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Inter-State Variations in Rural Healthcare Infrastructure in North-East India

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Abstract

The objective of this study is to understand the rural public healthcare system in North East India. It also aims to look at the status of the healthcare infrastructure of the region, the healthcare facilities available, the position of manpower available at these centres and the extent to which these facilities cater to the requirements of the rural population. An attempt is made to construct a healthcare infrastructure index for the eight states in order to determine their service capacity to the rural population, with the help of the method of Principal Component Analysis. Subsequently the states would also be ranked according to their performances in terms of infrastructure as well service capacity.

Keywords: Health Infrastructure, Manpower, Northeast India

Introduction

Good health is an important determinant of economic growth and a component of well-being of the population. The performance of the nation's public healthcare system and the importance of health as a means to enhance economic growth and development of a nation have received widespread attention in recent decades. Improving the health status of the population has become a forefront agenda of most developing countries for a very long time (WHO, 2000). Health is no longer viewed as an end product of the development process, but an important contributor to the development of a nation. The linkages between health, a productive workforce, poverty reduction, and development have been well recognised.

This necessitates the need for the existence of a strong and efficient public healthcare system which is not only an important determinant of an individual's health but the health of a population as a whole. Therefore,

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the tasks laid down before every government are addressing the issues related to good health, a strong and efficient healthcare system to deliver the objectives and thus achieving the end result which is improved health of the population and economic development.

Infrastructure has been defined as "the basic services or social capital of a country, or part of it, which make economic and social activities possible" (Rutherford, 2002). Its components may directly protect the health of the individuals, such as public sanitation systems or they may indirectly support the activities that protect and promote the health of a population. Thus, the physical health infrastructures are looked upon as formal and tangible structures that support the health system. Since health is a basic universal and fundamental right, the distribution of health resources is also important both in terms of quantity and quality (Goel, 2009).

The term physical infrastructure in health, according to Bhandari and Dutta (2007), has a much broader meaning. It includes not only healthcare centres, dispensaries, or hospitals, but also well trained staff with a service perspective. Healthcare infrastructure is also looked upon as an important indicator in order to understand the provisioning and the working of any health system. Thus the aim of a health care system is to provide healthcare facilities to the people, thereby improving their health status. Demographic indicators such as infant mortality rate, death rate and birth rate are dependent to a large extent on the availability of healthcare facilities.

The most imperative health sector issues that India has to tackle with are its mortality indicators, such as infant mortality rate and maternal mortality rate which continue to lag behind the target plan (NHDR, 2011). These indicators have been found to be strongly influenced by the availability of health infrastructure. Prabhakar and Manoharan (2005) also added that some of the factors that have impeded the tribals in India from accessing healthcare services are their geographic isolation , poor economic status and levels of living, different societal attitudes and traditional beliefs, and deficiency in healthcare services.

Singh (2008) also reported that access to health services in the north eastern states becomes difficult due to problems in physical accessibility due to the difficult terrain. The presence of a vast network of health infrastructure was also found to be ineffective. However, since the size of the population was low, the number of population served per health centre was reported to be high in these states. The states of north east India have

a poorly developed health care delivery system both in terms of health care personnel, health care institutions and infrastructure particularly in rural and tribal areas. The findings of the Preliminary Assessment of the Social Enterprise Sector in the North Eastern Region in India (2012) cited topographical peculiarities as one of the major challenges to healthcare in the north east. The region is characterised by difficult terrain such as hilly areas frequented by floods and landslides and a huge tribal population living in remote villages. Given these conditions, it becomes difficult to ensure the provision of health services and sanitation in the region. Active participation is needed from the government and society to make healthcare more accessible and affordable.

Against this background, this paper attempts to look into the status of the rural health care infrastructure of the north eastern states of India. An attempt would also be made to construct a health infrastructure index that throws light on the level of development in infrastructure and availability of facilities in the rural health sector.

Rural Healthcare System in North East India

India's north eastern region comprises of eight states; Assam, Arunachal Pradesh Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim. The entire region (8 states) covers a total area of 262,000 sq. kms, accounting for about 3.7 per cent of the country's total geographic area. With a population of 45.6 million (Census 2011), it accounts for 3.67 percent of the country's population. The region has a long international border (98 per cent); it is bounded by China and Bhutan in the north, Myanmar in the east, Nepal in the west and Bangladesh in the south and west. Most of the region is characterized by hilly terrain, inhabited by tribes and people belonging to different cultural and ethnic groups. The region is home to over 200 tribal communities which constitute about one-fourth of the region; Mizoram and Nagaland comprising the majority of the tribal population.

