

Effects of COVID-19 on Diabetic Patients and its financial impacts

Vashist N^{1*}DOI: <https://doi.org/10.17511/ijphr.2025.i01.03>

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Introduction: COVID-19 restrict insulin production by developing diabetic ketoacidosis, anti-pancreatic antibodies and destroying islets and beta cells of the pancreas to trigger an autoimmune process. Virus infection increases insulin resistance by increasing stress hormones, and glucocorticoids, which disturb carbohydrate metabolism, leading to general malaise and fatigue. Rs. 14,217 crore was spent on COVID-19 emergency response and health system preparedness package and COVID-19 vaccination for healthcare and frontline workers.

Method: The case study method is used. The research work is conducted by collecting the data of Diabetes and Diabetes with Hypertension patients during COVID-19, for 4-5 years. The sample size is 947 participants and the total investigations are 5498 from about 30,000 population.

Results: Total investigations = 5498, normal persons= 4551(82.78%), Total diseased persons 947(17.22%), diabetes = 368 and hypertension = 579. Out of these diabetic patients, 296 show a major increase in blood sugar level and 72 patients have a minor impact in blood sugar level. This variation leads to financial load on diabetic patients which may vary from 20 -25% in government, market and actual price for allopathic medicines to 40-45% in traditional medicines.

Conclusion: Cost of treatment for 368 patients of diabetic mellitus [sample size] of modern allopathic medicines has increased from expected expenditure of government price Rs.1,099,125/- to 1,314,568/-, market price from Rs. 11,184,358/- to 14,075,112/- and actual expenditure from Rs.3,089,198/- to 4,989,876/- and for traditional herbal medicines for government price Rs.138,448/- to 326,737/-, market price and actual price from Rs. 289789/- to 498879/-. The total expenditure of both systems has increased from Rs. 3415935/- to 5488755/-. The average cost of treatment of diabetic patients in Himachal Pradesh is Rs. 61,153,688/-, 63,051,188/-, 64,803,144/-, 63,474,710/-, respectively for 2020 to 2023.

Keywords: Diabetes, COVID-19, NCDs, allopathic medicines, traditional herbal medicines

Corresponding Author	How to Cite this Article	To Browse
Naresh Vashist, Doctor of Letters [Pursuing], Public Health Management, Singhania University, Jhunjhunu, Rajasthan, India and Pharmacy Officer, Health and Family Welfare Department, Himachal Pradesh, India, . Email: drnareshvashistPO24@gmail.com	Vashist N, Effects of COVID-19 on Diabetic Patients and its financial impacts. Public Health Rev Int J Public Health Res. 2025;12(1):18-25. Available From https://publichealth.medresearch.in/index.php/ijphr/article/view/190	

Manuscript Received 2024-12-18	Review Round 1 2024-12-26	Review Round 2 2025-01-03	Review Round 3 2025-01-11	Accepted 2025-01-20
Conflict of Interest None	Funding Nil	Ethical Approval Yes	Plagiarism X-checker 11.19	Note



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Introduction

COVID-19 increases the blood sugar level by developing diabetic ketoacidosis in approximately 40% of patients and this virus increases the risk of developing type 1 diabetes in patients. Viral infection increases the production of anti-pancreatic anti-bodies which restrict the production of insulin from beta cells of the pancreas and develop insulin-dependent diabetes and type 1 diabetes in an individual. The autoimmune process is triggered by the penetration of the COVID-19 virus which destroys the islets and beta cells of the pancreas.[1] Insulin level is reduced by COVID-19 which contributes to inducing diabetes and deteriorates its control in an existing diabetes.[2] Sugar level in the blood is increased by the stress hormone, glucocorticoids which is induced by the infection of this virus.[3] Infection with this virus disturbs carbohydrate metabolism which increases insulin resistance and leads to an increase in the sugar level in the blood of diabetic patients as well as in normal persons.[4] Deregulation in metabolism and hyperglycemia by long-term COVID-19 infection may lead to general malaise and fatigue. Union budget of the health sector has increased by approximately 13% from Rs. 79,145 crores for the financial year 2022-23 to Rs. 89,155 crores for 2023-24.[5-6] In Himachal Pradesh for the financial year 2019-20 has allocated 6.4% of its total expenditure on health, for 2020-21, it is 6.6%, for 2021-22, it is 6.7% and for 2022-23 it is 6.6%. The healthcare budget for the Health and Family Welfare Department of Himachal Pradesh for the financial year 2017-18 is Rs. 2006 crores, for 2018-19 is Rs. 2557 crores, the revised estimate for 2018-19 is Rs. 2644 crores, for 2019-20 is Rs. 2751 crores, for 2020-21 is Rs. 2497 crores, for 2021-22 is Rs. 2976 crore and revised budget Rs. 3185 crore and for 2022-23 is Rs. 3032 crores whereas for 2023-24 is proposed Rs. 3139 crore.[7] COVID-19 virus infection causes an 85% probability of mortality in diabetic patients in Himachal Pradesh as compared to 50% in non-diabetic persons.[8] As compared to the global prevalence increase of diabetes from 4% in 1995 to 5.4% by the year 2025, in India, approximately 33 million adults of diabetes will increase to 57.2 million by the year 2025.[9] Diabetes is increasing in low and middle-income countries which is approximately 422 million adults worldwide and 592 million by 2035.[10-11]

