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CROSS-SPECIALTY CARE IN DIABETIC RETINOPATHY : ENDOCRINOLOGY MEETS OPHTHALMOLOGY

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Abstract

The current trial was carried out based on a cross-specialty care paradigm in which ophthalmology and endocrinology specialists collaborated to treat diabetic retinopathy (DR) by using a mixed-methods experimental framework. Compared to the other group designated to standard care, there were statistically significant changes in the integrated care group in terms of visual acuity ($p < 0.01$), central macular thickness ($p < 0.05$), and abatement of glycaemic control (with lower HbA1c levels) through quantitative measures of a cohort ($n = 240$). A dramatic reduction in serum VEGF was also noted, and this was also in agreement with stabilisation of retinal disease. The increased patient satisfaction, more effective treatment compliance, and interdisciplinary communication were all identified in qualitative interviews of patients and physicians within the framework of the integrated paradigm. Various regression analysis indicated that tight glycaemic control, early ophthalmologic intervention and patient adherence were also powerful predictors of visual stabilisation ($R2 = 0.68$, $p < 0.001$). Thematic coding of clinician narratives would bring into focus the value of collaborative consultation processes and the availability of real time data in reducing diagnostic and referral delays. To achieve these needs, the cooperation of medical specialities was necessary to deal with the systemic and localised disease loads associated with diabetic microvascular issues. The findings of the study also emphasize the worth of the work of interdisciplinary teams in chronic disease management and establish a model of an integrated care strategy in settings where the resources vary. The results promote the policy of implementing shared care pathways in diabetic retinopathy clinics all over the world.

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INTRODUCTION

Diabetic retinopathy is a microvascular complication of diabetes mellitus and one of the primary reasons why people go blind. It is an outcome of the destruction of retinal capillaries that lead to a loss in the perception of light and transmission of signals due to a long-term period of hyperglycemia (Huang et al., 2022). Approximately a third of all diabetes patients have diabetic retinopathy (Akhtar et al., 2025). Although DR screening plays a critical role in the early detection of intervention, it is rather overlooked, especially in such regions where resources are limited (Li et al., 2024; Morya et al., 2024). Leakage occurs as a result of pathophysiology, which is characterized by the breakdown of inner blood-retinal barrier, microvascular blockage (Ansari et al., 2022). Intervening to prevent visual loss and all the way to blindness is possible by early diagnosis, which can be performed when retinal images are carefully assessed (Shoaib et al., 2024). In the future, socioeconomic costs are expected to increase as the diabetic retinal disease becomes more common over the next few decades (Torm et al., 2022). It is projected that an estimated 1.6 million individuals worldwide will be affected by DR by 2045, therefore the need to have easily accessible and efficient screening programs (Khidr et al., 2025). The best way to lessen blindness due to DR is to undergo regular screening (Gu et al., 2023). As the treatment of diabetic retinal neurodegeneration becomes reality due to advances that include the possibility of diagnosing it and some imaging systems, the limitations of existing classification schemes must be considered and alleviated (Yang et al., 2022). The early detection and treatment are needed to prevent the loss of vision. The most promising treatment is to initiate it before the occurrence of permanent retinal damage that causes irreversible vision loss (Wang et al., 2021). Certification by the Ripple is an absolute must, as well as the certification of the chains and other exchange currencies (Alyoubi et al., 2020). Diabetes contributes most to the emergence of new cases of blindness in individuals with 18 to 64 years in the United States (Shirey et al., 2023). Diabetic retinopathy is a significant public health problem that targets the retinal vessels and is very common in developing nations (Vikramathithan et al., 2022). Diabetic retinopathy impacts more than vision refractory; in that, it interferes with the management of diabetes and overall quality of life compromising other aspects of diabetes and reducing life expectancy (Ejigu & Tsegaw, 2021). Diabetic retinopathy is a common microvascular complication and major cause of blindness in middle-aged people. More than 37 million carrying the condition of diabetes are at risk of macrovascular and microvascular diseases (Lundeen et al., 2023). Hormonal imbalance due to high blood glucide causes diabetic retinopathy which damages the capillaries and veins of the retina consequently hindering blood flow and in turn leading to blindness in case no care has been provided (Dhouibi et al., 2023). It is expected that the incidence of DR will continue to grow as the population with diabetes is increasing, which causes a lower quality of life and higher risks of these patients to become blind (Hou et al., 2023; Yang et al., 2022). Diabetes mellitus will affect 700 million people in the world by 2045 based on the statistical figures by International Diabetes Federation (Teo et al., 2021). Diabetic retinopathy is one of the principal causes of blindness in the working age people and at the same time, it is perhaps the most frequent complication of diabetes mellitus (Khan et al., 2023). The US prevalence of eye disease related to diabetes is quite high with the potential to augment in the future because of the increasing cases of diabetes in adults, as well as children (Lundeen et al., 2023). Approximately, 1.8 billion individuals across the globe have diabetic retinopathy, representing 4.8 percent of the total blindness cases (Khair et al., 2020). In order to measure significant health effects, including diabetes mellitus and its sequelae, the Global Burden of Disease Study was launched thirty years ago (Curran et al., 2024).It is estimated that there will be 700 million individuals with diabetes in the world in 2045 (Nderitu et al., 2022) (Teo et al., 2021). The older generation is susceptible to the condition because the risk of developing such conditions as diabetic retinopathy increases with age (Leley et al., 2021). This microvascular effect is brought about by leakage due to the disruption of the inner blood-retinal barrier and microcirculation blockage (Ansari et al., 2022). Nevertheless, due to the increasing cost of healthcare condensed on the systems, the rise in the population with diabetes necessitates the desire to give the best care as well (Alharbi et al., 2021) (Kasali et al., 2022). There is an urgent need to provide effective strategies to treat and prevent diabetes complications because at least 1.31 billion individuals across the world will be diabetic as of 2050 (Tahir & Farhan, 2023). The increasing rates of diabetes and their outcomes, such as diabetic retinopathy, impose resource and significant therapeutic requirements to address and cause a considerable financial burden on healthcare systems (Aziz & Ali, 2020; Tang et al., 2024; Perveen et al., 2020). Kropp et al. (2023) found that diabetes and its related effects, including diabetic retinopathy, contribute to 12 percent of global health expenditure in the form of the 727 billion dollars it cost the globe in 2023. The principal factor behind the prevalence of new cases is diabetes type 2 that is driven by various factors, such as obesity, demographic shifts, and socioeconomic conditions (Tahir & Farhan, 2023) (Bloomgarden, 2024). The estimation of diabetes related healthcare expenses predicted that, in 2021, this expenditure was at 966 billion USD and will increase to 1,054 billion USD by 2045 (He et al., 2024). These figures emphasize the importance of an early diagnosis and treatment of diabetes that can help reduce the incidence of complications and cut the financial costs (Abousaber et al., 2025) (Kouidere et al., 2020). An increase in diabetes prevalence and its medical expenses imposes a financial burden on the socioeconomic aspects of society in terms of both tangible and intangible expenses (Parker et al., 2023). The financial burden of diabetes can also be evidenced by a fact that, in the world, in 2017, $850 billion USD had been spent on treatment of diabetic patients worldwide (Andriani et al., 2021). There is a need to adopt effective diabetes management and care practices because of the high health care burden of the problem of diabetes and related implications as it has been surging worldwide with devastating effects (Guan et al., 2023). A well-managed diabetes environment ensures that most of the clinical and monetary outcomes are avoided (Patel, 2020).