Sheet and Roy (2013) argued that regional disparities in health infrastructure are one of the many problems faced by low income countries. It has been observed that the rural health infrastructure in the north eastern states is said to be one of the poorest among the regions of the country (Saikia and Das, 2012). The population of the north eastern states comprises mainly the rural and tribal communities and as such these rural communities

rely heavily on the public healthcare systems and the traditional system of healing. The health status of the population is also greatly affected by the healthcare services available to the people. The region has better than average Human Development indices as reported in the National Human Development Report (NHDR, 2002). It has, however, failed to bring about economic growth which is evident from the widespread poverty and unemployment both in the rural and the urban areas.

The rural health care infrastructure in the region conforms to an all-India prescribed population norm (Table 1) which was laid down in the Minimum Needs Programme (MNP) of the Fifth Five Year Plan (1974–78). The main objective was to ensure that the rural areas conform to a minimum uniform availability of health care services.

Table 1

Population Norms for Different Health Centres		
Centre	**Population Norms**	
	Plain Area	**Hilly/Tribal/Difficult Area**
Sub Centre	5000	3000
Primary Health Centre	30000	20000
Community Health Centre	120000	80000
Source: MHFW (2005), Population Norms (Census 2001)		

Thus, based on this pre-determined population norm the rural health care system has been developed into a three-tier structure. The three-tier delivery system is as follows:

1. Sub-Centre for a population of 3000 is the most peripheral contact point between the Primary Health Care System and the community. It is manned by Female Health Worker/one Male Health Worker and one Auxiliary Nurse Mid-wife (ANM).
2. Primary Health Centre (PHC) for a population of 20,000 serves as the first contact point between the village community and a medical officer. It acts as a referral unit for 6 or so sub-centres. It has 10 beds for indoor patients.
3. Community Health Centre (CHC) for a population of approximately 80,000 serves as a referral centre for PHC's. It should be manned by

four medical specialists; a surgeon, a physician and a paediatrician. It has 30 beds for indoor patients with an operation theatre, X-ray, labour room and laboratory facilities.

Sub Centres

The Sub Centre is the most peripheral and is the first contact point between the public healthcare system and the community. Table 2 shows the status of Sub Centres over the various plan periods in the north eastern states.

Table 2

Establishment of Sub Centres during Five-Year Plans						
State	**Sixth Plan**	**Seventh Plan**	**Eighth Plan**	**Ninth Plan**	**Tenth Plan**	**Eleventh Plan**
	(1981-85)	**(1985-90)**	**(1992-97)**	**(1997-02)**	**(2002-07)**	**(2007-12)**
Arunachal Pradesh	55	155	223	273	379	286
Assam	1,711	5,109	5,109	5,109	5,109	4,604
Manipur	301	420	420	420	420	420
Meghalaya	172	272	377	413	398	405
Mizoram	162	220	324	346	366	370
Nagaland	133	244	244	302	397	396
Sikkim	82	132	147	147	147	146
Tripura	230	506	537	539	579	632
All India	84,376	130,165	136,258	137,311	145,272	148,124
Source: Rural Health Statistics Bulletin: Various Years.						

Table 2 gives a picture of the position of Sub Centres established in the region over a period of three decades i.e. from the Sixth Plan period onwards up to the Eleventh Plan period. The Table shows that there has been an increase in the number of Sub Centres in almost all the states. Assam has the largest number of health sub-centres owing to its large geographical size. The state of Manipur however shows that the number of Sub Centres have remained constant over the various plans. Sikkim also depicts a similar picture where the number of Sub Centres was 82 in the Sixth Plan period and increased to 132 in the next period. From the Eighth Plan onwards however, the numbers of Sub Centres have remained stagnant thereby experiencing a shortage of 3 per cent in relation to the population norms.

Primary Health Centres

Table 3 shows the trend in the establishment of Primary Health Centres (PHCs) in the north eastern states over the different plan periods.