The global diabetes prevalence in 2019 is estimated to be 9.3% (463 million people), rising to 10.2% (578 million) by 2030 and 10.9% (700 million) by 2045. The prevalence is higher in urban (10.8%) than rural (7.2%) areas and in high-income (10.4%) than low-income countries (4.0%).[12]

Diabetes affects approximately 422 million adults worldwide and 592 million people by 2035.[13] Diabetes causes a substantial economic burden for individuals, households and health systems, in addition to morbidity and mortality.[14]

As per the International Diabetes Federation, India has 73 million diabetic patients, the second-largest in the world which is expected to double by 2045 which encompasses a massive economic burden. [15] Mortality and morbidity rates due to COVID-19 vary in diabetic patients.[16-21]

IDSP analysis of India, shows deaths due to comorbidities like diabetes with COVID-19, are more than 57% whereas less than 43% are normal deaths whereas comorbidity deaths in Himachal Pradesh are more than 85%.[22-25]

Viral infections of COVID-19 are increasing much more in older adults with diabetes which leads to serious threats like mortality and morbidity. COVID-19 viral infection also spreads like nosocomial infection.[26]

Research Objectives

Analysis of effects of COVID-19 on diabetic patients and its financial impacts.

Material and Method

Setting: The population included is near about 30,000 in five medical blocks.

Duration and type of study: 4-5 years [2019-20 to 2023-24]. Data-based study.

Sampling methods: Case study method

Sample size calculation: 947 patients of NCDs after doing 5498 investigations.

Inclusion criteria: All diabetic and hypertension with diabetic patients under treatment.

Exclusion criteria: Emergency patients.

Data collection procedure: Institutional level, by visiting selective areas, online methods, by well-developed questionnaire

Any scoring system: No.

Surgical procedure if any: No

Ethical consideration & permission: As the study is data collection based, therefore there is no need for ethical consideration and permission
Statistical Analysis: Case study method.

Results

Of the total persons investigated are 5498, normal persons are 4551(82.78%), diseased persons with diabetes and other NCDs are 947 (17.22%), out of these 368 are of diabetic and diabetic with hypertension patients and 579 were other NCDs like hypertension. Of these 368 diabetic patients, 296 patients show a major increase in blood sugar level and 72 patients have a minor impact in blood sugar level. Out of these 368 patients, 87 patients show more than 200 mgdl variation in blood sugar level, 115 show variation from 100-200 mgdl and 94 patients show variation from 50-100 mgdl. And remaining 72 patients have less than 50 mgdl variations. This variation has increased the financial load on diabetic patients which on average initially was expected at Rs.1,099,125 but it is now raised to Rs. 1,314,568. The total government price for the purchase of allopathic medicines for the calendar years 2020-23 for 368 diabetic patients is expected as Rs. 1,099,125/- but it is raised to Rs. 1,314,568 and market price expected as Rs.11,184,358/- but it is raised to Rs. 14,075,112/- and actual expenditure is expected as Rs. 3,089,198/- but it is raised to Rs. 4,989,876/- now. The government cost for traditional medicines for these patients is expected as Rs. 138,448/- but it is raised to Rs. 289,789/-, market price is expected as Rs. 326,737/- but it is raised to Rs. 498,879/- whereas actual expenditure is Rs. 498,879/-. The total actual expenditure is Rs. 5,488,935/- The average cost of treatment for the patients taken for a sample is Rs.1329428/-, Rs. 1370678/-, Rs. 1408764, Rs.1379885 and for a population of Himachal Pradesh is Rs. 61153688/-, Rs. 63051188, Rs. 64803144, Rs, 63474710, respectively for 2020 to 2023 calendar years.

