AIDS education under the Information, Education, and Communication initiative (IEC) [26]. These efforts mainly targeted sex workers and their clients or partners, homosexual men, and injection drug users (IDUs) as well as people living with HIV (PLHIV) and their partners [26]. Between 2007 and 2010, more than 200 Voluntary Counseling and Testing (VCT) centers were established in 118 cities and districts across the country [20]. These counseling, testing and outreach services are provided by the government, the private sector, and NGOs [26].

Unfortunately, the number of PLHIVs needing treatment far exceeded the number of individuals who actually receive treatment [20,27]. In addition, treatment for opportunistic infections and the provision of second line ARV were not part of these initiatives [20,27]. The progress of prevention, intervention, and care is also hampered by social stigma as people who are most at risk refrain from getting tested [26].

## Review of relevant literature

In Indonesia, HIV and AIDS related studies focus mainly on program evaluation [7,26] and the genetic characterization of the HIV virus [22]. In other countries, studies tend to focus on health and socioeconomic inequality among HIV positive or infected individuals. Much of the work conducted in many European countries and in China and Argentina examining the risk factors and outcomes of HIV and AIDS have been conducted at the individual or patient-level [3,4,15,18,19,21,23,28]. To my knowledge, only five studies conducted in Canada, the United States, and Switzerland take regional characteristics into account [5,12,14,16,23]. Three of these studies focus on neighborhood-level socioeconomic characteristics [12,14,16] while the other two focus on neighborhood residential patterns and HIV prevalence [5,23]. Studies in North America find a positive association between neighborhood-level poverty and the risk of death in HIV-infected patients after taking age, clinical, and treatment variables into account [14,16].

Similarly, evidence in Switzerland suggests that mortality among HIV-positive individuals varies according to the socio-economic position (SEP) of neighborhoods [12].

To fill this research gap, this study seeks determine whether distinctive clusters of case rates, number of new cases, treatment types, and other socio-demographic characteristics exist among provinces in Indonesia. Hierarchical Agglomerative and k-means clustering techniques are used to empirically derive the patterns of AIDS among Indonesian provinces by forming clusters of provinces with similar characteristics. Maps created through ArcGIS software are also used in conjunction with the cluster analysis to visualize the data. Taking multiple provincial contexts into account can add value to the existing literature examining AIDS and HIV infection because little is known about how the rates of medical care and the number of new cases of AIDS varies with respect to the socio-economic characteristics and sustainable health system of the province in most developing countries, Indonesia included. Given the delineation of its provinces into distinct clusters, health policy-makers and practitioners can design and customize their delivery approaches for different segments of the population to reduce health burdens associated with HIV and AIDS.

## Methods

### Data

Data on case rates, number of new cases, population, population density, inequality, poverty, illiteracy, self-treatment, as well as the number of opportunistic infections (i.e. tuberculosis and pneumonia) were obtained from the *Statistik Indonesia*, an institution that collects data that describe the conditions of Indonesia across multiple indicators. A description of the dataset can be found at the institution's public domain. Data on unmet need for tuberculosis treatment services, the credentials of *Puskesmas* heads, and the density of medical professionals were obtained from a World Bank report [24] that used information from the 2006 Governance and Decentralization Survey.

### Measures

The *case rates* refer to the number of AIDS cases per 100,000 persons. The *incidence rates* refer to the number of new AIDS cases in 2011. Both population and population density are continuous variables. The degree of *inequality* is measured by the 2013 Gini ratio of the province. *Poverty* is measured by the percentage of poor people in 2011. *Illiteracy rates* are represented by the percentages of illiterate individuals who are 10 and older in 2011. Measures for *self-treatment* are the percentages of individuals who used modern and traditional self-treatment in 2011. *Unmet need for health services* is represented as the proportion of inpatient and outpatient tuberculosis services that are unavailable at the *Puskesmas* level in 2006. The *credentials of Puskesmas heads* is measured as the proportion of head *Puskesmas* with higher education. The *density of medical professionals* is represented as the ratio of doctors/midwives per 100,000 people. Because tuberculosis and pneumonia occur commonly among individuals with AIDS and

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