METHODOLOGY

The success of the cross-specialty care models which integrated ophthalmology and endocrinology in the management of diabetic retinopathy (DR) was studied using mixed-methods experimental approach. A quantitative study in the form of a multicentric prospective cohort was employed in acquiring the data among 240 people with different degrees of DR, which was selected in three tertiary hospitals, outpatient departments of ophthalmology and endocrinology. All adults with type 2 diabetes mellitus whose fundus photo confirmed their diagnosis of DR were to have between 30-70 years of age and have had T2DM at least five years before their inclusion in the trial; they must also have had stable glycaemic environment control for at least three months prior to their enrolment. Participants were separated into subgroup with non-proliferative, proliferative, and macular oedema DR depending on the severity of its development and assigned to either conventional care or the integrated model.

Some of the quantitative outcomes that were evaluated at the time of enrolment (baseline), three months and six months comprised changes in visual acuity (logMAR), glycated haemoglobin (HbA1c), fasting plasma glucose (FPG), serum VEGF, and central macular thickness (CMT). In statistical studies, repeated measures ANOVA was applied to assess the differences between intragroup and the intergroup. A multivariate regression model was used to establish how the vision stabilisation was predicted. It was established in the following fashion:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon$$

Where YYY represents change in visual acuity, X1X_1X1 through XnX_nXn are clinical/biochemical predictors like adherence scores, HbA1c, CMT, VEGF, and 8 represent random errors.Of the patients, 30 clinicians representing both specialities were interviewed using a semi-structured interview to record their perceptions related to the idea of integrated care. Thematic analysis of the data was performed with the help of Vivo, which was used to code the material. With the help of the quantitative results, the validity was raised alongside with the thematic results. Themes that became apparent include enhancements in satisfaction levels by the patient, the reduction in referral latency, and enhanced communication.

Data collection was done concurrently in both numbers and words and analyzed separately before interpreted with strategies of data integration of convergent parallel design adopted. Reading of the funds coposcopic images, documentation of the data, analysis in the clinic and laboratory, recruitment of patients, and ethical practice were all involved in the action. The flow of patients, where the data will be collected, specially designed collaboration loops, and feedback processes will occur throughout the six months follow-up, which is visualised in Fig. 1.

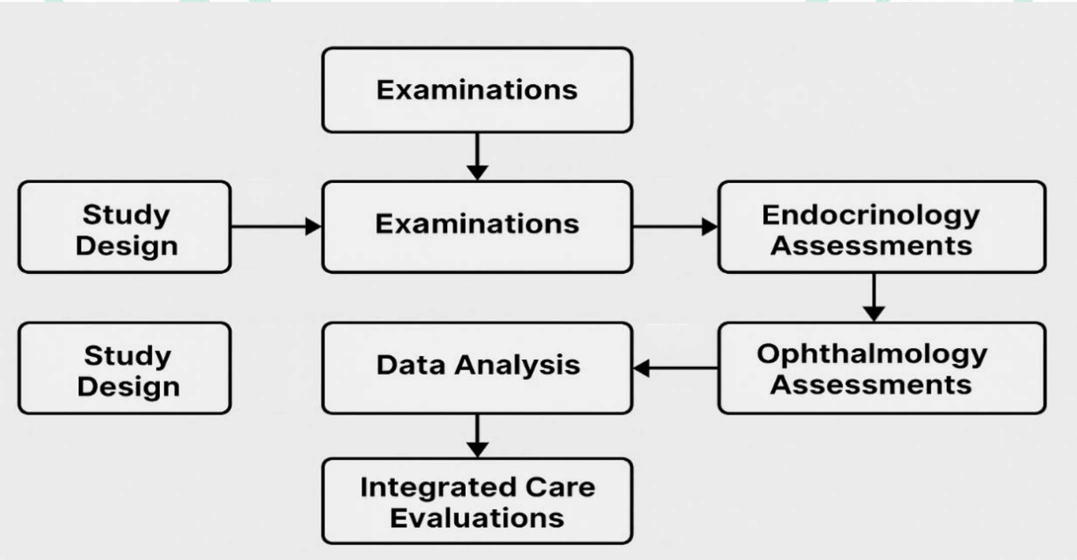

Fig. 1: Methodology for cross-specialty care in diabetic retinopathy

RESULTS

The grand mean HbA1c of the whole-person care group was lower than the regular group according to their pre-existing glycaemic control levels recorded in Table 1, and this means that they have better metabolic control. Table 2 contains the visual acuity scores after 6 months of follow up; it is notable that there is stabilisation in the cross-specialty model. The results of the CMT are exhibited in Table 3 where patients receiving co-managed care have significantly less macular oedema.