Table 1: Diabetic, Hypertension and Diabetic with Hypertension patients During COVID-19:

S.N.	Total Persons Investigated	Normal Persons	Diseased	DM	NCDs [HTN]
1.	5498	4551	947	368	579
2.	Percentages	82.78%	17.22%	6.69%	10.53%

The total number of persons investigated is 5498, normal persons are 4551 [82.78%],

Diseased are 947[17.22%], diabetic mellitus [DM] is 368 [6.68%] and HTN [other NCDs] are 579 [10.53%].

Figure -1

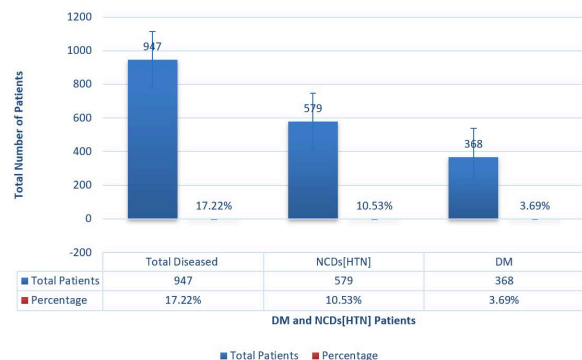


Figure 1: Diabetes and Hypertension Patients

DM - Diabetic Mellitus.

NCDs - Non- communicable diseases.

HTN - Hypertension.

Table 2: Diabetic Mellitus and HTN [Other NCDs] patients during COVID-19

S.No.	Total Patients of DM	Variation in Blood Sugar Levels in Diabetic Patients During COVID-19			
		More than 200 mgdL	Between 100-199 mgdL	Between 50-99 mgdL	Less than 49 mgdL
1.	368	87	115	94	72
2.	Percentage	23.64%	31.25%	25.34%	19.57%

From total of 368 diabetic mellitus patients, 87 patients have more than 200mgdL [23.64%] variation in sugar level during COVID-19, 115 DM patients have 100-199mgdL [31.25%] variation, 94 DM patients have 50-99mgdL [25.34%] variation and 72 DM patients have less 49 mgdL [19.57%] variation in sugar level.

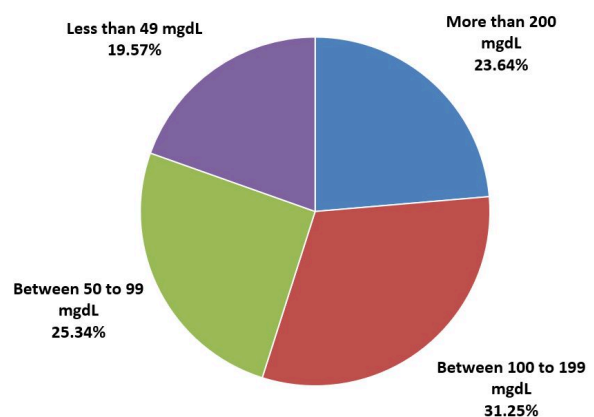
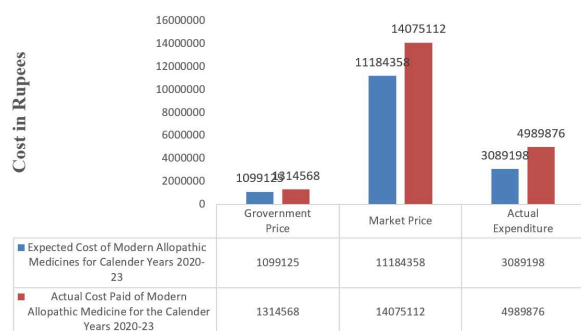


Figure 2: Variation in blood sugar level in diabetic patients during COVID-19.