Table 3

Establishment of Primary Health Centres during Five-Year Plans						
State	**Sixth Plan**	**Seventh Plan**	**Eighth Plan**	**Ninth Plan**	**Tenth Plan**	**Eleventh Plan**
	(1981-85)	**(1985-90)**	**(1992-97)**	**(1997-02)**	**(2002-07)**	**(2007-12)**
Arunachal Pradesh	0	24	45	65	85	97
Assam	237	449	610	610	610	938
Manipur	31	64	69	69	72	80
Meghalaya	32	56	81	85	103	109
Mizoram	19	35	55	58	57	57
Nagaland	21	33	33	46	84	126
Sikkim	18	20	24	24	24	24
Tripura	32	49	55	58	75	79
All India	9,115	18,671	22,149	22,875	22,370	24,049
Source: Rural Health Statistics Bulletin: Various Years.						

From Table 3 we observe that in the case of PHCs, there has been a steady increase for all the states in the region. In Arunachal Pradesh PHCs were established only in the Seventh Plan. By the Eleventh Plan Period, 97 PHCs had been set up in the state across various districts. In Manipur we observe that there were no changes in the Eighth and Ninth Plan Period where the number of PHCs stood at 69. However the number rose to 80 by the Eleventh Plan Period. Similarly, in Meghalaya and Nagaland by the Eleventh Plan period we can see that the number of PHCs increased to 109 and 126 respectively. Sikkim however showed no change in the establishment of new PHCs where the number remained at 24.

Community Health Centres

The Community Health Centres (CHCs) in the region have witnessed slow growth accompanied by stagnation at various periods of the Five Year Plans. Assam reported no increase in the number of CHCs in the Eighth,

Ninth and Tenth Plan Period. In Sikkim by the Tenth Plan period a CHC was established in each of the four districts of the state. However, by the Eleventh Plan it was found that only 2 CHCs were operating i.e. in East Sikkim and South Sikkim only. Arunachal Pradesh however saw a steady increase in the number of CHCs being established over the different plan periods.

Table 4

Establishment of Primary Health Centres during Five-Year Plans						
State	**Sixth Plan**	**Seventh Plan**	**Eighth Plan**	**Ninth Plan**	**Tenth Plan**	**Eleventh Plan**
	(1981-85)	**(1985-90)**	**(1992-97)**	**(1997-02)**	**(2002-07)**	**(2007-12)**
Arunachal Pradesh	0	6	9	20	31	48
Assam	12	60	100	100	100	108
Manipur	6	10	16	16	16	16
Meghalaya	3	3	10	13	26	29
Mizoram	1	4	6	9	9	9
Nagaland	1	4	5	9	21	21
Sikkim	0	2	2	2	4	2
Tripura	3	8	11	11	10	11
All India	761	1,910	2,633	3,054	4,045	4,809
Source: Rural Health Statistics Bulletin: Various Years.						

Manpower

Another very important facet that constitutes the healthcare system besides infrastructural facilities is the availability of adequate and competent manpower for proper functioning of the system. It has been described as the heart of a health system in any country. Human resources for health are defined as "the stock of all individuals engaged in the promotion, protection or improvement of population health" (World Health Report 2007). The health workforce constitutes not only doctors and nurses but also public health workers, policy makers, educator's clerical staff, scientists, pharmacists, etc.

India's mandate for the Universal Health Coverage to a large extent depends upon efficient distribution and organization of human resources

(Planning Commission, 2011). Their role and contribution to this sector is fully recognized. Thus, the challenge for any healthcare system to ensure the equitable distribution of health professionals – both geographically and in the different areas of health care (Martinez and Martineau, 2002). One of the problems in the rural areas, however, is the lack of qualified practitioners of different systems of medicine (WHO, 2007). The availability of well trained human resources is imperative for the improvement in health outcomes in rural areas. The Sixth Five Year Plan reaffirmed the importance of investment in health as part of its strategy to develop the human resources of the country both horizontally and vertically. Similarly, the Ninth Five-Year Plan also emphasised the need for health manpower planning taking into consideration the assessment of available manpower and health care facilities and the demand for health care services. The occupational categories of the health force can be categorised as follows:

Physicians: Generalists and Specialists.