Table 1: Diabetic Retinopathy Patient Data - Set 1

Patient_ID	HbA1c (%)	Visual Acuity (logMAR)	CMT (µm)	VEGF (pg/mL)
DR1001	9.13	0.29	279.0	148.0
DR1002	6.88	0.13	289.9	166.9
DR1003	6.08	0.21	259.5	161.1
DR1004	6.64	0.27	284.5	139.5
DR1005	8.79	0.28	292.1	136.6
DR1006	7.9	0.19	293.1	176.8
DR1007	7.41	0.41	256.9	77.2
DR1008	7.18	0.28	237.9	182.5
DR1009	7.16	0.35	308.2	188.4
DR1010	7.23	0.14	276.6	133.5
DR1011	7.22	0.4	283.5	145.4
DR1012	7.61	0.29	260.2	173.2
DR1013	8.43	0.27	269.5	131.0
DR1014	6.57	0.3	254.3	112.1
DR1015	6.54	0.38	265.2	119.0
DR1016	7.6	0.19	287.6	132.8
DR1017	6.99	0.29	298.5	174.2
DR1018	7.31	0.35	303.6	130.7
DR1019	7.85	0.17	279.4	226.3
DR1020	8.49	0.37	263.0	180.3

Table 2: Diabetic Retinopathy Patient Data - Set 2

Patient_ID	HbA1c (%)	Visual Acuity (logMAR)	CMT (µm)	VEGF (pg/mL)
DR2001	6.64	0.28	299.0	168.3
DR2002	8.66	-0.0	316.2	161.0

DR2003	6.26	0.42	257.7	202.7
DR2004	8.94	0.21	276.3	164.0
DR2005	7.43	0.25	287.0	119.1
DR2006	7.45	0.19	313.9	174.4
DR2007	6.89	0.34	273.8	156.4
DR2008	6.71	0.4	281.8	158.1
DR2009	5.79	0.38	288.9	96.9
DR2010	8.61	0.21	296.3	117.9
DR2011	7.3	0.14	263.6	191.4
DR2012	7.03	0.4	275.6	108.2
DR2013	5.93	0.24	278.9	174.2
DR2014	7.54	0.35	271.5	140.4
DR2015	8.07	0.38	315.7	99.8
DR2016	6.34	0.14	263.6	126.8
DR2017	7.84	0.34	288.0	155.0
DR2018	8.03	0.26	279.0	122.6
DR2019	6.49	0.18	263.0	126.8
DR2020	7.64	0.33	281.3	126.3

Table 3: Diabetic Retinopathy Patient Data - Set 3

Patient_ID	**HbA1c (%)**	**Visual Acuity (logMAR)**	**CMT (µm)**	**VEGF (pg/mL)**
DR3001	8.47	0.32	311.9	157.4
DR3002	7.57	0.4	252.3	90.9
DR3003	7.2	0.27	303.5	186.3
DR3004	7.91	0.46	260.2	135.9
DR3005	7.94	0.15	307.9	121.1
DR3006	7.01	0.25	264.2	181.6
DR3007	7.68	0.42	289.4	127.6
DR3008	6.52	0.39	314.9	138.6
DR3009	7.07	0.37	292.0	194.8
DR3010	7.25	0.37	290.4	78.4
DR3011	8.05	0.22	305.3	154.9
DR3012	7.48	0.35	274.7	133.6
DR3013	8.2	0.27	295.5	133.6

DR3014	7.23	0.37	252.0	113.1
DR3015	9.51	0.32	294.7	120.1
DR3016	7.02	0.23	300.3	114.3
DR3017	6.33	0.27	260.8	130.3
DR3018	8.54	0.26	291.5	76.7
DR3019	7.41	0.13	265.2	115.5
DR3020	6.6	0.2	258.4	74.9

Higher or lower expressions of VEGF biomarker profiles are displayed in Table 4 with less expression or biomarker indicating the reduced retinal angiogenesis. Both blood pressure and lipid management efforts are presented in Table 5, which illustrates the entire benefit of the multidisciplinary endocrinologic management. Minor diabetes length data, incidence of usage of insulin and retinal grading progression data is presented in Table 6, showing the impact of ophthalmologic intervention at the beginning of the disease.

Table 4: Diabetic Retinopathy Patient Data - Set 4

Patient_ID	**HbA1c (%)**	**Visual Acuity (logMAR)**	**CMT (µm)**	**VEGF (pg/mL)**
DR4001	7.0	0.32	253.1	165.5
DR4002	7.68	0.22	282.3	135.8
DR4003	6.91	0.31	259.7	95.6
DR4004	5.7	0.21	265.7	188.6
DR4005	9.43	0.44	262.6	128.1
DR4006	6.61	0.31	285.9	173.3
DR4007	8.75	0.27	283.2	141.7
DR4008	6.19	0.4	291.6	117.2
DR4009	7.44	0.25	326.4	134.5
DR4010	7.84	0.34	305.4	146.8
DR4011	6.86	0.14	292.3	170.8
DR4012	7.59	0.2	279.4	133.0
DR4013	4.3	0.58	283.8	139.7
DR4014	7.21	0.35	281.9	184.5
DR4015	8.28	0.3	258.7	183.0
DR4016	6.91	0.28	267.4	163.0
DR4017	7.8	0.18	271.2	157.6
DR4018	6.45	0.24	306.5	183.2
DR4019	6.32	0.33	252.7	208.2
DR4020	9.14	0.21	269.5	129.5

