Meta Analysis of State-Wise Communicable Diseases in India

Shailendra Kumar Tripathi
Department of Science, Sampurnanand Sanskrit University, Varanasi, India

Abstract

Balanced diet and clean surrounding play vital role in maintaining human health and fitness. Monitoring of health indicators overtime allow us to see, how the health of population is changing. Communicable diseases are an important health indicator that represents the overview of current nutritional and hygienic picture of an area. The present study was aimed to find the prevalence of Malaria, Kala-Azar, Dengue, Chikungunya, Chicken Pox, Encephalitis and Viral Meningitis in the major states of India during 2010-2015. State - wise data base of NHP-2015 was compiled in MS-$Excel_{2010}$ and statistical analysis was performed in $SPSS_{20}$ software, to study the trend of communicable diseases in India. The data analysis observed acute respiratory infection, acute encephalitis syndrome and Pneumonia as a largest mortality causing communicable diseases in India with maximum death reported in Uttar Pradesh. Bihar accounted for maximum death caused due to Kala-Azar, the second largest communicable disease in India. This study can be useful for policy maker, state health department and other government departments to plan for improved immunization and clean surrounding to control human death rate caused due to communicable diseases.

KEYWORDS: Communicable diseases, Health indicators, Mortality, Immunization

1. Introduction

Infectious disease is a great challenge to the development of modern medicine in recent years. Mortality rate of infectious disease has risen within the recent past or threatens to increase in the near future. The rampant and unjustifiable use of antibiotics has made the pathogens resistant to the medicines, contributing in raising the number of infections. This leads to reappearance of old diseases with new features, which would classify it as a re-emerging infectious disease. The epidemics caused by these emerging and re-emerging infections often increase mortality rate by rapidly spreading across borders and are also responsible for much more concern and panic situation. These emerging infections can also raise the economic, developmental and security challenges (Berger, 2015). The changing age structure, lifestyles, climate and environmental pollution increased the risk of a new pathogens particularly viruses to continue, emerge and spread across the countries and challenge public health as never before. These will represent a serious burden, causing untold morbidity and mortality, disrupting trade and travel, and negatively affecting the economy (Nongkynrih, et al., 2004).

Under such circumstances it has became necessary to review the emerging and re-emerging communicable diseases causing increased incidences of death. This paper provides a trend analysis of such disease associated death in states and union territories of India, during last five years and their determinants.

2. Methodology

The present study was conducted based on secondary data on state and union territories wise mortality associated with communicable diseases in India. The data base of National health profile- 2016 was retrieved from the web site of Central Bureau of Health Intelligence (CBHI), Ministry of Health & Family Welfare, Govt. of India (www.cbhidghs.nic.in). Communicable diseases wise database for the period from 2010 to 2015 of all Indian states/UT was compiled using MS-Excel$_{2010}$ and statistical analysis performed in SPSS$_{20}$ software.

A trend analysis has been performed on year to year basis of state-wise data set of communicable diseases to assess the proportion of mortality rate in India. The Pearson correlation analysis was performed to determine the strength of interrelationship between mortality cases caused by communicable diseases and its significance at 1% and 5% level. Cluster analysis (CA) was performed for identifying the relatively homogeneous groups of Indian states/UT based on their similarities of mortality rate. A Dendrogram was constructed, where cohesiveness and correlations among the variables can be clearly observed. It presents a visual summary of intra-relationship amongst variations in death rate, which can lead to a better understanding of governing factors of communicable diseases in India.

3. Result and discussion

3.1. Communicable disease associated mortality

The analysis of mortality associated with communicable diseases revealed that out of total 36255 cases reported in India during 5 years, more that 5000 cases were caused due to Acute respiratory infection (18%), Acute encephalitis syndrome (17%) and Pneumonia (15%). The cases of Malaria (9%), Swine Flu (9%), Acute Diarrhea (8%) and Meningococcal Meningitis (8%) were ranged in-between 2000 to 3000 (Figure-1). The other communicable diseases caused death was 5000 (16%) during last five years in India. This indicates the impact of the emerging and re-emerging communicable diseases in India at socioeconomic and public health levels. This may be due to inadequate containment of the vector resulted the recurrent outbreaks of communicable disease in India (Chugh, 2008; John et al., 2011).