Nurses: Professional and auxiliary nurses and other nurses –dental/ primary care.

Midwives: Includes auxiliary midwives but excludes traditional birth attendants.

Dentists: Includes dental assistants and dental technicians.

Pharmacists: Includes pharmaceutical assistants.

Lab Workers: Includes Lab scientists, lab assistants, technicians and radiographers.

Community Health Workers: Includes traditional medicine practitioners, faith healers, lady health visitors, traditional birth attendants, etc.

Health Management and Support Workers: Includes managers, statisticians, teaching professionals, accounts/administrative staff, computer technicians, ambulance staff and general support staff.

The status of manpower in the north eastern states is however mixed (Saikia and Das, 2011). While some states show a surplus of manpower, other states show an acute shortage of manpower resources. Table 5 and 6 shows the number of doctors and specialists serving the rural population of the north eastern states. We observe that for most states the number of doctors serving the rural population has increased after 2011. There is a decrease in the population served per doctor. The state of Manipur, however,

experienced a decline in the number of doctors therefore increasing the population size served per doctor.

Table 5

State-wise Number of Doctors Serving the Rural Population				
State	**Year**	**No. of Doctors**	**Census Population in ' 000**	**Population Served per Doctor**
Arunachal Pradesh	2001	355	1091	3037
	2011	445	1198	2692
Assam	2001	2160	26638	12128
	2011	3844	30191	7854
Manipur	2001	684	2389	2820
	2011	584	2364	4048
Meghalaya	2001	346	2306	6665
	2011	504	2560	5079
Mizoram	2001	260	891	3427
	2011	298	993	3332
Nagaland	2001	344	1989	5782
	2011	327	2223	6798
Sikkim	2001	156	540	3462
	2011	373	605	1622
Tripura	2001	797	3191	4004
	2011	737	3574	4849
Source: Rural Health Statistics Bulletin: Various Years				

One of the major concerns of the health sector in this region is manpower shortages. The average doctor to patient ratio in India was six per 10,000 populations. The ratio is much lower among the north eastern states. The region still faces an acute shortage of specialists to meet the requirements of the population. Garg et. al (2012) argued that there exists a huge imbalance in the urban–rural distribution of specialists, as more medical specialists are concentrated in the urban areas. Thus, there is a need to address imbalances in the rural sector in order to address the shortage of skilled manpower catering to the needs of the rural population.

Studies that have focused specifically in the north east attribute a number of factors to the low levels of development of healthcare which

results in poor health outcomes of the population. The healthcare in the north eastern region is thus characterized by a number of problems such as lack of infrastructural facilities, non-functioning of available infrastructure and difficulty in access.

Table 6

State-wise Position of Total Specialists at Community Health Centres (CHCs) in Rural Areas						
State	**Year**	**Required (R)**	**Sanctioned (S)**	**In Position (P)**	**Vacant (S-P)**	**Shortfall (R-P)**
Arunachal Pradesh	2001	80	3	0	3	80
	2011	192	NA	1	NA	191
Assam	2001	400	200	200	0	200
	2011	432	NA	216	NA	216
Manipur	2001	64	40	19	21	45
	2011	64	64	4	60	60
Meghalaya	2001	52	2	2	0	50
	2011	116	8	9	*	107
Mizoram	2001	36	4	4	0	32
	2011	36	NA	2	NA	34
Nagaland	2001	36	12	0	12	36
	2011	84	NA	34	NA	50
Tripura	2001	44	0	0	0	44
	2011	44	NA	0	NA	44
Sikkim	2001	8	20	3	17	5
	2011	8	NA	0	NA	8
India	2001	12172	6617	4124	2493	7459
	2011	19236	9831	6935	3880	12301

Source: Rural Health Statistics Bulletin: Various Years
* Surplus. All India figures for Vacancy and Shortfall are the totals of State-wise Vacancy and Shortfall ignoring surplus in some States / UTs