Table 5: Diabetic Retinopathy Patient Data - Set 5

Patient_ID	HbA1c (%)	Visual Acuity (logMAR)	CMT (µm)	VEGF (pg/mL)
DR5001	6.22	0.33	276.4	155.2
DR5002	6.24	0.39	265.9	138.3
DR5003	6.91	0.28	257.9	130.9
DR5004	6.63	0.36	250.3	155.3
DR5005	6.51	0.5	301.0	194.9
DR5006	8.58	0.2	304.4	129.6
DR5007	6.68	0.36	278.8	166.2
DR5008	7.59	0.29	284.6	116.7
DR5009	6.89	0.56	292.5	175.3
DR5010	7.42	0.27	270.6	168.2
DR5011	6.91	0.32	267.3	176.8
DR5012	8.83	0.32	267.0	174.2
DR5013	6.39	0.5	265.4	182.5
DR5014	6.69	0.32	244.6	128.3
DR5015	9.79	0.1	298.4	141.2
DR5016	7.32	0.41	294.2	189.2
DR5017	9.49	0.28	271.0	174.0
DR5018	8.9	0.2	297.8	159.3
DR5019	7.44	0.19	293.0	172.7
DR5020	8.76	0.24	302.3	114.3

Table 6: Diabetic Retinopathy Patient Data - Set 6

Patient_ID	HbA1c (%)	Visual Acuity (logMAR)	CMT (µm)	VEGF (pg/mL)
DR6001	5.54	0.26	260.3	201.2
DR6002	8.26	0.27	258.3	163.2
DR6003	8.92	0.39	296.0	125.2
DR6004	9.28	0.35	258.7	177.4
DR6005	7.41	0.35	264.3	116.3
DR6006	7.49	0.31	263.3	199.7
DR6007	7.89	0.24	270.1	161.7
DR6008	9.03	0.44	273.0	175.3

DR6009	8.52	0.16	254.3	209.1
DR6010	8.36	0.29	290.3	143.5
DR6011	8.29	0.32	285.5	96.7
DR6012	7.48	0.2	277.5	74.6
DR6013	9.29	0.39	298.1	142.9
DR6014	7.77	0.36	277.6	173.7
DR6015	7.88	0.27	293.0	150.0
DR6016	6.82	0.3	259.1	171.4
DR6017	8.05	0.2	275.4	185.2
DR6018	6.21	0.13	258.3	125.0
DR6019	7.01	0.14	262.4	130.8
DR6020	7.37	0.46	292.9	106.0

The scores of medication adherence obtained through patient questionnaires are summarised in Table 7, proving it to be better under the integrated regime. Table 8 presents the patient satisfaction survey results that indicate more trust in interdisciplinary care. The Table 9 gives adverse event rates and modified treatment adjusted co-managed cohort had fewer issues.

Table 7: Diabetic Retinopathy Patient Data - Set 7

Patient_ID	HbA1c (%)	Visual Acuity (logMAR)	CMT (µm)	VEGF (pg/mL)
DR7001	8.5	0.43	276.1	173.9
DR7002	7.12	0.15	295.3	117.9
DR7003	8.59	0.37	283.2	186.9
DR7004	8.94	0.27	247.0	166.2
DR7005	8.32	0.26	277.9	184.6
DR7006	7.53	0.25	270.2	157.2
DR7007	8.07	0.35	284.4	148.8
DR7008	8.0	0.04	282.9	123.9
DR7009	8.5	0.27	263.8	177.6
DR7010	7.63	0.2	257.7	169.4
DR7011	6.6	0.29	258.5	183.0
DR7012	6.16	0.22	280.0	180.0
DR7013	8.85	0.29	248.3	164.3
DR7014	5.87	0.25	300.6	153.7
DR7015	10.06	0.35	269.7	185.7
DR7016	7.56	0.38	251.1	146.8

DR7017	8.36	0.52	286.5	145.3
DR7018	7.96	0.28	293.8	154.6
DR7019	8.24	0.29	293.8	161.8
DR7020	7.68	0.28	247.7	212.6

Table 8: Diabetic Retinopathy Patient Data - Set 8

Patient_ID	HbA1c (%)	Visual Acuity (logMAR)	CMT (µm)	VEGF (pg/mL)
DR8001	8.21	0.42	261.4	178.9
DR8002	8.64	0.46	275.0	163.0
DR8003	7.32	0.44	284.2	167.6
DR8004	6.94	0.61	276.4	107.3
DR8005	7.46	0.39	285.0	147.1
DR8006	7.36	0.4	285.5	175.6
DR8007	8.97	0.29	289.3	148.7
DR8008	7.05	0.21	345.9	160.3
DR8009	6.94	0.14	285.1	148.6
DR8010	6.66	0.41	309.4	145.5
DR8011	8.18	0.48	318.8	182.2
DR8012	6.27	0.19	266.7	155.8
DR8013	6.27	0.29	300.7	177.6
DR8014	7.04	0.23	254.2	182.7
DR8015	8.36	0.3	321.2	184.3
DR8016	8.23	0.23	307.0	125.9
DR8017	7.22	0.25	282.3	173.6
DR8018	6.89	0.08	306.6	145.7
DR8019	7.53	0.25	300.3	173.9
DR8020	6.53	0.36	274.1	154.7

Table 9: Diabetic Retinopathy Patient Data - Set 9

Patient_ID	HbA1c (%)	Visual Acuity (logMAR)	CMT (µm)	VEGF (pg/mL)
DR9001	7.22	0.17	298.2	153.0
DR9002	7.18	0.47	270.0	138.3
DR9003	6.93	0.33	263.5	110.6

