Development of Government Health System in Sri Lanka during Last Three Decades

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Authors' contributions

Original Research Article

ABSTRACT

Aims: Several aspects are associated with the health system. Development in each aspect in health sector is required parallel to the growth of the population of patients. This study was carried out with the intention of investigating the development in physical resources, human resources, and funds allocation for government health system in Sri Lanka**.**

Methodology: This study considered the development within the period from 1987 to 2019. Necessary data were collected from the annual reports of central bank of Sri Lanka. Data for physical resources, human resources, patients, and expenditures were gathered. Parallel developments of these aspects were analyzed by using descriptive and confirmatory techniques: Pearson' correlation and canonical correlation. Apart from that some graphical techniques and summary measures were also used in the analysis.

Results: Number of both in-patients and out-patients has rapidly increased during this period, while expenditure on the health system also has exponentially grown. However, percentage of GDP allocated for health system has remained almost same. There can be seen a reasonable development in both human resources and physical resources.

Conclusion: Even though, health system has been developed to a greater extent, developments in some aspects are not parallel to the development in other aspects. However, further development is needed to meet the growing demand for health services due to increasing population of patients.

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1. INTRODUCTION

Health sector is an important aspect in any country and public are also much concerned about its quality and development. The history of health system of Sri Lanka leads back to several centuries. Sri Lanka is one of the dveloping countries, that has an efficient health systems[1]. Health system in Sri Lanka consits of different systems of medicine such as traditional, western, ayurwedic, unani, sidha, homeopathy and acupuncture. Among them, the western medicine is the main sector providing health services.

The western medical system was first introduced by the Portuguese in 1505. After 1658 some hospitals were established in the maritime provinces by the Dutch. They built the Colombo hospital. In 1796, British captured the coastal areas and continued to develop the western medical system. In 1870, they established the Colombo Medical School [2]. After independence in 1948, all successive governments have implemented a number of welfare-oriented policies and programs. Compared with other Southeast Asian countries, they have achieved a higher level of social and health development [3]. The first health unit was established in 1926 at Kalutara, a suburb of Colombo [4,5]. Disease prevention and health education were the main principles of the program. The health units were primarily concerned with the prevention of infectious diseases, health education, and maternal and child health services. This was an important milestone in the health development of the country [6].

Both the government and private sector are higly engaging in health services. All health facilities provided by the state is available free of charge to every citizen, including all inpatient, outpatient. Three types of hospitals such as primary, secondary and tertiary are in the country. Primary hospitals located throughout the island provide basic outpatient health care. The secondary hospitals mainly located in semi-urban areas provide basic outpatient and partial inpatient medical services. Tertiary hospitals are mainly located in larger cities and provide basic outpatient and specialist medical services. The ministry of health maintains national hospitals, teaching hospitals, provincial general hospitals, district general hospitals, base hospitals (type A and B), and divisional hospitals (type A, B and C). The provincial council is responsible for the management of provincial health institutions and plans. The primary health care programme in Sri Lanka has mainly focused on maternal and child health, environmental sanitation, and communicable diseases, adopting prevention and health promotion strategies based on the health unit system.

The main sources of funding for Sri Lanka's health system are the government and households. The state finances health care services through general taxation. Sri Lanka provides free medical care to patients with a GDP per capita of USD 3,852 (World Bank, 2019). However there is not separation of purchasing and provistion [7].

Even in this situation, status of Sri Lankan health system is in higher level compared to the most of the other countries in the South Asia. In 2015, Sri Lanka had the lowest maternal mortality ratio, 30 maternal deaths per 100,000 live births. This ratio in Bangladesh was (176) while India had 174 deaths. Maldives recorded 68 deaths, and 258 deaths were in Nepal. Pakistan showed a rate of 178 [8]. Further, Sri Lanka has been able to control several intractable communicable diseases, such as poliomyelitis, malaria, and, most recently, measles [9,]. Free healthcare system in Sri Lanka has become a critical factor for this achievement in health sector [7,10].

Country population is rapidly increasing with time. By 2019, the total population of the country has become 21.8 million. With the ever-increasing population, the demand for health services is steeply developing. By 2010 also, some health facilities such as secondary and tertiary health care facilities were getting overcrowded with high demand for bed [11].

As a result, wards in government hospitals are overcrowded with in-patient and long queses for out-patients health services. Furhter, there can be observed a shortage of medicines in many hospitals and in turn, patients find it difficult to get the some medicines at the proper time in proper quantities. For obtaining the laboratory and other diagnostic facilities, patients have to wait for a long time. Long queues are for specialized health clinics and patients are in waiting list for a long time for some surgeries. A patient may get a date after six months time for some surgeries such as

heart surgery. The public health sector is now struggling to meet the demand for services [12].

As a results of high demand for medical services, the private companies and organizations also have entered to the field of health to fulfill the demand [13]. Households pay out of their pockets to obtain services from service providers in the private sector [14] and increasing expenditures for health services has become a major challenge [15]. Nowadays these privat hospitals are also getting crowded. In the year 2015, 54% of health income has come from private health system among which 85% of this was from payments of patients, 5–8% was from employers, 5% was from health insurance [15].

This leaves a doubt whether this is due to various new diseases spreading over time making many people sick or due to lack of development in government health sector parallel to the growing population. Or this may be due to unparallel development in all aspect. All aspects in health sector need to be developed continously parallel to the growth of the population.

This study was carried out with the intention of identifying the development in different aspects such as physical resources, human resourses in government hospital system and funds allocation by the government to maintain this free medical services. Development of in each aspect, as welll as growth of each aspect relative to other aspect and growing population of patients, were considered. Under the physical resources, the development especially in number of government hostpitals, number of central dispensaries and number of beds were considered. Number of doctors in all fields, nurseses, and attendants were considered under the human resources. Further, growth in patients and funding were also analyzed. This analysis allowed us to underdatnd the trend of the development in each aspect and in turns, to recognize the sub-sectors or aspects that need further development.

2. LITERATURE REVIEW

The relationship between the scale of implementation of hospital quality improvement and the hospital's clinical performance has been studied by Weiner et al. [16]. Weeravansa has examined inpatient satisfaction of private and public hospitals in the Colombo district in Sri Lanka [17]. The results indicated that the inpatient of the private hospitals were much more satisfied with the quality than the public hospitals. Rannan-Eliya et al compared the quality of clinical care and patient satisfaction in public and private outpatient primary care services in Sri Lanka [18]. The comparison was made by using three district data with StataCorp 2011. Somatung et al examined the factors affecting the ongoing quality improvement program at the Government Hospital of Sri Lanka [19]. They found that there is no significant factors affecting the quality improvement program. It has been explained whether the downward trend in public healthcare financing can explain the growing trend in out-of-pocket medical expenditures and the seeming increase in private healthcare services for public substitution by Pallegedara et al. [20]. Silva analysed a larger ethnography study that explored health care system and nurses' cancer pain management in Sri Lanka [21]. Kumar analysed the contradictions and political tensions surrounding Sri Lanka's global health care policy and focused on the MOH's plans for a public-private partnership [22]. Perera et al identified rapid health care reforms for global health care in Sri Lanka [22]. Taner & Antony have examined the differences in service quality between public and private hospitals in using the "Service Quality Scale" [23]. Renggli et al analysed the development of electronic tools to assess and monitor the quality of primary care in Tanzania [24].