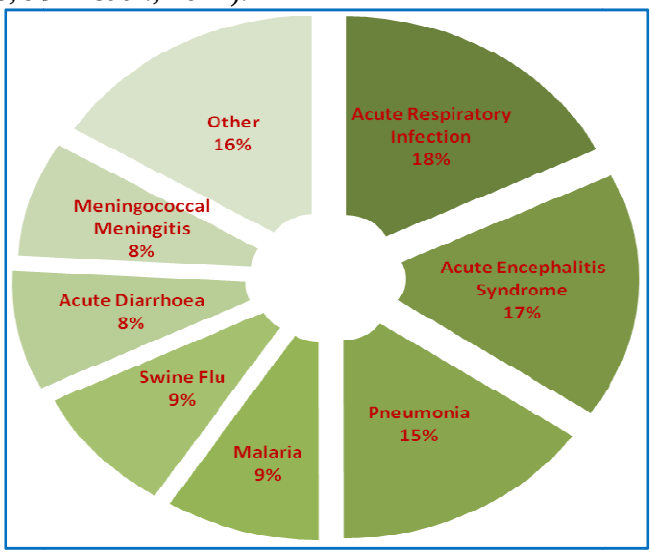

Figure-1: Distribution of death caused by communicable diseases in India

3.1.1. Acute Respiratory Infection

Acute respiratory infection is an infection that may interfere with normal breathing. It usually begins as a viral infection in the nose, trachea (windpipe), or lungs. If the infection isn't treated, it can spread to the entire respiratory system. Acute respiratory infections are infectious and cause four and a half million deaths among children every year, the overwhelming majority occurring in developing countries (Graham, 1989). In present study total 6445 death caused by acute respiratory infections were recorded in India during 2010-15. Most of the diseased were from Andra Pradesh (1378) and Arunachal Pradesh (996), whereas no death was reported from Daman & Diu, Delhi, Lakshadweep and Pondicherry. Risk factors that increase the incidence and severity of acute respiratory infections include large family size, lateness in the birth order, crowding, low birth weight, malnutrition, vitamin A deficiency, lack of breast feeding, pollution, and young age (Berman, 1991).

3.1.2. Acute Encephalitis Syndrome

Acute Encephalitis Syndrome (AES) is a group of Clinical neurologic manifestation caused by wide range of viruses, bacteria, fungus, parasites, spirochetes, chemical and toxins. AES infection may cause febrile illness, meningitis, myelitis or encephalitis (Dikid et al., 2013). During the past five years, the incidence of AES has been reported high in five Indian states Andhra Pradesh (2866), Arunachal Pradesh (1228), Assam (977), Bihar (731) and Chhattisgarh (112). The causative agent of the AES varies with season and geographical location. Characteristically, in most outbreaks, the etiological agents responsible for this life threatening disease remain undetermined but most of the cases were observed in monsoon and post monsoon period when the density of mosquitoes increases (Saminathan et al., 2013).

3.1.3. Pneumonia

Pneumonia is an inflammatory condition of the lung affecting primarily the microscopic air sacs known as alveoli (McLuckie, 2009). The major outbreak of Pneumonia was recorded in Andhra Pradesh (995), Arunachal Pradesh (715), Assam (704) and Bihar (563). A high proportion of pneumonia caused deaths occur in the children's below 2 years age. The major risk factors of childhood pneumonia includes under nutrition, minimum breastfeeding, and zinc deficiency (Walker et al., 2013).

3.1.4. Malaria

Malaria is a major vector-borne disease in India caused by parasitic protozoan's Plasmodium falciparum and Plasmodium vivax, which are transmitted to people through the bites of infected female Anopheles mosquitoes. The topographic and climatic diversity of India associated with high parasite genetic diversity and rapidly evolving drug resistance, differential distribution of vector species and emerging insecticide resistance have possibly changed the epidemiology of malaria to a great extent. The outcome of these changes is an increased incidence of Plasmodium falciparum over the P. vivax malaria in recent years (Kochar et al., 2005 Singh et al., 2009). In India total 3266 death caused by malaria was recorded during last five years. The majority of malaria caused death was reported from Andhra Pradesh (565), Arunachal Pradesh (557) and lower mortality was reported in Assam (332), Bihar (280), Chhattisgarh (275), Goa (258), Gujarat (175), Haryana (165), Himachal Pradesh (137), J&K (134), Jharkhand (112) and Karnataka (110). This indicates the declining overall endemicity of malaria as compare to other death causing communicable diseases in India.