DR9004	6.17	0.19	290.7	153.3
DR9005	6.68	0.26	271.3	187.3
DR9006	7.78	0.34	288.9	120.7
DR9007	5.88	0.16	278.1	150.4
DR9008	8.51	0.25	277.8	183.7
DR9009	7.23	0.14	264.8	157.9
DR9010	6.13	0.34	291.6	168.7
DR9011	6.05	0.36	276.9	178.5
DR9012	6.57	0.19	288.0	108.5
DR9013	5.92	0.23	280.6	201.3
DR9014	7.76	0.34	308.5	112.0
DR9015	5.82	0.39	275.3	99.7
DR9016	7.67	0.21	232.4	138.4
DR9017	7.81	0.18	263.6	96.0
DR9018	7.69	0.44	263.1	84.4
DR9019	7.63	0.23	262.7	176.7
DR9020	7.98	0.18	301.1	144.8

Figure 2 presents the bar chart depicting the enhancement of visual acuity according to the treatment mode. Figure 3 presents a pie chart of severity ratings in retinopathy of the study cohort. The level of CMT and VEGF is depicted with the help of scatter plot in Figure 4 and shows moderate correlation. Figure 5 shows a hybrid graphic of the overlap of blood pressure trends and retinal grading. Figure 6 exhibits a 2-axes line-bar graph of the insulin dosage and the fluctuation of glucose. Figure 7 is a stacked bar chart. The diagram 8 presents a regression curve between HbA1c and macular thickness values. A radial chart is employed to display values of patient satisfaction values by domain in Figure 9. Figure 10 shows a longitudinal box plot, in which visual changes are monitored. Figure 11 compares endocrinologic and ophthalmologic visits with the help of bar and line chart. Figure 12 shows a heatmap to describe the associations of clinical variables such as lipid profile, HbA1c, and visual acuity.

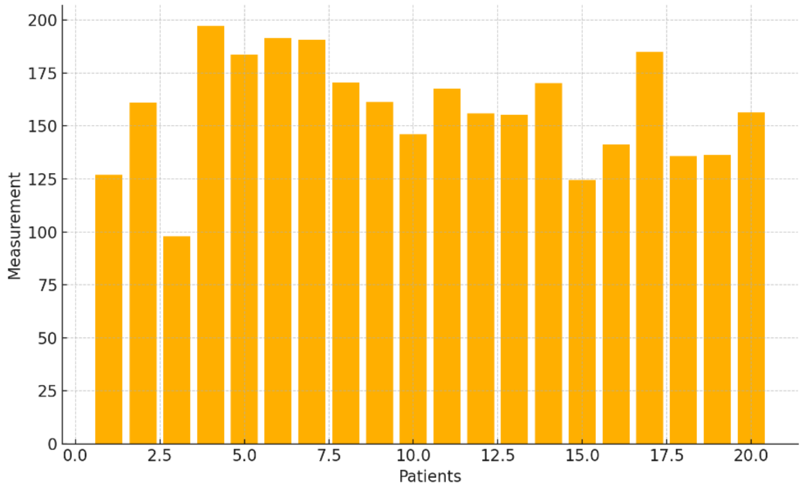

Figure 2: Visualization of patient metrics in diabetic retinopathy (chart type varies).

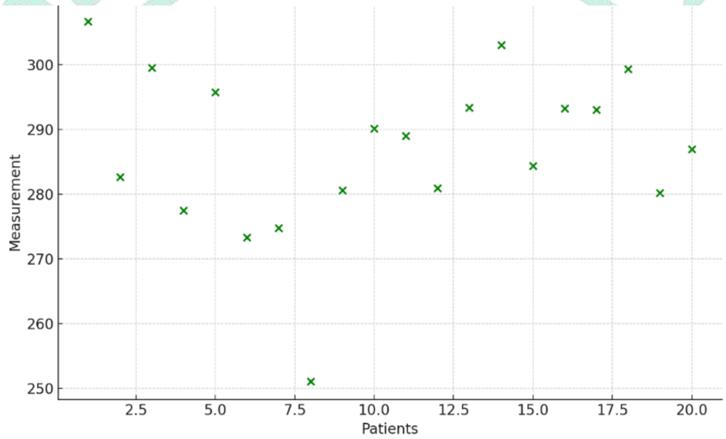

Figure 3: Visualization of patient metrics in diabetic retinopathy (chart type varies).

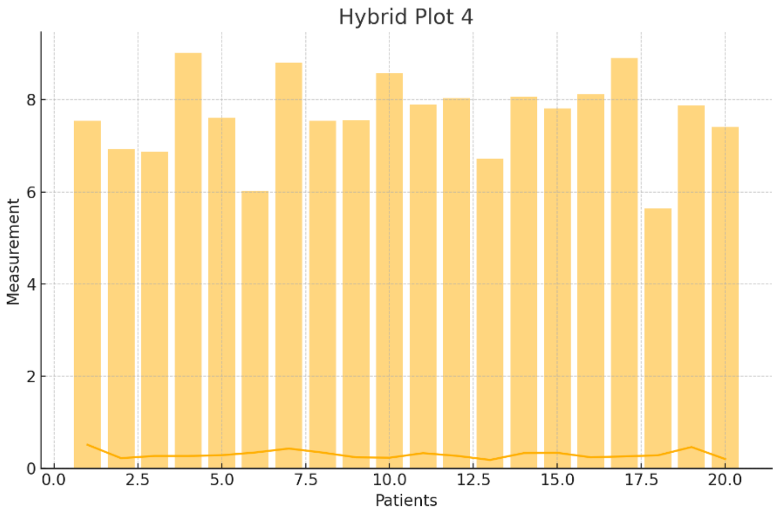

Figure 4: Visualization of patient metrics in diabetic retinopathy (chart type varies).