3. METHODOLOGY

Analysis of both quantitative and qualitative development of health related aspects in government health system in Sri Lanka was the main aim of this study and this analysis was carried out by using secondary data. The central bank annual reports were the source of data. Data in the period from 1987 to 2019 were collected for four categories: physical resources; human resources; patients; and expentidures. Under the physical resources, number of government hospitals, central dispensaries, beds in the government health system were considered. Number of doctors, assistant medical practitioners, nurses, attendants, and Ayurvedic physicians were taken into account under the category of human resources. Number of internal patients (in-patients) and external patients (out-patients) were in the third category, while total expenditures, recurrent expenditures, capital expenditures and total expenditure as the percentage of gross domestic products (GDP) were used as variables under the category, expenditure.

Quantitative growth of the health aspects was analysed by using both descriptive and confirmatory analysis. Line graghs produced by using Excel were used to exhibts the changes of variables over the period considered. At the same time, development in each aspect during this period was discussed as a difference between initial year and the last year. Furhter, percentage increment/decrement relative to the status in year 1987 also was used. At the same time, average inrement per year was used as the direct measures for the growth. Apart from that qualitative development in the health sector, was also analysed through some health indicators such as death rates, and life expectation at birth were also analyzed as a quality measure.

Correlation analysis was performed to identify the relationships among these variables or the parallel development in these aspects. At the first stage, pairwise correlation analysis was done by using Pearsons' product moment correlation coefficient. Furhter, since these variable are inter-correlated within each group and among groups, a multivariate approach called canonical correlation also was used to understand the relationships among different categories considered. Accordingly, pair-wise canonical correlation was produced for each pair of these categories. Significance of correlation between different categories, was tetected with three tests: Wilks' lamda test; Hotlein test; and Pillai test. Both Pearson and canonical correlation analysis was performed in R software version 4.0.3. CCA package was used for the canonical correlation. Necessary graphs and calculations were produced by using MS Excel.

4. RESULTS

Distribution of hospitals and central dispensaries over the period is exhibited in the Fig. 1 below.

During the period from 1987 to 2019, both number of hospital and central dispensary in Sri Lanka have increased gradually. Number of hospital, in 1987, was about 500 and by 2019 it has exceeded 600 hospitals. Number of central dispensaries has developed up to 500 from about 350 in 1987. However, number of central dispensaries is below the number of hospitals throughout the period.
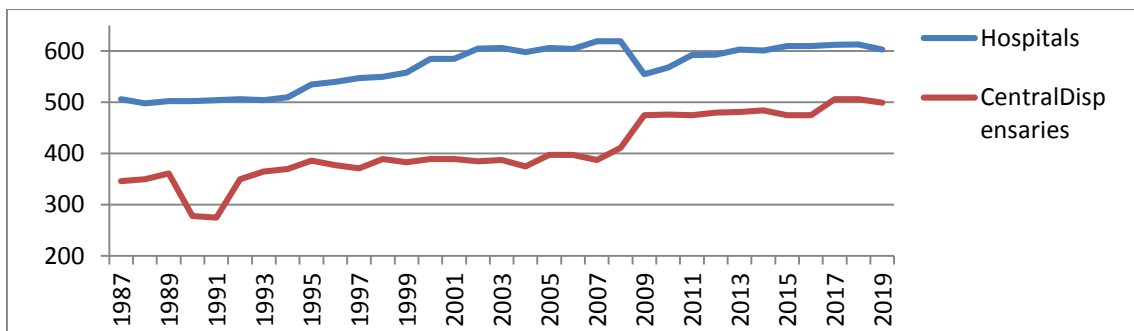

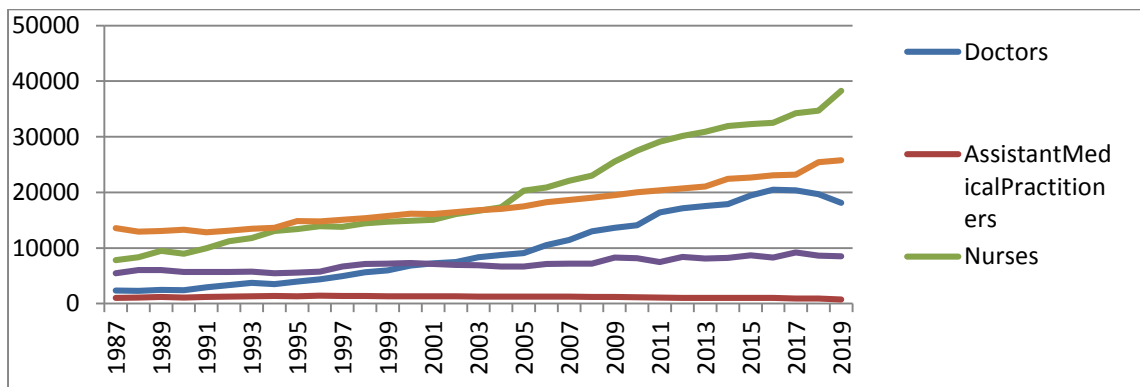**Fig. 1. Growth of number of hospitals and central dispensaries**

Fig. 2. Growth of aspects in category, human resources

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Development of human resources is illustrated by Fig. 2. A sharp increasing trend can be seen in the number of nurses. It has reached almost upto 38200 by 2019 from about 8300 in 1987. It has improved by almost five times. In 1987, ayurvedic physicians' number was about 13500 and thereafter it has gone upto 25700 by 2019 by showing an increment, nearly double the value compared to year 1987.

An increment from 2350 to 20450 can be seen in number of doctors during this period. It is more than eight times with compared to the value at the initial period. About 5400 attendants were in 1987. With time, it has reached to about 9000 and then declined to 8500 by 2019.

Total number of internal (in) and external (out) patients in each year from 1987 to 2019 are given in Fig. 3. It is clear from the figure, that number of out-patients is much higher rather than in-patients in each year. Even though it can be seen a development with some drastic fluctuation in the number of out-patients during this time period, series of in-patients is having a steady increment. With compared to initial difference between number of in-patients and out-patients, difference at the end of this period is much higher

Total number of out-patients (external patients) in a year has almost doubled during the period considered. In 1987, total number of out-patients has been about 34139000, and thereafter it has gradually developed to a level just about 57950000 with some fluctuations. During the periods 1987-1991, 1992-1995, 2002-2006, 2014-2016, slight decreases have taken place. Meantime, in 1987, total number of in-patients has been about 2772000 and thereafter it has developed to 7290000 by 2019.

The expenditure that government has made on health sector (in million) is given in Fig. 4. There can be seen two phases in the series of total health expenditure and recurrent expenditure. Upto about year 2002, both series showed a steady and slight increment. However, thereafter a higher development can be observed in both series.

Total health expenditure was Rs. 3380 million in 1987 and it has reached up to Rs. 244307 million by 2019. Higher amount of this total expenditure is as the recurrent expenditure. It has gone up from Rs. 2401 million to Rs. 211555 million. Meantime, capital expenditure gradually increases with almost a steady rate. By 2019, the capital expenditure has reached to Rs. 32752 million from Rs. 979 million in 1987.