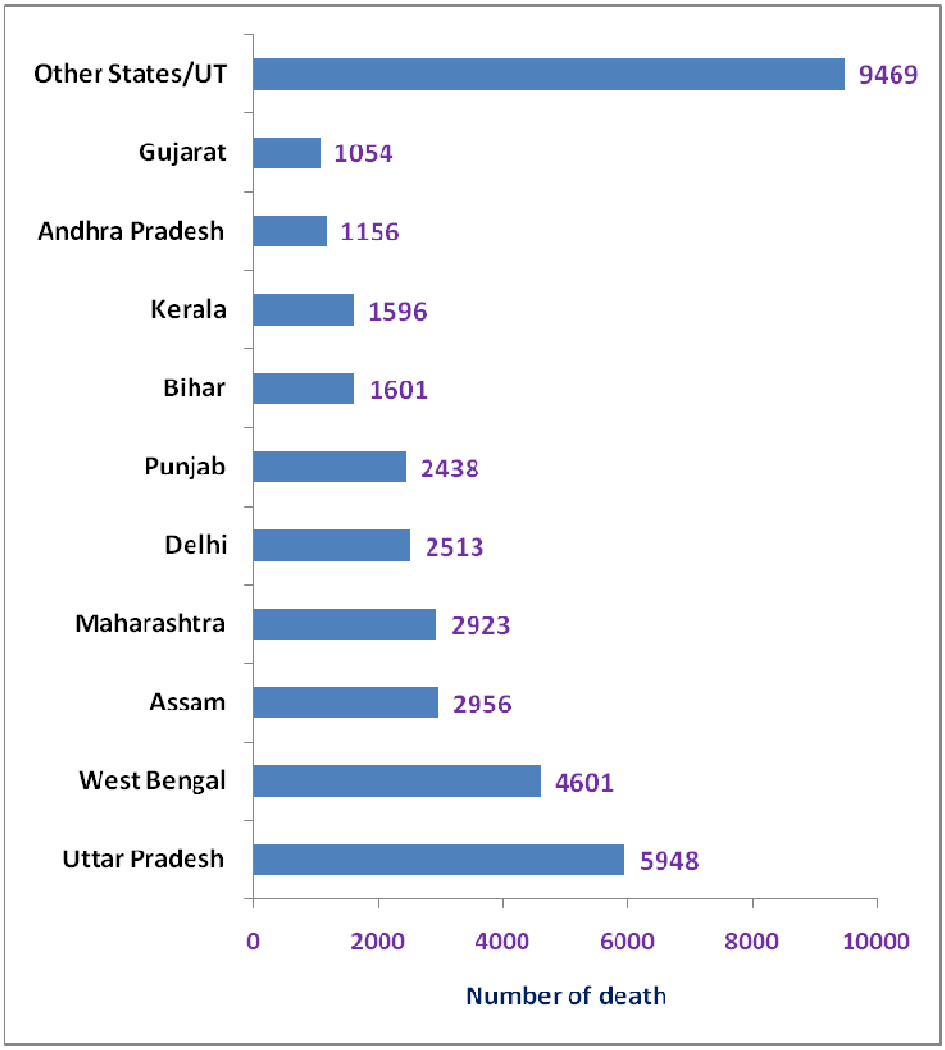

Figure-2: State-wise death caused by communicable diseases in India

3.1.5. Swine Flu

Influenza viruses that commonly circulate in swine are called swine influenza viruses. It was first recognized in the border area of Mexico and United States in April 2009 and during a short span of two months became the first pandemic. The infection of Swine Flu is caused by H1N1 virus that infects the respiratory tract of pigs and transmitted to humans by nasal secretions droplets (Sebastian et al., 2009; Das et al., 2011). During last 5 years total 3161 death cases cased by Swine Flu was reported in India. The higher incidence were from Andhra Pradesh (1001, 32%) and Arunachal Pradesh (648, 20%). The regular exposure of people to pigs as a pet animal and consumption of infected pork (meat from domestic pig) may have increased the risk of swine flu infection.