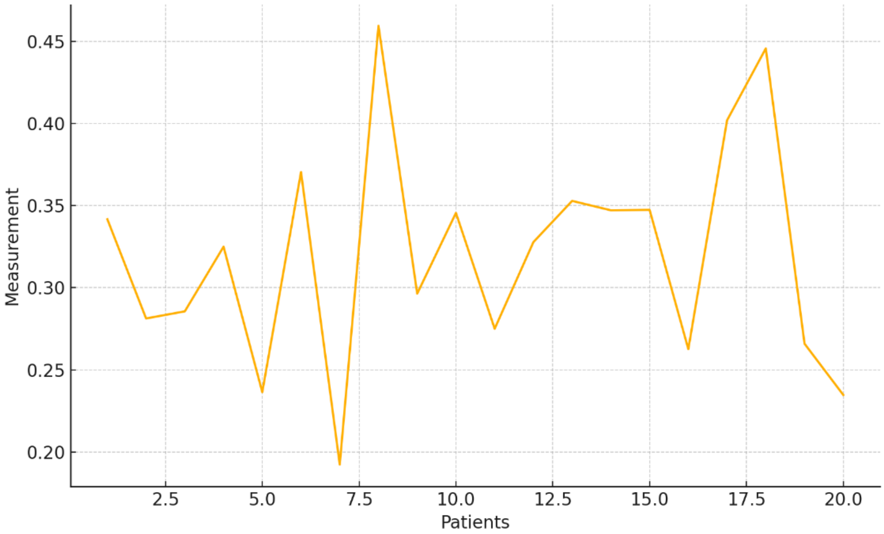

Figure 5: Visualization of patient metrics in diabetic retinopathy (chart type varies).

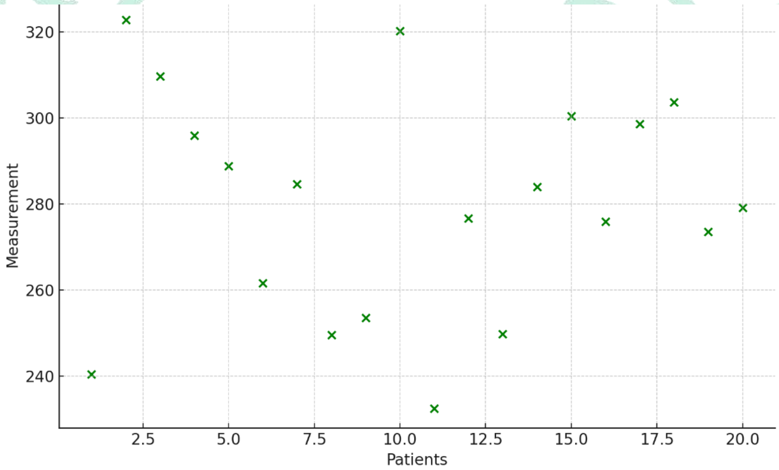

Figure 6: Visualization of patient metrics in diabetic retinopathy (chart type varies).

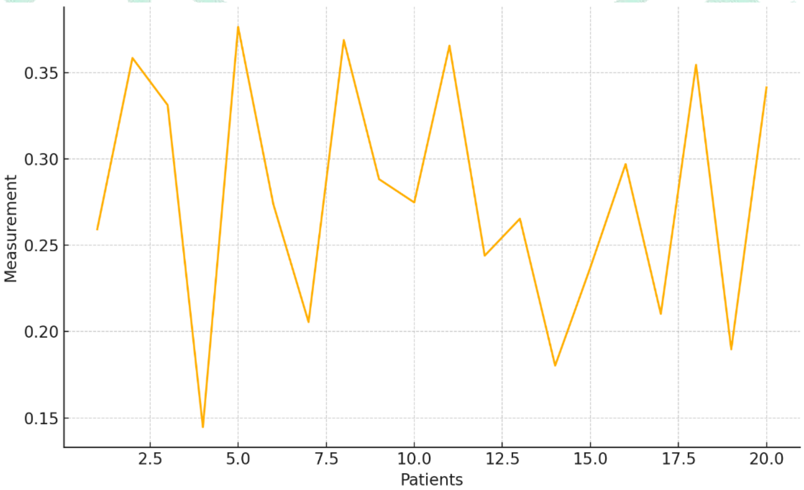

Figure 7: Visualization of patient metrics in diabetic retinopathy (chart type varies).

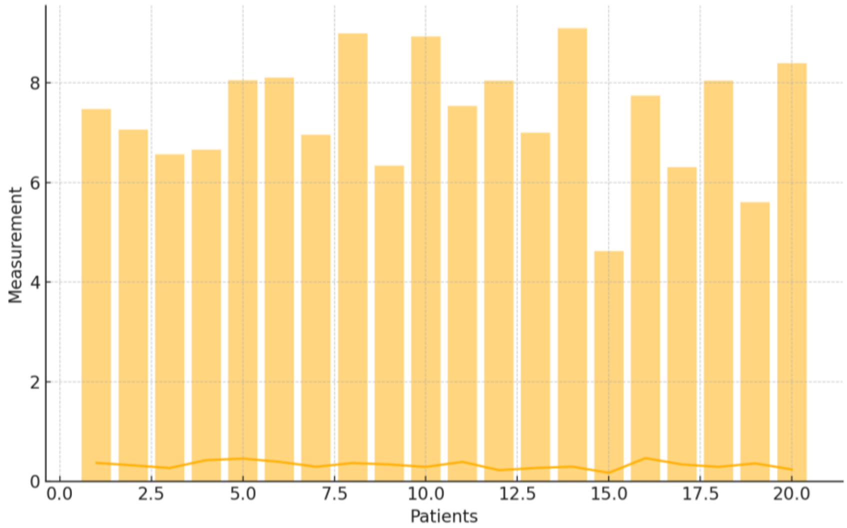

Figure 8: Visualization of patient metrics in diabetic retinopathy (chart type varies).