Fig. 5 above explains the ratio between beds and other aspects. Only number of beds per hospital shows an improvement while improvement in number of beds relative to other aspects decline with time. On average, number of beds per hospital has developed from 88 to 140 per hospital during this period. When, number of beds per patient is considered, a slight decrement can be observed. At the beginning, it was just closer to 20. But, by 2019, it has become about 10. The ratio between beds and doctors was 20:1 in year 1987, which implies that on average one doctor has to take care nearly 20 beds. However, by the year 2019, it has become about 2 to 3. Beds per a nurse also have declined slightly. There can be seen a minor development in the ratio beds: attendants.
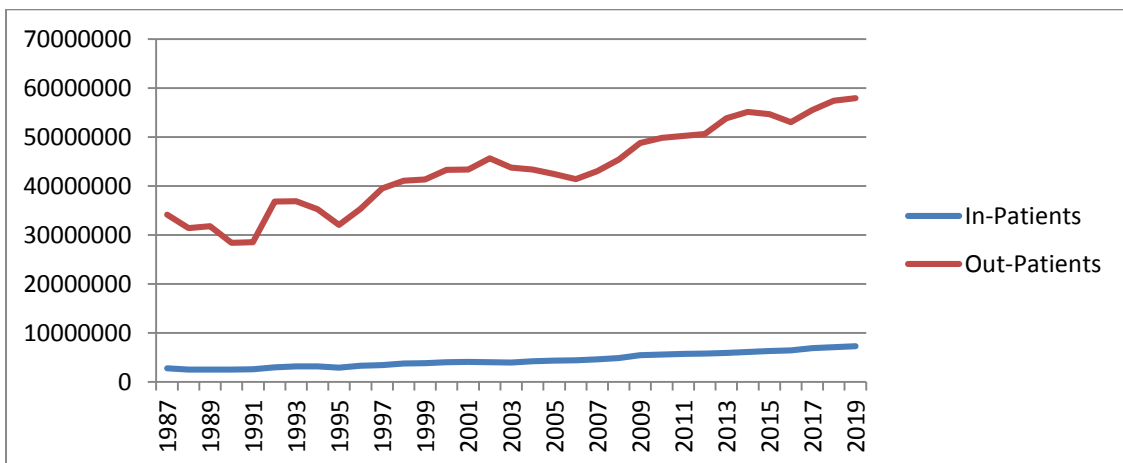

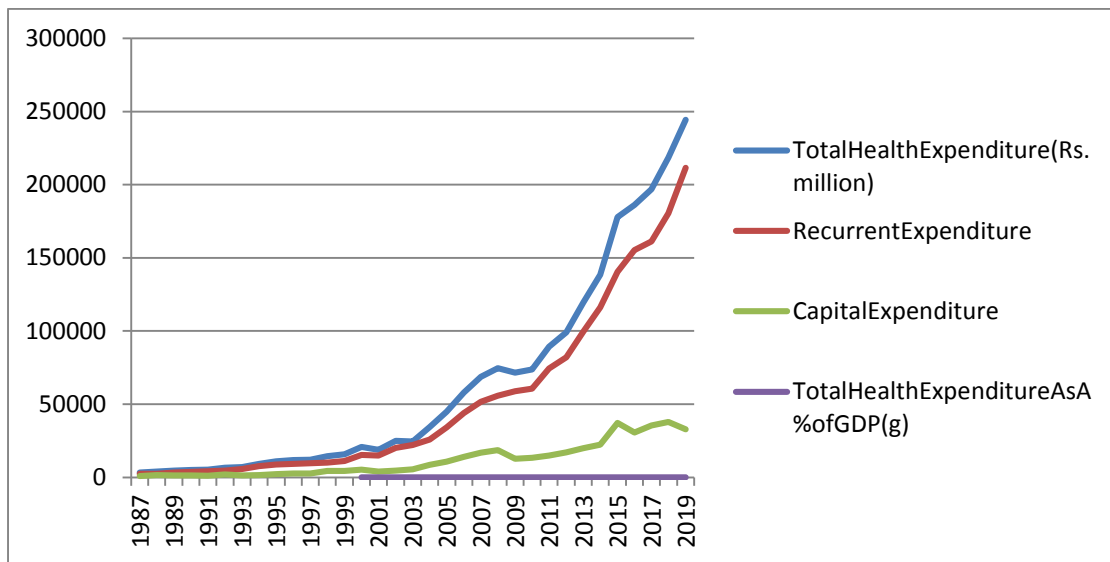**Fig. 3. Growth of number of internal and external patients**

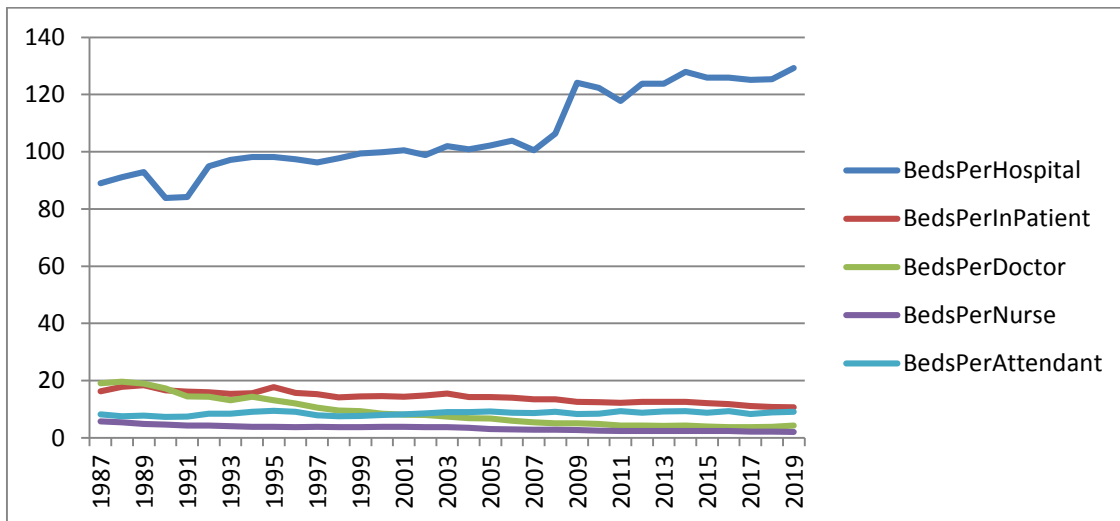**Fig. 4. Growth of expenditures related variables**

Fig. 5. Growth of number of beds

Fig. 6 shows that number of doctors per hospital has increased from 5 to nearly 30 during this period, on average, while doctors per in-patient have increased slightly up to year 2016 and then has declined till 2019. But, it is not more than 4. Doctors per bed remain constant over the period at a minimum level closer to zero. At the beginning, ratio was 0.052289. Whilst with time it has raised up to 0.234543.

Distribution of the assistant medical practitioners relative to some other aspects is illustrated in the Fig. 7 above. It is apparent that assistant medical practitioners per hospital was above 2 at the beginning and then has slowly increased up to 2.5 with some fluctuation, during the period till

1996 and then it has declined till 1.75. Number of assistant medical practitioners per bed, per doctor and per nurses has gone down with compared to situation at the beginning.

The development in the number of nurses relative to other aspects is illustrated in Fig. 8. Number of nurses per hospital has rapidly increased from 15 to a level just above 60 which is more than four times compared to initial number. Average number of nurses per one doctor has gone down from 3. 33 to 1.59 during the period from 1987 to 2016. However, since 2017, it has turned upward and has reached to 2.11 in 2019.