3.1.6. Acute Diarrhea

Diarrhea is an important contributor to childhood deaths in India, being one of the top 10 causes of deaths among infants and children of 0-4 year of age. In India out of total 2952 death caused by Acute Diarrhea, increased incidence was reported from Andhra Pradesh (573, 19%), Arunachal Pradesh (502, 17%) and Assam (386, 13%)

during 2010-15. This indicates the poor sanitation and unhygienic conditions are prevailing in these Indian states. Mode of water transportation, and poor handling of water at the household level, presence of wastewater in the street, refuse storage, collection and disposal, domestic water reservoir conditions, faeces disposal and presence of vectors predispose the under-five children to diarrhea (Simiyu, 2010; Kumar & Subita, 2013). Indiscriminate stool disposal by the mothers, lack of hand-washing before feeding their children and hand-washing without soap were associated with increased risk (Jayalakshmy et al., 2011).

3.1.7. Meningococcal Meningitis

Meningococcal Meningitis is an infection of the thin lining that surrounds the brain and spinal cord. It is caused by Neisseria meningitidis bacteria isolated from blood or cerebrospinal fluid ((Ni et al., 1992). In present study the higher incidence of Meningococcal Meningitis associated mortality was reported from Andhra Pradesh (404, 14%), Arunachal Pradesh (365, 13%) and Assam (334, 12%) out of total 2858 deaths recorded in India during 2010-15. Routine vaccination of high risk population with meningococcal polysaccharide vaccines is the best way to prevent meningitis (Pollard & Cohn 2016).

3.2. Correlation analysis

The Correlation analysis calculates the Pearson`s correlation coefficient between two measurement variables. It is particularly useful when there is more than two measurement variables and a predictable relationship between the two or more variables it to be measured (Vishwakarma & Tripathi, 2015). The correlation coefficient (r) among various mortality associated communicable diseases has been calculated. The significantly correlated (*p* Value <0.01) diseases and their values of correlation coefficient are presented in table No. 1.

Table-1: Correlation analysis of communicable diseases associated mortality cases

Sr. No.	Significantly correlated communicable diseases	Correlation coefficient	*P* Value
1.	***Acute Diarrhea*** and Acute Respiratory Infection	0.9032	<0.01
2.	Acute Diarrhea and Typhoid	0.8356	<0.01
3.	Acute Diarrhea and Tetanus (Non-Neonatal)	0.8262	<0.01
4.	Acute Diarrhea and Meningococcal Meningitis	0.7662	<0.01
5.	Acute Diarrhea and Encephalitis	0.7249	<0.01
6.	Acute Diarrhea and Acute Encephalitis Syndrome	0.7097	<0.01
7.	***Acute Respiratory Infection*** and Tetanus (Non-Neonatal)	0.7608	<0.01
8.	Acute Respiratory Infection and Rabies	0.7188	<0.01
9.	Acute Respiratory Infection and Chicken Pox	0.7062	<0.01
10.	Acute Respiratory Infection and Meningococcal Meningitis	0.7019	<0.01
11.	***Pneumonia*** and Meningococcal Meningitis	0.9773	<0.01
12.	Pneumonia and Measles	0.7564	<0.01
13.	Pneumonia and Viral Hepatitis	0.8560	<0.01
14.	***Acute Encephalitis Syndrome*** and Typhoid	0.8528	<0.01
15.	Acute Encephalitis Syndrome and Tetanus (Non-Neonatal)	0.8286	<0.01
16.	***Viral Hepatitis*** and Meningococcal Meningitis	0.8144	<0.01

17.	Viral Hepatitis and Diphtheria	0.7323	<0.01
18.	Meningococcal Meningitis and Encephalitis	0.7106	<0.01
19.	Typhoid and Tetanus (Non-Neonatal)	0.7304	<0.01

The result found statistically significant (p=<0.01) correlation between Acute Diarrhea with Acute Respiratory Infection (r=0.9032), Typhoid (r=0.8356), Tetanus in adults (r=0.8262), Meningococcal Meningitis (r=0.7662), Encephalitis (r=0.7249) and Acute Encephalitis Syndrome (r=0.7097). The result indicates the appearance of Acute Diarrhea symptoms associated with Acute Respiratory Infection, Typhoid, Tetanus (Non-Neonatal), Meningococcal Meningitis, Encephalitis and Acute Encephalitis Syndrome (Lopez-Alarcon, 1997; Baqui, 2003).