Table 3: Expected Expenditure for Diabetic Patients during COVID-19

S. No	Particulars of Treatment System Used	Total Expected Cost for Diabetic Patients during COVID-19 in (Rs)(Calender Years Wise)				Total	
		2020 (Jan. to Dec.)	2021 (Jan. to Dec.)	2022 (Jan. to Dec.)	2023(Jan. to Dec.)		
i)	Modern Allopathic medicines/ Conventional System	GP	251563	264783	289036	293743	1099125
		MP	2751920	2780104	2808380	2843954	11184358
		AE	722475	758757	805870	802096	3089198
ii)	Traditional Medicines (TM)/ Non-Conventional System	GP	31078	33114	36411	37845	138448
		MP	76453	81421	83394	85469	326737
		AE	76453	81421	83394	85469	326737
Total Actual Cost			798928	840178	889264	887565	3415935

**Figure 3: Expected Expenditure vs Actual Expenditure for Modern Allopathic Medicines of Diabetic Patients after Variation of Blood Sugar Level during COVID-19**

Total expected cost for diabetic patients during COVID-19 in different calendar years i.e. in 2020 for modern allopathic medicines for GP Rs. 251,563/-, MP Rs. 2,751,920/- AE Rs. 722,475/-. For traditional medicines GP Rs. 31,078/-, MP and AE Rs. 76,453/-. In 2021, modern allopathic medicines for GP Rs. 264,783/-, MP Rs. 2,780,104/-, AE Rs. 758,757/- and for traditional medicines GP Rs. 33,114/-, MP and AE Rs. 81,421/-. In 2022, modern allopathic medicines for GP Rs. 289,036/-, MP Rs. 2,808,380/-, AE Rs. 805,870/- and for traditional medicines GP Rs. 36,411/-, MP and AE Rs. 83,394/-. In the calendar year 2023, for modern allopathic medicines GP Rs. 293,743/-, MP Rs. 2,843,954/-, AE Rs. 802,096/- and for traditional medicines, GP Rs. 37,845/-, MP and AE Rs. 85,394/-.

Total expected expenditure for modern allopathic medicines for years 2020,2021,2022, and 2023, GP Rs. 1,099,125/-, MP Rs.11,184,358/- and AE Rs. 3,089,198/- and for traditional medicines, GP Rs. 138,448/-, MP and AE Rs. 326,737/-. Total actual cost for 2020, for both modern allopathic medicines as well as traditional medicines, Rs. 798,928/-, for 2021, Rs. 840,178/-, for 2022, Rs. 889,264/-, for 2023, Rs. 887,565/-.

Table 4: Actual Expenditure for Diabetic Patients during COVID-19

S. No	Particulars of Treatment System Used		Total Cost Utilization raised during COVID-19 in (Rs)(Calender Years Wise) for DM Patients after variation of blood sugar level during COVID-19				
			2020 (Jan. to Dec.)	2021 (Jan. to Dec.)	2022 (Jan. to Dec.)	2023(Jan. to Dec.)	Total
i)	Modern Allopathic medicines/ Conventional System	GP	305424	318644	342897	347603	1314568
		MP	3474608	3502792	3531068	3566644	14075112
		AE	1205475	1241757	1287870	1254774	4989876
ii)	Traditional Medicines (TM)/ Non-Conventional System	GP	68913	70947	74244	75685	289789
		MP	123953	128921	120894	125111	498879
		AE	123953	128921	120894	125111	498879
	Total Actual Cost		1329428	1370678	1408764	1379885	5488755

Total cost utilization for diabetic patients after variation of blood sugar level for diabetic patients during COVID-19 in different calendar years i.e. in 2020 for modern allopathic medicines for GP Rs. 305,424/-, MP Rs. 3,474,608/-, AE Rs. 1,205,475/-. For traditional medicines GP Rs. 68,913/-, MP and AE Rs. 123,953/-. In 2021, modern allopathic medicines for GP Rs. 318,644/-, MP Rs. 3,502,792/-, AE Rs. 1,241,757/- and for traditional medicines GP Rs. 70,947/-, MP and AE Rs. 128,921/-. In 2022, modern allopathic medicines for GP Rs. 342,897/-, MP Rs. 3,531,068/-, AE Rs. 1,287,870/- and for traditional medicines GP Rs. 74,244/-, MP and AE Rs. 120,894/-. In the calendar year 2023, for modern allopathic medicines GP Rs. 347,603/-, MP Rs. 3,566,644/-, AE Rs. 1,254,774/- and for traditional medicines, GP Rs. 75,685/-, MP and AE Rs. 125,111/-.