Number of nurses per patient and per bed is much closer to zero. Ratio between number of nurses and number of patient (internal) has gone upto 0.00525 from 0.002829 meantime number of nurses per bed also has increased from 0.174 upto 0.49.
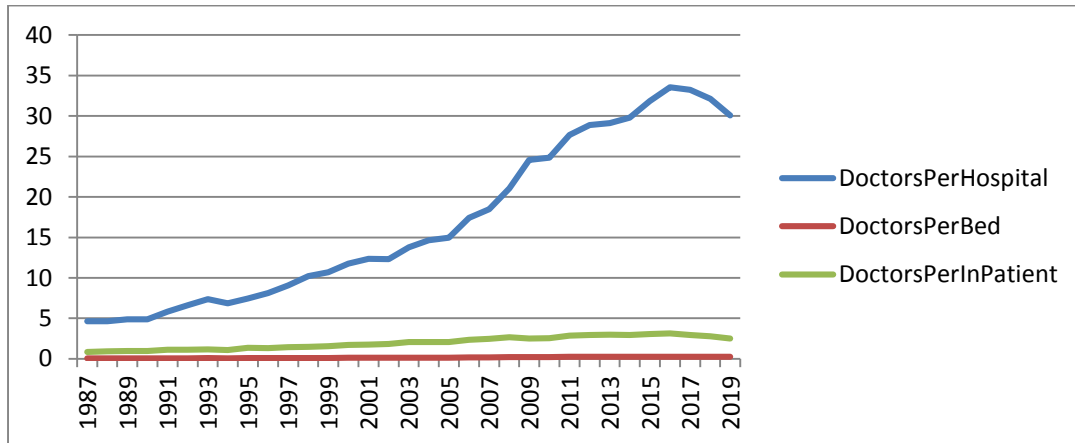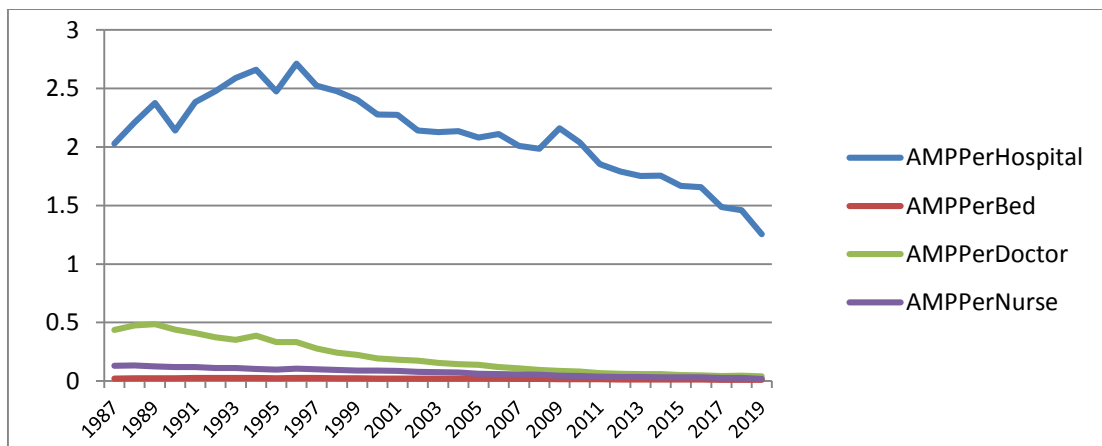

Fig. 6. Growth in number of doctors

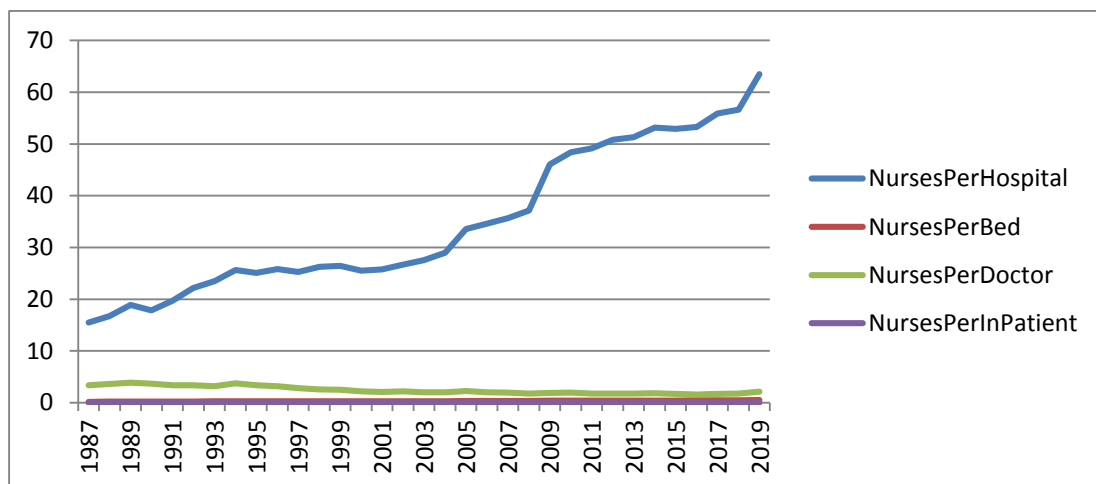**Fig. 7. Growth of number of beds**

Fig. 8. Growth in number of Nurses

Fig. 9 above shows how number of attendants has recruited with time relative to other aspects of interest. It is clear from the above graph that number of attendant per hospital has, on average, increased from to 11 to 14. Number of attendants per doctor was about 2.3 at the initial time and by 2019, it has declined to 0.47 gradually. Number of attendant per nurse also has gone down from 0.69 to 0.22. Number of attendants per patient (in-patient) remains almost constant throughout the period at a lower level. It is about one attendant for 100 patients. Ratio of number of attendants and number of beds was about 12: 100 at the first part of the period while it becomes 10:100 by 2019 with some minor fluctuations in some years in this period.

The expansion of out-patients' amount parallel to other aspects with time is exhibited in the Fig. 10.

Out-patients per hospital has developed from 67470 to 96100 within this time. On average, out-patients for a dispensary has distributed in the range 10000 to 12000 with the maximum in 2002. Meanwhile out-patient per doctor has gradually come down. At the initial part of the period, about 14500 external patients were available for one during a year. However, by end of this period it has come closer to 3200.

Development in number of ayurvedic doctors is illustrated in Fig. 11 above. It clearly shows that number of ayurvedic doctors per hospital has developed by a reasonable amount. Compared to initial period, it has developed more than 1.5 times. However, relative increment of ayurvedic doctors compared to increment of western doctors rapidly has gone down. It was about 5 to 1. But, now it is about 2 to 1.
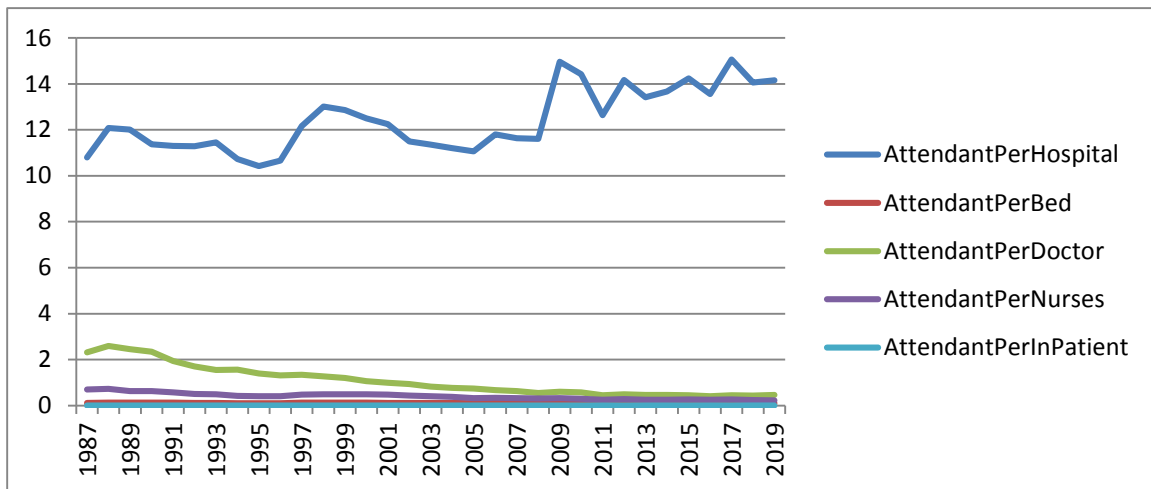