The death cases caused by acute respiratory infection in India was found to have significant (p=<0.01) correlation with Tetanus (Non-neonatal) (r=0.7608), Rabies (r=0.7188), Chicken Pox (r=0.7062) and Meningococcal Meningitis (r=0.7019). This indicates that respiratory infection can be a common disease, which develops in association with Tetanus, Rabies, Chicken Pox and Meningococcal Meningitis. Chicken Pox associated respiratory infection was being observed in 20 weeks pregnant women in a study **(**Pastuszak, 1994).

The death caused by Meningococcal Meningitis (r=0.9773), Measles (r=0.7564) and Viral Hepatitis (r=0.8560) shown statistically significant (p=<0.01) correlation with Pneumonia. This indicates that the possibility of Pneumonia in persons infected with Meningococcal Meningitis, Measles and Viral Hepatitis (Berman, 1991). The Acute Encephalitis Syndrome infection cased death in India was found have significant (p=<0.01) correlation with Typhoid (r=0.8528) and Tetanus (Non-Neonatal) (r=0.8286). Typhoid fever associated acute disseminated encephalomyelitis infection was observed by many researchers (Ramachandran et al., 1975; Wali, 1991). There was statistically significant (p=<0.01) correlation found between Meningococcal Meningitis (r=0.8144) and Diphtheria (r=0.7323) with Viral Hepatitis (Ellison et al., 1983). Another significant correlation was observed between Meningococcal Meningitis with Encephalitis (r=0.7106) (Reiber & Peter, 2001) and Typhoid with Tetanus (Non-Neonatal) (r=0.7304) (Tishler & Shoenfeld, 2004).

3.3. Cluster analysis

Cluster analysis (CA) is useful in grouping objects (cases) into classes (clusters) on the basis of similarities within a class and dissimilarities between different classes. The results of CA help in interpreting the data and indicate patterns (Dabgerwal & Tripathi, 2016). In present study CA rendered a Dendrogram (Fig.3), which has grouped all the 36 Indian states and Union territories, into three statistically significant clusters. The Dendogram generated three groups of states and Union territories, which have similar number of communicable disease associated death cases, were recorded. Cluster-1 represents only one state Uttar Pradesh and cluster-2 represents six states/UT i.e. West Bengal, Delhi, Punjab, Kerala, Bihar and Assam. Cluster-3 shows a group of 29 Indian states/UT. CA has reveled that cluster-1 represents an Indian state (Uttar Pradesh), where high mortality rate caused by communicable disease was recorded as compare to cluster-2 and cluster-3. This technique supports the trend analysis (Figure-2) as a confirmatory statistical tool. It is very useful in offering a reliable and more economical classification

of multiple sampling sites without losing any significance of the outcome (Sreenivasulu et al., 2014).