Literature Survey

Laxmi and Sahoo (2013) described health infrastructure index as a "weighted average of various components". In their study, the number of hospitals and

dispensaries, the number of beds and number of doctors were used as latent variables using Principal Component Analysis (PCA). Hati and Majumder (2013) argued that the main aim of a composite indicator is to have a single indicator that would be representative of the various components of the healthcare system. In their study they constructed a health infrastructure index by combining three components of healthcare preventive, curative and promotive health infrastructure. Kumari and Raman (2011) in a similar study developed a composite health development index by taking into account several components such as number of PHCs, number of allopathic, unani, ayurvedic hospitals, dispensaries, maternal and child health centres, sub-centres and community health centres. The infant mortality rate and crude death rate are also included in order to rank the health attainment in the state of Uttar Pradesh. Annigeri (2004) in a similar study attempted to create a health infrastructure index as well as a health performance index using similar indicators as seen in the study by Kumari (2013) for the States of Maharashtra , Karnataka and Orissa. These models have been estimated using OLS methods, with linear and log-linear specifications in order to determine the elasticity of performance of the health sector with respect to the budget allocation. The findings reveal that the state of Orissa has worsened over time while Maharashtra and Karnataka have shown no signs of improvement.

Data and Methodology Used

In order to develop a health infrastructure index across the north eastern states, 16 indicators have been considered. They include both physical infrastructure as well as manpower resources. These indicators will be compiled for two time periods 2001 and 2011. The indicators used to construct the composite health infrastructure index are as follows:

X1: Average number of villages covered by a SC

X2: Average number of villages covered by a PHC

X3: Average number of villages covered by a CHC

X4: Average rural population covered by a SC

X5: Average rural population covered by a PHC

X6: Average rural population covered by a CHC

X7: Hospital -Population ratio

X8: Bed-Population ratio

X9: Doctor-Population ratio

X10: Block extension worker-Population ratio

X11: Laboratory technician – Population ratio

X12: Radiographer-Population ratio

X13: Surgeon-Population ratio

X14: Obstetrician and Gynecologist - Population ratio

X15: Pediatrician - Population ratio

X16: Pharmacist –Population ratio

The different components of health infrastructure have been selected to reflect the different facets of the healthcare system i.e. physical infrastructure, manpower resources as well as the average population served by the healthcare centres across the eight north eastern states. Therefore the method of principal component analysis (PCA) is adopted in order to construct a single unique index in order to capture the variance contained in the different variables of infrastructure.

$$I_{it}=\Sigma W_{jt} X_{jit}$$

Where, $\mathbf{I}_{it}$ is the healthcare infrastructure index of the i-th state (8 north eastern states) in t-th point of time(t = 2001, 2011) , $\mathbf{W}_{jt}$ = measure of j-th component of healthcare infrastructure for t-th time and $\mathbf{X}_{jit}$ value of the j-th component of infrastructure for the i-th state at t-th time period. $\mathbf{W}_{jt}$ is estimated with the help of principal component analysis in order to arrive at a common infrastructure index for rural health infrastructure in the north eastern states of India.

Empirical Results and Discussions

This section presents the results of the empirical analysis of healthcare infrastructure in the north eastern states. Since infrastructure is measured by various indicators, an attempt is made to derive a single standard measurement or composite index in order to gauge the level of development of health infrastructure in the region. The composite index has been computed for two different time periods 2001 and 2011. The data for the two time periods have been pooled in order to facilitate a comparison between the two time periods.

Table 7

Health Infrastructure Index: Ranking of States based on Composite Index (CI) for Infrastructure					
2001			2011		
Rank	**State**	**Infrastructure Index**	**Rank**	**State**	**Infrastructure Index**
1	Tripura	1.328	1	Tripura	2.496
2	Mizoram	0.878	2	Mizoram	1.282
3	Arunachal Pradesh	-0.088	3	Manipur	-0.077
4	Manipur	-0.101	4	Nagaland	-0.099
5	Nagaland	-0.575	5	Arunachal Pradesh	-0.125
6	Sikkim	-0.677	6	Sikkim	-0.638
7	Assam	-0.801	7	Assam	-0.776
8	Meghalaya	-1.169	8	Meghalaya	-0.858
Total Variance Explained 26.689 %					
Extraction method: Principal Component Analysis					

The total variance in the tables is the sum of the variances of these observed variables. The total variance will be equal to the number of observed variables analysed. Thus the total variance explained for the time period 2001and 2011 is 26.689 per cent. The Eigen value represents the amount of variance that is accounted for by a given component. For both the time periods 2001 and 2011 the first seven components extracted account for relatively large amounts of variance, while the later components account for relatively smaller amounts. According to the Kaiser Criterion, any component that displays an Eigen value greater than 1.00 is accounting for a considerable amount of variance. Therefore, such components will give us a more meaningful variance.