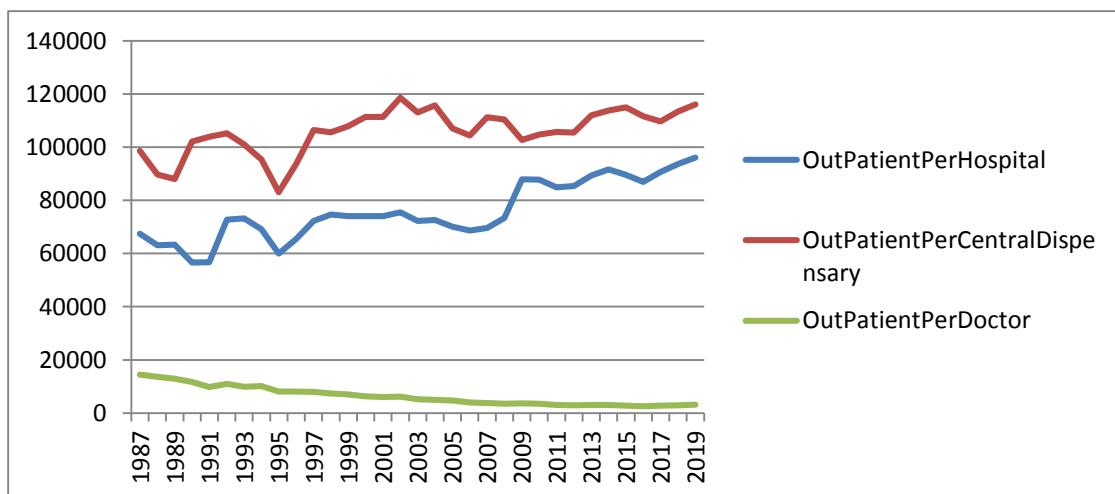
Fig. 9. Growth in number of attendants

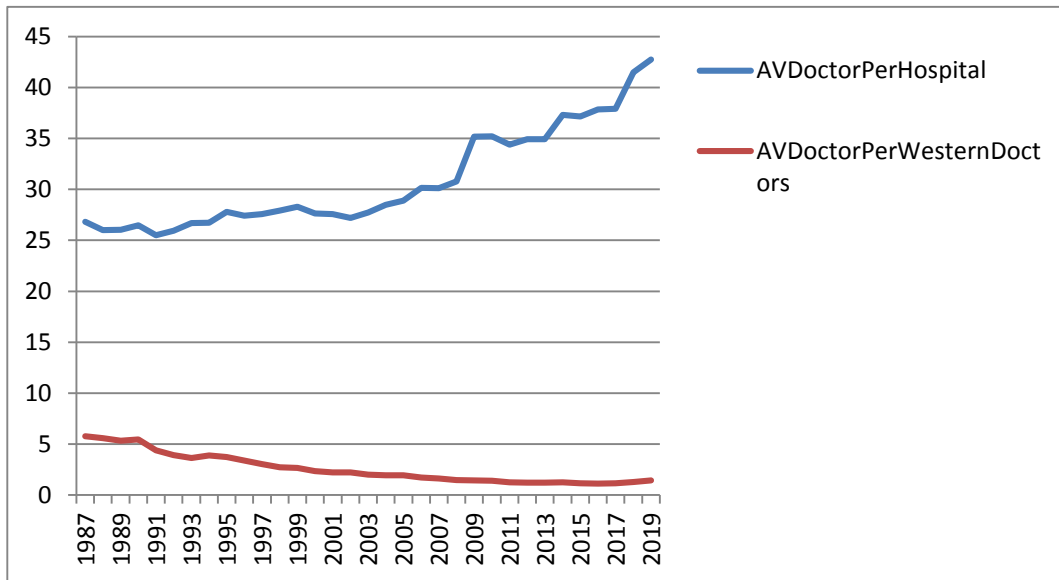**Fig. 10. Growth in number of external patients**

Fig. 11. Growth in number of Ayurvedic doctors

Indicators in the Fig. 12 imply that quality of health service also has developed parallel to the quantitative development. Mortality rate of male, which was more than 275 per 1000 peoples, has steeply declined up to 150 by 2019. However, in 1997, it has gone up than initial status and then declined. Compare to mortality rate of male, females' rate is lower over the period. In 1987, it was about 125, after which it reduced to just above 50 in 2019. Mortality rate of infant was standing at about 20 and it has gradually reached to a level about 6. Crude death rate remained constant around 6 over the period considered. These measures indicate the development of quality of health services.

Fig. 13 exhibits the growth of number of in-patients and out-patients parallel to the growth of the population. Both ratios have increasing trend. But, ratio between out-patients and population is higher than the ratio between in-patients and population throughout the period. The ratio out-patients: population is between 1.5 and 2.75. This implies that same person has appeared as a patient several time. By 2019, it is about 2.75 times. However, ratio in-patients: population is 0.5 which indicates that one patient is for two persons. This may has controlled by the limited resources in health system.

The development of each aspect relative to the population is exhibited in the Fig. 14. Ratio between total expenditure and population has exponentially developed which shows a rapid development after year 2000. Parallel to this, recurrent expenditure also has risen up. That is because higher amount of total expenditure is the recurrent expenditure. However, this ratio is just below 0.012. Except total expenditure and recurrent expenditures,

Only the ratio between number of beds and population among other aspects is reasonably in a higher level than that of others, whilst that is also less than 0.0004. This indicates that there are less than 4 beds for 10000 peoples. Ratio between aspects (nurses, capital expentiure, ayurvedic physicians, doctors, attendants) and population show at least slight increment while other aspects (assistant medical practitioners, central dispensaries, hospital, total health expenditure as a percentage of GDP) slightly decline or stay almost contant over the period. By 2019, ratio between number of hospitals and population is nearly 0.000028, which indicates that a mximum of 3 hospitals for 100000 peoples. According to this ratio, there are only two central dispensaries for 100000 peoples. For 10000 people, only 4 doctors are available by 2019.

Details about the development in each aspect are given in the Table 1, in terms of number, average development or increment per year and percentage development with compared to the initial year, 1987. During this period from 1987 to 2019, number of hospitals has gone up by 97 with an average increment of 2.54 per year. It is a 19% increment relative to the situation in 1987. With compared to hospitals, increment in number of central dispensaries is higher. It shows a 44%

of percentage with an increment of 153 central dispensaries. The increment in number per year is about 4.6%. According to figures, number of beds in hospitals for the use of in-patients has developed by 32945 in this time period. On average, it is a 998 increment per year with a 73% rise compared with the number at the beginning.

In the health system, a significant development can be observed in the human resources except in assistant medical practitioners. Number of doctors and nurses have developed by 15776 and 30433 respectively with a relative increment of 670% and 388%. On average, about 478 doctors and 922 nurses have been appointed within a year during last 3 decades. Parallel to

this, number of attendants has increased by 3069 within this period at a rate of 93 per year.