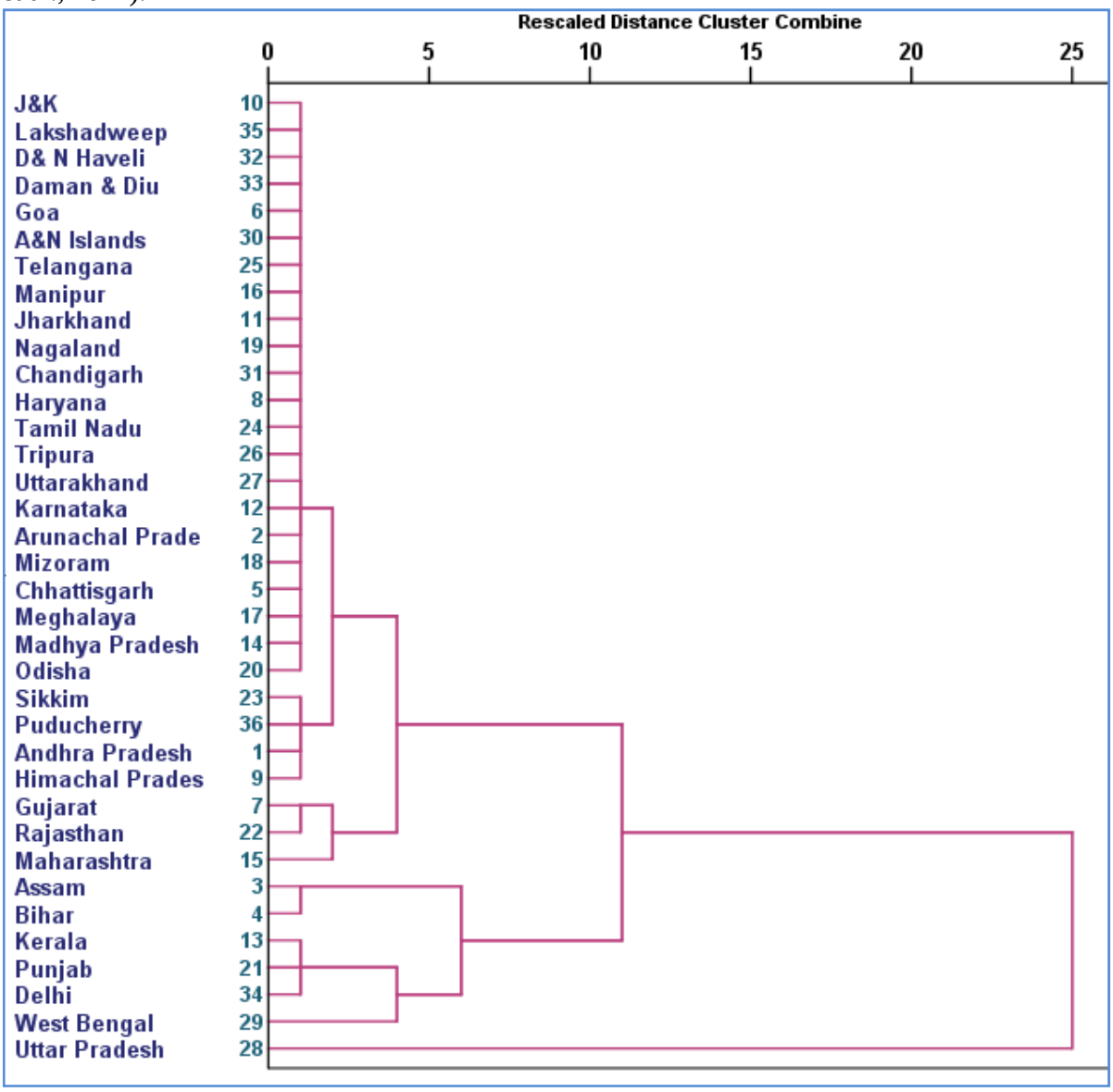

Figure-3: Dendogram of communicable disease associated deaths in Indian state`s/UT

4. Conclusion

It is evident from the present study that mortality associated with communicable diseases are declining in India but still the burden of traditional infectious diseases are challenge to health sector. In present majority of death was found in Uttar Pradesh and West Bengal. This indicates the declining performance and implementation of National health programme in Indian states. The higher mortality incidence associated with acute respiratory infection, acute encephalitis syndrome and Pneumonia represents the existence of gap in our understanding regarding the disease epidemiology including the mode of transmission, incubation period of vector, which hampers efforts for effective

control. The correlation analysis identified three most common disease acute diarrhea, acute respiratory infection, Pneumonia and acute encephalitis syndrome that can appear in association with the other communicable diseases.

Therefore a comprehensive national strategy on infectious diseases is to be developed to address the challenges of emerging and re-emerging infections. The advanced counter measures such as surveillance tools, diagnostic tests, vaccines and therapeutics through basic, translational and applied research are also need to be developed. Along with these country has to deal with chronic and newer diseases induced by the changing climate, lifestyles and environmental pollution.

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