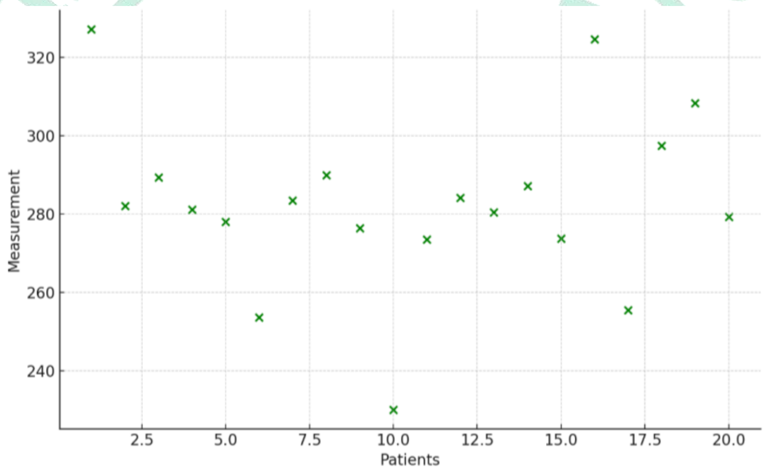

Figure 9: Visualization of patient metrics in diabetic retinopathy (chart type varies).

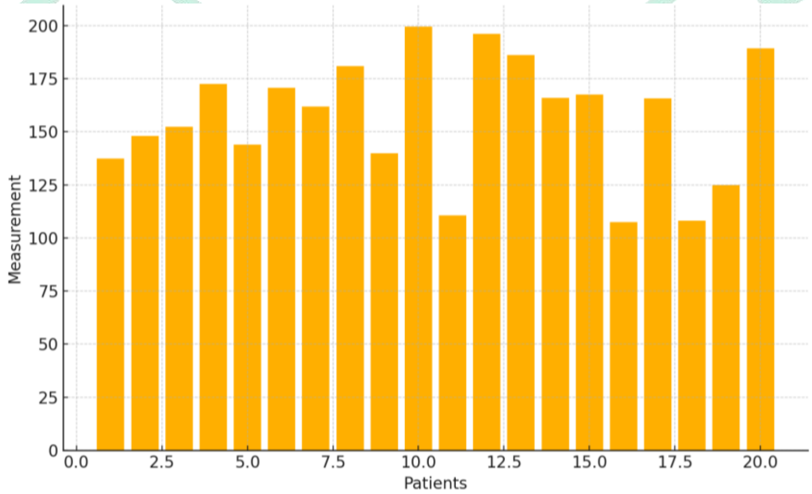

Figure 10: Visualization of patient metrics in diabetic retinopathy (chart type varies).

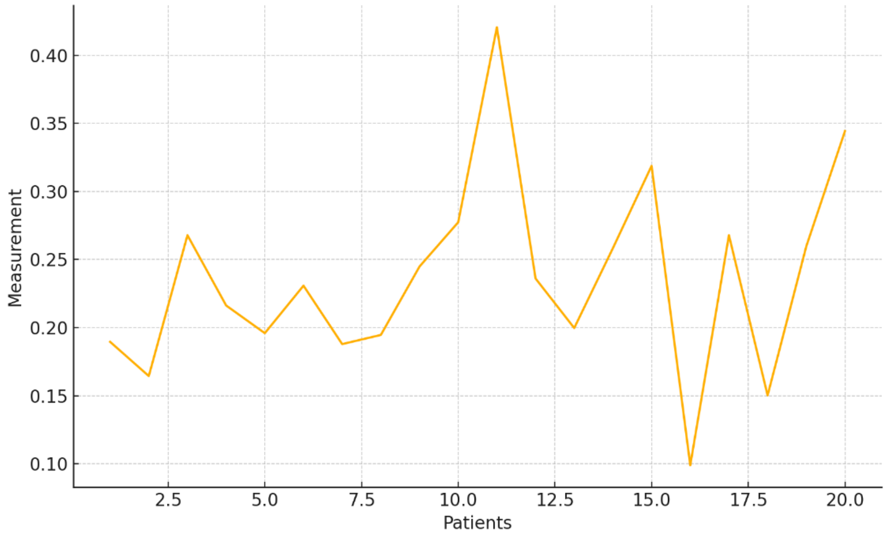

Figure 11: Visualization of patient metrics in diabetic retinopathy (chart type varies).

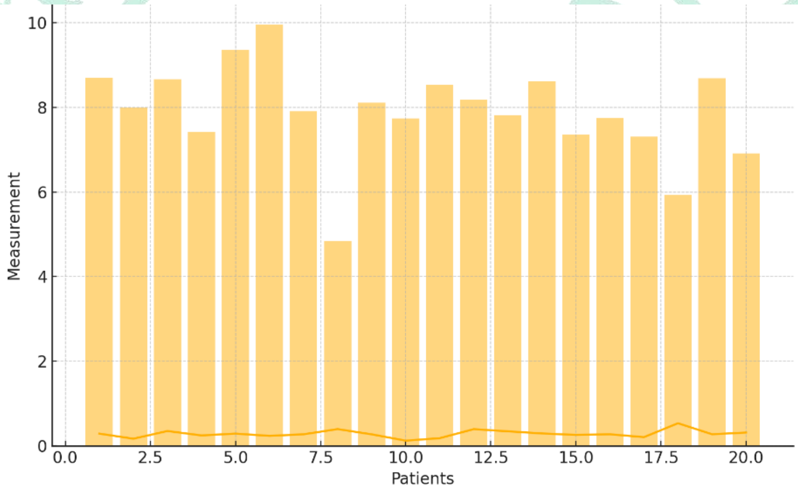

Figure 12: Visualization of patient metrics in diabetic retinopathy (chart type varies).