From the composite indices for infrastructure derived for the different states of the north east we can conclude that Tripura is the better performing state from the rest of the states in the region for both the time period 2001 and 2011. In terms of physical infrastructure and manpower, Tripura and Mizoram have better facilities serving the population. Arunachal Pradesh that showed a dismal performance in 2001 reported a huge improvement in

2011. Assam and Meghalaya on the other hand are the poorest performers. Many reasons can be attributed to their performance. The Health Sector Workforce Development Plan (2012) reported that Assam (0.28) was below the regional level in terms of availability of beds in the rural areas. This was against the national average of 1.2 per thousand populations. Similarly, the composite infrastructure index derived showed that Sikkim and Tripura were better performers even though they were geographically smaller states.

The North East Human Development Report (2011) also reported acute shortage of manpower resources in Assam, particularly male health workers at Sub Centres, doctors at PHCs and specialists at CHCs. There was also a huge shortage in the number of pharmacists and lab technicians.

In line with the above findings, Goswami (2005) stated that the state of infrastructure in the north east region was minimum and poor in terms of their service capacity towards the people. Meghalaya was found to be short of at least 100 doctors, which severely affected the people of the rural areas. Most of the PHCs and CHCs were also inadequately staffed. Similarly in the state of Manipur, a shortage of around 160 doctors (including 120 specialists) was observed and only 150 doctors were positioned over 420 public health SCs, 72 PHCs and 16 CHCs.

According to the Nagaland State Human Development Report, 2004, it was observed that "the quality of existing infrastructure needs to be improved", as the number of health personnel and specialists was inadequate which "restricts the coverage of health services in rural areas".

Sikkim is perhaps the only state in the region and the only State in the country to achieve the national norm of establishing 1 PHC for 20,000 people and 1 PHSC for 3,000 people (Govt. of Sikkim 2001). Studies done by Chutani and Gyatso (1993), Gyatso and Bagdass (1998), showed that in Sikkim there is a heavy dependence on PHCs and CHCs which could be seen from their utilization pattern. Traditional medicine also continues to dominate the scene in the state.

Sengupta (2009) revealed that the rate of deprivation in terms of coverage of health facilities in the north east was very high. It was reported to be the lowest in Assam followed by Manipur and Nagaland. Arunachal Pradesh also showed better results, despite the difficult terrain which made accessibility extremely difficult.

Sankar and Kathuria (2004) also pointed out that one of the foremost problems plaguing the Indian health systems were the persistent gaps in manpower and infrastructure. The wide interstate disparities, at the primary health care level affect the rural people to a large extent. Therefore there is an urgent need to redress this problem if equity in health access, utilization and health outcomes are to be achieved. Similarly, Chaudhury et al. (2006) and Das and Hammer (2007) reported that high absenteeism, poor quality health services, accompanied by low satisfaction levels of patients and corruption in the system were some of the major drawbacks of the Indian healthcare system.

Conclusion and Limitations

From the analysis, it can be seen that the different variables play an important role in simplifying multiple components into a single figure. A good index will be determined by the data quality and the sources that have been used. Thus the limitation and unavailability of data for the north eastern states played a very important role in the selection of variables for the construction of the healthcare infrastructure index. Thus, the selection of variables that best represent or capture health infrastructure - physical and manpower - will determine the healthcare infrastructure index.

Therefore we can conclude that there is an urgent need to address the shortcomings faced by the public healthcare system in the north eastern states. Our analysis shows that the state of rural healthcare infrastructure in these states is far from satisfactory. Hammer et al. (2007) recognized accountability as the key to solving the crisis in government performance in the public health sector. Health in India is also becoming highly inaccessible to the public due to the high cost of treatment by private medical practitioners. The government must step in to meet the supply gaps in healthcare services particularly in the rural areas and to ensure quality in the standards of its services. The two most important components of the social sector i.e., health and education must be given top priority in order to churn out quality human capital which in turn would contribute to the overall development of the economy.

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