There is an increment of 12213 in ayurvedic physicians' number with a 90 percentage development compared with year 1987. This shows 370 new entrants, on average, per year. A significant difference can be seen in the annual total number of in-patients between year 1987 and 2019. It is a 162% development with compared to in-patients in 1987. In number, it is 4510000. In patients has developed at a rate of 136000 per year. However, out-patient number has gone up by 23811000 which is almost twice the development of in-patients' number. Relative to status in 1987, this is a 70% increment.
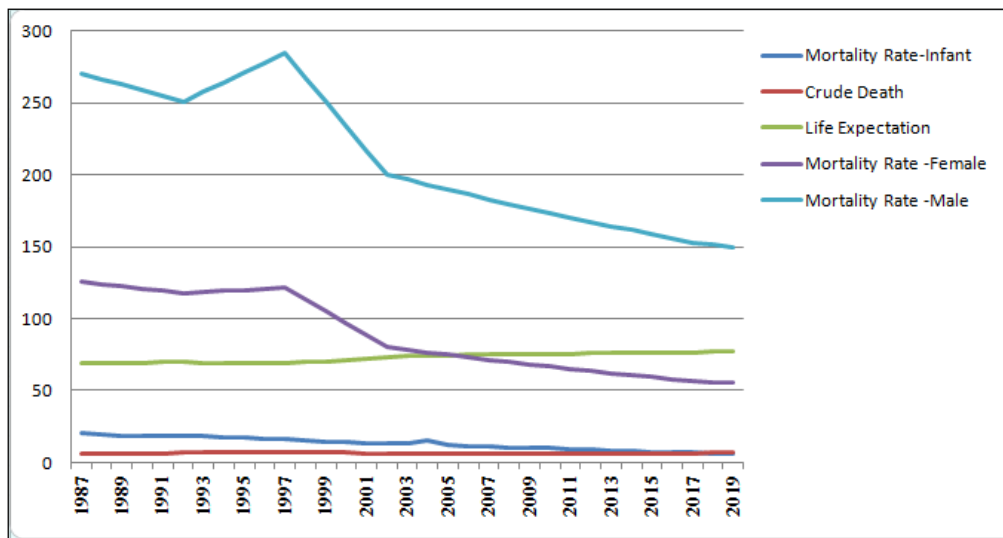

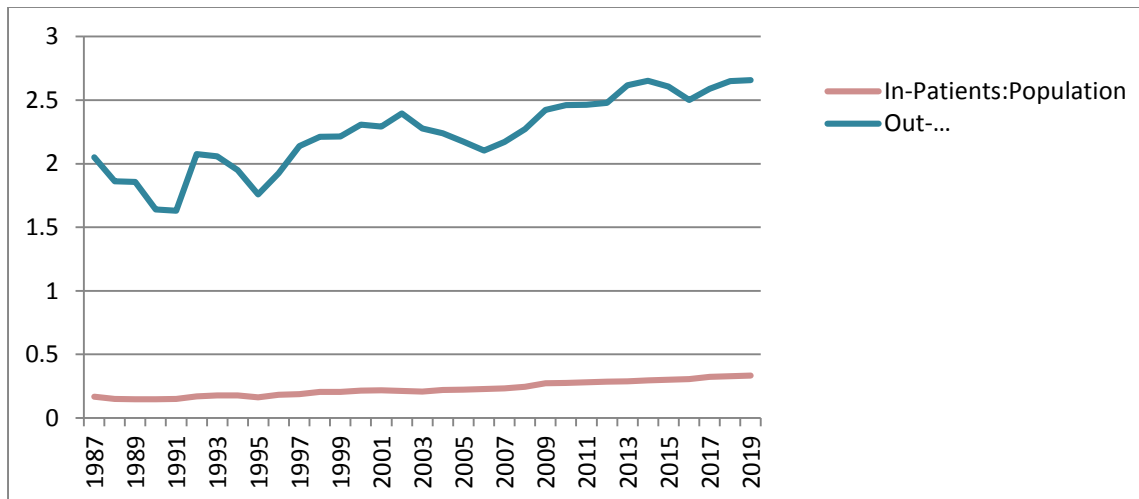**Fig. 12. Mortality rate, crude death and life expection**

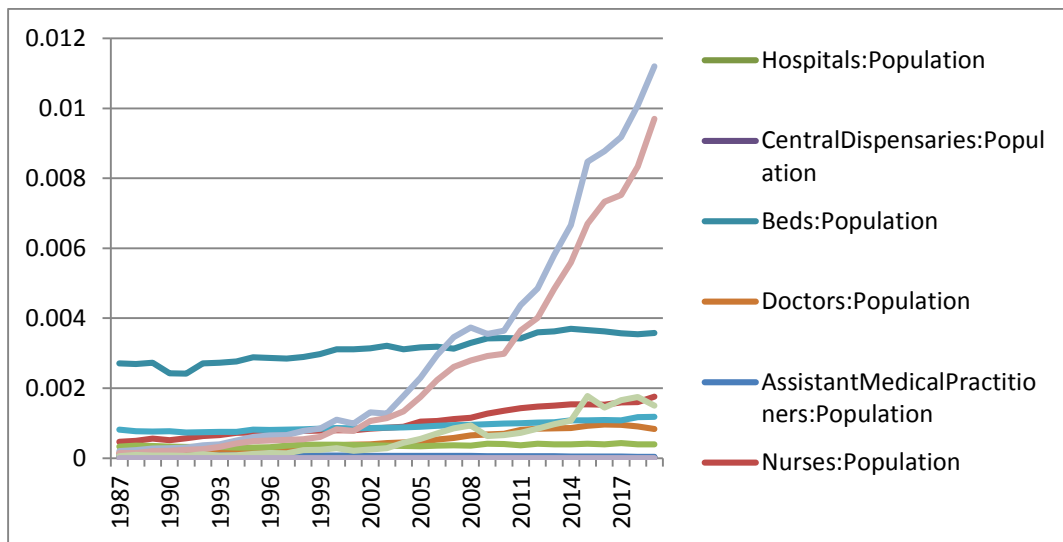**Fig. 13. Ratios between patients of each type and population**

Fig. 14. Ratio between each aspects and population

This shows an increment of 721000, on average, per year. Total expenditure on the health system has gone up from Rs. 3380 to Rs. 244307 millions since 1987 with an increment of 240927 millions. On average, increment per year and percentage increment with regard to initial status are Rs. 7300 million and 7128 respectively. A total of 2094555 million have been spent on the health system by the government as the recurrent expenditure and capital expenditure which is much less than recurrent expenditure.

During this, government has increased amount of recurrent expenditure by 209154 million with per year average increment of 8711 million. Percentage development of recurrent expenditure is about 8711%. Rs. 1707904 million has been allocated in total as the recurrent expenditure of health system by the government.

In this period, it has been invested a total of Rs. 389653 million as the capital expenditure including construction of buildings and establishment of new facilities. This amount has increased by Rs. 31773 millions with an average annual increment of Rs. 962. That is, compared with year 1987, a 3245% development.

Total health expenditure as a percentage of GDP in 2000 was 1.65 and in year 2019, it is 1.63. There can be seen a decrement of 0.02% in this allocation during this period. However, it has remained almost same in most of years in this period. As an average annual decrement it is a 0.001. As a percentage, this is a drop of 1.212% compared with year 2000.

Strengths of relationships between each pair of variables considered are given in the Table 2 with P-values within bracket. All most all pair of the variables shows positive strong relationships except the pairs with medical practitioners. This indicates that all these aspects have developed with time except number of medical practitioners. Differences in these correlation coefficients imply that ratios of the growth of these aspects are not the same.

Number of medical practitioners shows a negative relationship with all other aspects, out of which all are significant except the relationship between number of medical practitioners and number of hospital. This implies that there is a decline in number of medical practitioners while other factors have developed with time.

Canonical correlation: Canonical correlation between two set of data sets, expenditure and physical resources, are discussed in this section.

Tests of dimensionality for the canonical correlation analysis, as shown in Table 3, indicates that two of the three canonical dimensions are statistically significant at the 5% significance level. Dimension 1 had a canonical correlation of 0.9177 between two sets of variables, while for dimension 2, the canonical correlation was 0.5502. Other dimension is not statistically significant. This indicates a parallel development in these two aspects: financial resources and physical resources.