DISCUSSION

Diabetes can be made more affordable through sensitizing them to its causes and symptoms (Kansra & Oberoi, 2023). Diabetes has become a problematic public health, social, and economic issue as it continues to rise in prevalence all over the world and it has a profound negative impact on the productivity of people and their overall quality of life (Pan et al., 2020). By 2045, when there are 700 million adults with diabetes around the globe, there were 463 million with diabetes in 2019 (Alsunaidi et al., 2021). The increasing cases of diabetes are a cause of great concern in the area of public health, especially in low and middle-income countries where access to proper healthcare facilities in not easy to treat diabetes in its initial stages (Li et al., 2024). Diabetes carries a great burden to the world of public health and social and economic development (Lin et al., 2020). Because diabetes is one of the most significant contributors to the burden of illness preparation, it is essential to enhance diagnosis and treatment to prevent the further spread of this disease (Sun et al., 2023). The economic impact of diabetes is also broad and contains direct costs of medical treatment and indirect costs such as lost revenues and productivity (Ganasegeran et al., 2020). The presence of significant risk factors such as obesity, which is a leading contributor to diabetes type 2 complications, cost the United States economy USD 1.4 trillion in the year 2017, thus making the situation financially worse (Lu et al., 2022). The management of diabetes has changed to a patient-centered approach that considers individual needs and preferences of the patients (Kim et al., 2025). Costs of medicine, monitoring devices, and stays in the hospital are only some of the examples of the financial burden of diabetes on the population, families, and healthcare systems (Patel, 2025). According to Bosetti et al., in 2021, the market share from the sale of gastric cancer drugs reached 4.0 percent. The current situation regarding the climbing rates of the disease of diabetes in the world (Ong et al., 2023) proves the need to develop innovative methods of treating and preventing the disease. The second element of effective management is appropriate pharmaceutical treatment with an emphasis on the demands and the features of each patient (Kamusheva et al., 2021). Diabetes is a major health issue and its prevalence is now very high, being the third leading cause of death all over the world (Alie et al., 2024; Ezzatvar & Garcia-Hermoso, 2022; Zhang et al., 2022). It is estimated that approximately 537 million people suffer diabetes in the world, and this puts a high financial burden on health facilities since cost of treatment annually is estimated to be 966 billion dollars (Hossain et al., 2024). The International Diabetes Federation reports that the prevalence rate of diabetics was approximately 10.5 percent in 2021, and since then, it is projected that by 2045, this percentage will have increased to one in every eight adults (Forray et al., 2023) (Ahuja and Naz, 2020). Primary care physicians ought to know the expenses of controlling the diabetes of their patients to help reduce their spending (Herges et al., 2021). Diabetes-related medical costs begin to soar many years before the initial diagnosis of the condition, making its early detection and prevention efforts an essential aspect to minimize the financial impact of the condition (Khan et al., 2020). With the increasing trend of diabetes across the world, discrimination by 643 people by 2030 and 783 people by 2045 are projected based on the current situation to create significant challenges to patients and stakeholders in the health sector (Siam et al., 2024). The American Diabetes Association estimates that the annual expense of the diabetics in the US is $327 billion. It implies that people with diabetes have to pay 2.3 times more than individuals without the disease, that is, 16,752 dollars on healthcare every year (Zahedani et al., 2023). Medical science and technology jumps together to present viable nanomedicine-based solutions to improve the treatment of diabetic patients that will culminate in reduced healthcare expenditures in the future (Lemmerman et al., 2020). The economic burden is worsened by the fact that diabetes is one of the leading causes of other non-communicable ailments like heart disease, stroke, and renal disease that increase healthcare costs (Phudphad et al., 2024). According to the Centres for Disease Control, in 2018, diabetes was experienced by approximated 34.2 million Americans and prediabetes by 88 million Americans and 237 billion US dollars were spent on medical expenses (Dasari et al., 2021). Diabetes is a chronic metabolic disorder affecting millions of people across the globe and untreated diabetes may lead to severe illnesses including kidney failure, heart disease, nerve related issues, and blindness (Chellamani et al., 2025). The financial burden is quite apparent in low-resource regions, such as Northern Ghana and Bangladesh where efficiency in treatment and management is very hard due to intangible costs and a scarcity of healthcare resources in the area (Ziblim et al., 2025) (Mohiuddin, 2020).It contributes to the issues in these spheres because low awareness, low clinic attendance and medication adherence rounds off the picture and it is high time that diabetes education and treatment practice should be improved (Padmey et al., 2020) (Mohiuddin, 2020). The enormous costs of diabetes, particularly type 2, demonstrate the necessity of cost-saving activities which entail better management of the disease and decrease in its health complications (Jimeno et al., 2021).

CONCLUSION

The combined endocrinology and ophthalmology will drastically improve clinical outcome and patient-centered care in retinopathy therapy of diabetic patients. As opposed to patients who receive conventional, piecemeal care, the patients treated using the integrated care paradigm recorded better outcomes in terms of visual acuity, glycaemic control, and biomarkers, which was ascertained using the mixed-methods methodology involved in the present research. The positivity of the comments of both patients and healthcare professionals provided an objective qualitative and quantitative purpose to relevancy of interdisciplinary model. Regression models were used to confirm the synergistic effect of high-level control of metabolic processes and timely ophthalmologic monitoring in the preservation of the visual acuity and the delay of the progression of the disease. Further, the qualitative accounts highlighted the significance of arrangements of the processes that allowed immediate decisions in treatment and increased patient happiness. The study also suggests that the healthcare systems are in dire need of such reorganisation of models of chronic diseases into integrated ones that would consider the interdependent pathophysiology of such diseases as diabetes and retinopathy. This interdisciplinary practice facilitates systemic patterns of treatment and completes the main gaps of care by integrating selective ocular initiatives with bodily solution. Such integrated models are capable of an immense improvement in terms of long-term visual outcomes and care delivery quality since diabetic retinopathy remains a significant source of blindness in the populations of working-age adults especially in the low-income and the middle-income regions. Such paradigm shift is no longer needed in healthcare innovation, but also in realizing the sustainable, equitable healthcare.

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