Total cost utilized, for modern allopathic medicines for years 2020,2021,2022, and 2023, GP Rs. 1,314,568/-, MP Rs.14,075,112/- and AE Rs 4,989,876/- and for traditional medicines, GP Rs. 289,789/-, MP and AE Rs. 498,879/-. Total actual cost for 2020, for both modern allopathic medicines as well as traditional medicines, Rs. 1,329,428/-, for 2021, Rs 1,370,678/-, for 2022, Rs 1,408,764/-, for 2023, Rs 1,379,885/-

GP = Government Price

MP = Market Price

AE = Actual Expenditure

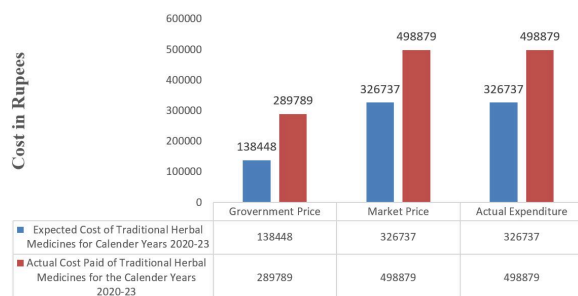


Figure 4: Expected Expenditure vs Actual Expenditure for Traditional Herbal Medicines of Diabetic Patients after Variation of Blood Sugar Level during COVID-19

Table 5: Comparison of Average Total Treatment Cost for DM Patients' [Sample Size] to Average Total Treatment Cost of DM Patients of Himachal Pradesh during COVID-19

S. No.	Year (w.e.f.01-31 Dec.)	Patients of DM		Average Cost of Treatment		Total Average Population Covered	
		Sample Size of Patients	Average Total Patients in HP	For Sample Size Patients	For Total Patients in HP	For Sample Size Patients	For Total Patients in HP
1.	2020	368	16924	1329428	61153688	29858	3465743
2.	2021	368	17456	1370678	63051188	30155	3787895
3.	2022	368	18352	1408764	64803144	32456	4056742
4.	2023	368	18759	1379885	63474710	35876	4687156

For calendar years 2020, 2021, 2022 and 2023, the sample size of DM patients is 368, the average cost of treatment is 1,329,428/-, 1,370,678/-, 1,408,764/- and 1,379,885/- respectively whereas for average total patients of HP, for these calendar years, 61,153,688/-, 63,051,188/-, 64,803,144/-, 63,474,710/-, respectively.

DM – Diabetic Mellitus

HP - Himachal Pradesh

Discussions

The total number of persons investigated is 5498, out of these investigations, normal persons are 4551(82.78%) and diseased persons with diabetes [DM] and other non-communicable diseases [NCDs] like hypertension [HTN] are 947 (17.22%). Of 947 diseased patients, 368 [6.69%] patients are of diabetic mellitus and 579 [10.53%] are of other NCDs like hypertension. [Table-1 and Figure 1] Out of 368 DM patients 87 patients [23.64%] have more than 200 mgdL variation in blood sugar level, 115 [31.25%] patients have variation between 100 to 199 mgdL, 94 [25.34%] patients have variation between 50 to 99 mgdL and 72 [19.57%] have variation less than 49 mgdL. [Table-2 and Figure-2]. For the calendar year 2020 expected government price[GP] of modern allopathic medicines [MAM] for 368 patients of DM, is Rs. 251,563/-, the market price [MP] is Rs. 2,751,920/- and the actual expected expenditure AE] is Rs. 722,475/-. For the calendar year 2021, GP is Rs. 264,783/-, MP is Rs. 2,780,104/- and AE is Rs. 758,757/-. For the calendar year 2022, GP is RS. 289,036/-, MP is Rs. 2,808,380/-, and AE is Rs. 805,870/-. For the calendar year 2023 GP is Rs. 293,743/-, MP is Rs. 2,843,954/- and AE is Rs. 802,096/-. The total expected expenditure for modern allopathic medicines for calendar years 2020-2023, GP is Rs. 1,099,125/-, MP is Rs.11,184,358/- and AE is Rs. 3,089,198/-. Whereas the expected price of traditional medicines, for the calendar year 2020, GP is 31,078, MP is Rs. 76,453 and AE is Rs. 76,453/-. For the calendar year 2021, GP is RS. 33,114/-, MP is RS. 81,421/- and AE is Rs. 83,394/-. For the calendar year 2022, GP is RS. 36,411/-, MP is RS. 83,394/- and AE is Rs. 83,394/-. For the calendar year 2023, GP is Rs. 37,845/-, MP is RS. 85,469/- AE is Rs. 85,469/-. Total expected expenditure for the years 2020-23, GP is Rs.138,448/-, MP is Rs.326,737/- and AE is Rs. 326,737/-.[Table-3 and Figure-3] Actual expenditure for modern allopathic medicines, for the calendar year 2020, GP is Rs. 305,424, MP is Rs.3,474,608/-, AE is Rs. 1,205,475/-. For the calendar year 2021, GP is Rs.318,644/-, MP is Rs.3,502,792/- and AE is Rs. 1,241,757/-. For the calendar year 2022, GP is 342,897/-, MP is Rs.3,531,068/-and AE is Rs. 1,287,870/-. For the calendar year 2023, GP is Rs. 347,603/- MP is Rs. 3,566,644/- and AE is Rs. 1,254,774/-.