Table 1. Growth in each variable

Items	Increment	Average increment per year	Increment as a percentage	Total
Hospitals	97	2.939	19.170	-
Central Dispensaries	153	4.636	44.220	-
Beds	32945	998.333	73.180	-
Doctors	15776	478.061	670.178	-
Assistant Medical Practitioners	-270	-8.182	-26.316	-
Nurses	30433	922.212	388.028	-
Attendants	3069	93.000	56.188	-
Ayurvedic Physicians	12213	370.091	90.000	-
In-Patients	4518	136.909	162.987	-
Out-Patients	23811	721.545	69.747	1431590
Total Health Expenditure (Rs.million)	240927	7300.818	7128.018	2094555
Recurrent Expenditure	209154	6338.000	8711.120	1707904
Capital Expenditure	31773	962.818	3245.455	389653
Total Health Expenditure As A % of GDP	-0.02	-0.001	-1.212	

Table 2. Pairwise Pearsons' correlation coefficients

	Hos	CD	Bed	Do	AM.	Nu.
CD	0.690 (0.00)					
Bed	0.848 (0.00)	0.948 (0.00)				
Do	0.793 (0.00)	0.923 (0.00)	0.978 (0.00)			
AM.	-0.281 (0.113)	-0.569 (0.001)	-0.57 (0.001)	-0.667 (0.00)		
Nu.	0.764 (0.00)	0.937 (0.00)	0.975 (0.00)	0.985 (0.00)	-0.676 (0.00)	
At	0.772 (0.00)	0.899 (0.00)	0.936 (0.00)	0.930 (0.00)	-0.583 (0.00)	0.916 (0.00)
IP	0.786 (0.00)	0.941 (0.00)	0.979 (0.00)	0.982 (0.00)	-0.667 (0.00)	0.990 (0.00)
AP	0.799 (0.00)	0.919 (0.00)	0.971 (0.00)	0.975 (0.00)	-0.696 (0.00)	0.986 (0.00)
OP	0.819 (0.00)	0.938 (0.00)	0.974 (0.00)	0.947 (0.00)	-0.575 (0.00)	0.947 (0.00)
THE	0.659 (0.00)	0.850 (0.00)	0.887 (0.00)	0.925 (0.00)	-0.807 (0.00)	0.942 (0.00)
RE	0.645 (0.00)	0.848 (0.00)	0.882 (0.00)	0.918 (0.00)	-0.814 (0.00)	0.939 (0.00)
CE	0.720 (0.00)	0.835 (0.00)	0.895 (0.00)	0.937 (0.00)	-0.747 (0.00)	0.932 (0.00)

Table 2. Pairwise Pearsons' correlation coefficients-continued

.	At	IP	AP	OP	THE	RE
CD						
Bed						
Do						
AM.						
Nu.						
At						
IP	0.942 (0.00)					
AP	0.921 (0.00)	0.99 (0.00)				
OP	0.941 (0.00)	0.972 (0.00)	0.951 (0.00)			
THE	0.847 (0.00)	0.942 (0.00)	0.958 (0.00)	0.875 (0.00)		
RE	0.840 (0.00)	0.938 (0.00)	0.955 (0.00)	0.872 (0.00)	0.999 (0.00)	
CE	0.862 (0.00)	0.934 (0.00)	0.951 (0.00)	0.870 (0.00)	0.977 (0.00)	0.967 (0.00)

CD: Central Dispensaries; Bed: Beds; Do: Doctors; AM: Assistant Medical Practitioners; Nu: Nurses; At; Attendants: IP: In-Patients; AP: Ayurvedic Physicians; OP: Out-Patients; THE: Total Health Expenditure; RE: Recurrent Expenditure; CE: Capital Expenditure

Table 3. Significance of dimensions

Dimensions	Canonical Correlation	Wilks Lamda	Hotelling	Pillai
1	0.9177	0.00E+00	0.00E+00	0.00E+00
2	0.5502	5.98E-07	9.01E-08	2.41E-06
3	0.638	5.34E-01	5.32E-01	5.25E-01

Figures in Table 4 represent the standardized canonical coefficients for the first two dimensions across both sets of variables. For the expenditure related variables, the first canonical dimension is negatively influenced by capital expenditure and recurrent expenditure while total health expenditure positively influenced. For the second dimension, total health expenditure only makes the influence negatively. In case of physical resources related variables, the first canonical dimension is negatively influenced by number of central dispensary and number of beds. The second dimension is highly influenced by number of hospitals. This implies that developments of some aspects are relatively low compared to the development of others.

Results of canonical correlation between expenditure and human resources are given in Table 5.

Canonical correlation analysis produces three canonical correlations. All canonical dimensions are statistically significant at the 5% significance level. Dimension 1 show a canonical correlation of 0.9805, while second dimension and third dimension show canonical correlations 0.7186 and 0.1589 respectively. It is clear that third canonical correlation is much smaller compared with the first and second dimensions. This elucidates that both expenditures and human resources have developed simultaneously to some extent.

Capital expenditure and recurrent expenditure among the expenditure related variables negatively affect the first canonical dimension, while only total health expenditure shows a positive effect. Among the human resources related variables, number of nurses and ayurvedic doctors have negatively affected first correlation. For the second correlation dimension, total health expenditures, nurses, only have shown negative impact. Recurrent expenditures, capital expenditures, assistant medical practitioners and ayurvedic doctor also have negatively related with the third canonical correlation.

Results of canonical correlation between two groups, expenditure and patients are given in Table 7.

Only two canonical correlations could be produced for this. Dimension 1 has a canonical correlation of 0.9602 meanwhile the second dimension, shows a canonical correlation of size 0.2656. Both dimensions are statistically significant which indicates a similar pattern in both set of data, a positive relationship.

First canonical correlation is negatively affected by total health expenditures, and number of internal patients with the highest impacts. Among all these variables, only total health expenditure and number of internal patients have positive impact on the second canonical correlation.

Results of canonical correlation between two groups, physical resources and human resources are given below Table 9.

Results of tests of dimensionality for the canonical correlation analysis are in the above table. All tests indicate that all three canonical dimensions are statistically significant at the 5% significance level. Dimension 1 has a canonical correlation of size 0.9919. The second dimension is with a canonical correlation of 0.7411. Last dimension, which is much less than first two canonical correlations, is 0.3445. A positive relationship between these two sets of aspects is indicated by these canonical correlations.

The first canonical correlation is positively affected by number of hospital and number of central dispensaries while it is negatively affected by all other variables. In case of the second canonical correlation, number of beds, nurses, and attendants show negative impacts. Number of beds, doctors, and ayurvedic doctors are positively related with the third correlation. This shows that relative development of these aspects are same.

Results of canonical correlation between two groups, physical resources and patients are given in Table 11.