Total actual expenditure for the years 2020-23, GP is Rs. 1,314,568/-, MP is Rs. 14,075,112/- and AE is 4,989,876/-. Actual expenditure of traditional medicines for calendar year 2020, GP is Rs. 68913/-, MP is Rs. 123,953/-, AE is Rs. 123,953/-. For the calendar year 2021, GP is Rs.70,947/-, MP is Rs. 128,921/-, and AE is Rs.128,921/-. For the calendar year 2022, GP is Rs. 74,244/-, MP is Rs.120,894/-, and AE is Rs. 120,894/-. For the calendar year 2024, GP is Rs. 75,685/-, MP is Rs. 125,111/- and AE is Rs. 125,111/-. Total actual expenditure for the calendar year 2020-23, GP is Rs. 289,789/- and MP as well as AE is Rs. 498,879/-. Total actual expenditure of modern allopathic and traditional medicines for the year 2020 is Rs.1,329,428/-, for 2021 is Rs. 1,370,678/-, for 2022 is Rs. 1,408,764/-, for 2024 is Rs. 1,379,885 and total actual expenditure for 368 diabetic patients is Rs.5,488,755/-.[Table-4 and Figure-4] In the calendar years 2020 to 23, the sample size of diabetic patients is 368, whereas the total patients in Himachal Pradesh are 16924, 17456, 18352, 18759, respectively in the years 2020 to 2023. The average cost of treatment for the patients taken for sample is Rs.1,329,428/-, 1,370,678/-, 1,408,764, 1,379,885 and for population of Himachal Pradesh is Rs. 61,153,688/-, Rs. 6,3051,188, Rs. 64,803,144, Rs. 63,474,710, respectively for 2020 to 2023 calendar years. The total average population covered for sample size is 29858, 30155, 32456, and 35876, respectively whereas for Himachal Pradesh is 3465743, 3787895, 4056742, and 4687156 respectively for the years 2020 to 2023.[Table 5].

Financial Impacts of COVID-19 on Diabetic Patients

The total expected expenditure of modern allopathic medicine for the treatment of 368 patients of diabetic mellitus for the calendar years from 2020 to 2023, total government price is Rs. 1,099,125, total market price Rs. 11,184,358 and the total actual expected price is Rs. 3,089,198 whereas the actual expenditure is increased due to variation or increase in blood sugar level during COVID-19 as the government price is Rs. 1,314,568/-, market price Rs. 14,075,112/-, actual expenditure Rs. 4,989,876/- and for traditional herbal medicines total expected expenditure for 2020 to 2023 calendar years, total government price is Rs. 138,448, total market and actual price is Rs.

326,737/- whereas actual expenditure is increased as government price Rs. 289,789/-, market price and actual expenditure is Rs. 498,879/-. The total expected expenditure of modern as well as traditional herbal medicines is Rs. 3,415,935/- whereas total actual expenditure is increased to Rs 5,488,755/-. This total expenditure in Himachal Pradesh has become Rs. 61,153,688/-, Rs. 63,051,188/-, Rs. 64,803,144/-, Rs. 63,474,710/- for calendar years 2020-23, respectively.

Conclusions

The cost of treatment for 368 patients of diabetic mellitus [sample size] of modern allopathic medicines has increased from the expected expenditure of government price Rs.1,099,125/- to 1,314,568/-, market price from Rs. 11,184,358/- to Rs.14,075,112/- and actual expenditure from Rs.3,089,198/- to Rs.4,989,876/- and for traditional herbal medicines for government price Rs.138,448/- to Rs. 326,737.-, market price and actual price from Rs. 289,789/- to Rs. 498,879/-. The total expenditure of both the systems has increased from Rs. 3,415,935/- to Rs.5,488,755/-

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