Table 4. Coefficients of expenditure related variables

Variables	Dimensions	
	1	2
Total Health Expenditure	1.65E-4	-1.10E-3
Recurrent Expenditure	-1.74E-4	9.50E-4
Capital Expenditure	-2.05E-4	1.29E-3
Hospitals	1.12E-02	4.04E-02
Cen. Dispensary	9.99E-03	-4.52E-03
Beds	-1.72E-04	-9.56E-05

Table 5. Significance of dimensions

Dimensions	Canonical Correlation	Wilks Lamda	Hotelling	Pillai
1	0.9805	0.00E+00	0.00E+00	0.00E+00
2	0.7186	4.30E-12	2.44E-15	1.54E-09
3	0.1589	4.95E-01	4.89E-01	4.81 E-01

Table 6. Coefficients of expenditure variables

Variables	Dimensions		
	1	2	3
Total Health Expenditure	3.41E-05	-5.74E-04	1.84E-03
Rec. Expenditure	-5.10E-05	5.13E-04	-1.85E-03
Capital. Expenditure	-3.38E-05	8.96E-04	-1.75E-03
Doctors	4.49E-05	8.07E-04	2.05E-04
Ass. Med. Practitioner	1.74E-03	4.24E-03	-2.08E-03
Nurses	-3.16E-05	-5.95E-04	4.63E-04
Attendants	9.99E-05	-1.71E-04	4.91E-04
Ayu. Physicians	-2.28E-04	3.12E-04	-1.61E-03

Table 7. Significance of dimensions

Dimensions	Canonical Correlation	Wilks Lamda	Hotelling	Pillai
1	0.9602	0.00E+00	0.00E+00	0.00E+00
2	0.2656	3.09E-02	2.90E-02	3.06E-02

Table 8. Coefficients of variables

Variables	Dimensions	
	1	2
Total Health Expenditure	-3.53E-05	1.90E-03
Rec. Expenditure	2.52E-05	-1.89E-03
Capital Expenditure	7.69E-07	-1.97E-03
In-Patients	-1.20E-03	2.68E-03
Out-Patients	9.19E-05	-4.88E-04

Table 9. Significance of dimensions

Dimensions	Canonical Correlation	Wilks Lamda	Hotelling	Pillai
1	0.9919	0.00E+00	0.00E+00	0.00E+00
2	0.7411	2.66E-15	0.00E+00	1.55E-12
3	0.3445	8.07E-03	6.25E-03	8.24E-03

Table 10. Coefficients of variables

Variables	Dimensions		
	1	**2**	**3**
Hospitals	2.00E-03	5.20E-02	-2.79E-02
Cen. Dispensary	2.15E-03	1.70E-02	-6.65E-02
Beds	-1.04E-04	-2.50E-04	4.27E-04
Doctors	-7.62E-05	2.53E-04	8.47E-04
Ass. Med. Practitioners	-9.73E-04	6.88E-03	-2.48E-03
Nurses	-2.38E-05	-5.50E-04	-5.39E-04
Attendants	-8.03E-05	-2.99E-04	-1.62E-03
Ayu. Physicians	-8.41E-05	1.16E-03	2.72E-04

Table 11. Significance of dimensions

Dimensions	Canonical Correlation	Wilks Lamda	Hotelling	Pillai
1	0.9848	0.00E+00	0.00E+00	0.00E+00
2	0.4250	7.76E-05	4.84E-05	1.02E-04

Table 12. Coefficients of variables

Variables	Dimensions	
	1	**2**
Hospitals	2.43E-03	5.88E-02
Cen. Dispensary	-2.83E-04	4.95E-02
Beds	-9.28E-05	-4.38E-04
Doctors	-7.62E-05	2.53E-04
Ass. Med. Practitioners	-9.73E-04	6.88E-03

Tests of dimensionality confirm two significant canonical correlations, which are 0.9848 and 0.4250 respectively. Dimension 1 is almost double the second dimension. This is an indication that parallel to the growth of patients, physical resources in the government health system has developed.

With the first canonical correlation, number of hospitals only shows a positive correlation while all other variables are having negative impacts on the first canonical correlation. The second correlation is negatively affected only by number of beds. It is apparent from these coefficients, that developments of all aspects are not same.

5. DISCUSSION

In this study, development of aspects related to heath sector was discussed relatively to the status at the initial year, 1987, and relative to the development of other aspects. Therefore, it indicates a relative improvement. Although, an improvement can be recognized, adequacy of the development in the health system is a question. Since the population in the country increases rapidly with time, development of

health facilities has been analyzed compared to the population of the country also as a ratio.

There is a reasonable development in all aspects considered in this study. Number of hospitals has reached to 600 from 500 which show about 20% increment with an average of about 3 new hospitals per year. This may not be uniform over the period as well as areas in the country. Apart from this, expansions of the existing hospitals is also has taken placed to greater extent and it also gives a higher contribution. The development of in number of beds also may not be uniform over the all hospitals in the country.

The ratio between number of beds and number of doctors was 20:1 in year 1987, which implies that on average one doctor has to take care nearly 20 beds. However by 2019 this ratio becomes 4:1. According to this ratio, one may feel that now more care is for patients because a doctor has to be responsible only for 4 beds. However, this may not be the reality because doctors are in different fields. There can be a lack of improvement in number of doctors in certain fields. In general, in developed hospitals, a set of doctors are responsible for a ward irrespective of the number of beds. Only

specialized doctors will be responsible for several wards. Further, some doctors are in common places such as X-ray room. However, it can be heard about the closure of some hospitals, especially small scale hospitals in rural areas due to lack of both human resources and physical resources.

Even though large amount of money is allocated for health system by the government, higher proportion of money is recurrent expenditures such as servants' salaries, and purchasing medicines, which is difficult for the government to bear.

However, further development is needed in all aspects. It is mentioned that Sri Lanka health system require major reforms to provide a better services and to face the future challengers [25]. The government health system needs twice the number of nurses than present number and a development in other paramedical staff to provide comprehensive health care to the public [26]. Further, it is essential to strengthen the PMC units in the country with special emphasis on quality of care [27]. It is mentioned that more nurses are needed than doctors and government has produced more doctors than nurses [27].

Parallel to the public health system, a fast-growing trend can be seen in private health sector and private sector is accounting for more than half of national health expenditures, much higher than its contribution to actual healthcare delivery [28]. Even though 40 to 45% of total health is from out-of-pocket of patients, public system still covers the bulk of (more expensive) inpatient care including catastrophic and impoverishing health expenditures [29,30].

Real image on total number of patients cannot be obtained from this data set. Number of patients is not available in the source for hospitals and dispensaries separately. Further, large amount of patients obtain health services from privet hospitals or privet dispensaries. Their records are not taken into account in this analysis, since data were not available. For a better understanding about total population of patients in the country those data also should be used parallel to this.

6. CONCLUSION

There is a considerable improvement in physical resources; human resources; financial resources. Number of hospitals has reached to 600 with about 20% increment. The number of beds has climbed up by 73% so that almost 78000 patients can be accommodated at the same time.

Number of doctors has developed by 670%. Number of doctors per Hospital, and per bed show increment while number of doctors per patient has fallen down. Number of nurses has increased by 388% compared to the initial status while number of nurses per bed, per doctor, and per in-patient indicates a decline trend. Number of attendant per hospital has improved while number of attendant per bed, per doctor, per nurse and per in-patient has a downward trend. However, there can be seen a 56% increment in number of attendants. Assistant medical practitioners remain constant over the period. Ayurvedic physicians also have gone up nearly by 90%. Ayurvedic physicians per hospital has developed while ratio between number of Ayurvedic physicians and western doctors is decreasing.

Total health expenditure show a 7128% increment and recurrent expenditures have gone up by 8711%. Meantime, capital expenditure also has gradually increased with a steady rate. However, allocation for total health expenditure as a percentage of GDP has declined by 1.21%.

Parallel to the quantitative development of human resources, physical resources and financial resources, qualitative development also has taken placed. Mortality rate of infant, adults male and adults female has come down. The life expectation of people also has increased. These measures confirm the improvement of quality of the health services in the country.

Both in-patients and out-patients have continuously increased, where number of out-patients is four times higher that the number of in-patients. Since facilities in government hospitals are limited, development in number of inpatient is very low. Ratio of number of outpatients with number of hospitals, and number of central dispensaries has developed. But, number of outpatients per doctor has declined

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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