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Clinical Supervision by Ophthalmologists on the Severity of Diabetic Retinopathy in Kapuas District

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Abstract

Diabetic retinopathy (DR) is a microvascular complication of diabetes mellitus (DM) and a leading cause of blindness among productive-age adults. Globally, the prevalence of DR reaches 34.6%, while in Indonesia it is 43.1%, making it the second most common diabetes complication after nephropathy. In Kapuas District, the 2022 data reported 5,390 DM patients and 56 DR cases, with a growing trend each year, particularly in areas with limited health services. This study, conducted in 2025, aimed to analyze the effect of clinical supervision by ophthalmologists on DR severity in relation to treatment duration, age, and healthcare access distance. A quasi-experimental design with a pre-test and post-test approach was applied to 52 non-proliferative DR patients divided into intervention (clinical supervision) and control groups. Results showed that clinical supervision effectively maintained mild DR conditions (p=1.000), while the non-supervised group exhibited increased severity (p=0.025). Longer treatment duration correlated with stable DR (p=0.000), age influenced severe DR (p=0.033), and healthcare distance affected moderate DR (p=0.045). Clinical supervision by ophthalmologists effectively slows DR progression, particularly among productive-age patients and those with limited access to eye care services

Introduction

Diabetes mellitus (DM) is one of the most prevalent chronic degenerative diseases, with its prevalence continuing to rise globally and nationally. According to the International Diabetes Federation (IDF) in 2021, the number of people with diabetes worldwide reached 537 million and is projected to continue increasing to 643 million by 2030 and 783 million by 2045. Indonesia ranks fifth globally with an estimated 19.5 million people living with DM in 2021, and this number has shown a significant upward trend each year (Miutescu *et al.,* 2023). Type 2 diabetes is the dominant form of diabetes in Indonesia, triggered by a complex interaction between genetic factors, environment, lifestyle, changes in consumption patterns, and urbanization (Ting *et al.*, 2016). Long-term complications of diabetes, both macrovascular and microvascular, have a significant impact on the quality of life of patients and the overall healthcare system. One of the most dangerous manifestations of microangiopathy is diabetic retinopathy (DR). DR is a pathological change in the blood vessels of the retina caused by chronic hyperglycemia, leading to retinal ischemia, vitreous hemorrhage, and neovascularization, which can result in irreversible blindness. Global data indicate that approximately one in three people with diabetes develop DR, and one in ten are at risk of developing its severe form, proliferative diabetic retinopathy (PDR) (Ting *et al.*, 2016).

In Indonesia, limited active screening and low health literacy result in many patients being diagnosed with DR at an advanced stage, when

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most retinal damage is irreversible. Studies in rural, remote areas such as Kapuas District, Central Kalimantan, highlight disparities in access to ophthalmological specialization, with a ratio of ophthalmologists of less than one per 250,000 people. Geographical challenges, vast areas, isolation, high DM prevalence due to lifestyle changes, low socioeconomic status, and limited access to advanced healthcare facilities are the primary drivers of the increasing incidence of severe DR diagnosed at a late stage (Dinas Kesehatan, 2022). The mechanism of DR is closely associated with metabolic dysfunction in chronic diabetes, particularly glucotoxicity, oxidative stress, and chronic inflammation, which lead to damage of the retinal microvasculature (Stratton *et al*., 2001). Repeated and uncontrolled exposure to hyperglycemia causes abnormal proliferation of endothelial cells, capillary leakage, and ultimately the formation of fragile neovascular membranes prone to rupture. The rapid progression from mild to severe stages is significantly influenced by classic risk factors: duration of DM, poor glycemic control (high HbA1c), hypertension, dyslipidemia, as well as socioeconomic and behavioral factors (Moss *et al.*, 1986). In rural areas like Kapuas, many patients seek healthcare when there is already a sharp decline in visual function, months or even years after the initial symptoms of DR begin to develop.

With the evolution of modern healthcare paradigms, the role of ophthalmologists in the tiered referral system has become increasingly vital, not only as providers of therapy but also as facilitators of screening, educators, promoters of disease control, and members of multidisciplinary teams in the management of DM complications (Ryan, 2014). The World Health Organization (WHO) and the Indonesian Ophthalmologist Association (PERSAMI) strongly emphasize the importance of direct clinical supervision by specialists for high-risk groups, as well as strengthening referral networks between primary, secondary (community health centers, district hospitals), and regional referral services. Optimizing monitoring of DR progression requires a holistic approach: early identification of mild stages, measurable progression evaluation, and structured interventions, both medical (laser, anti-VEGF, vitrectomy) and non-medical (education, counseling, behavioral motivation) (Sun *et al*., 2019). Furthermore, recent studies highlight that the progression of DR severity is not determined solely by "clinical factors." Socioeconomic factors, psychosocial factors, health literacy levels, geographical distance, and social support networks have been proven to play a crucial role in the success of management and long-term outcomes (Pomey *et al*., 2015). Studies based on health behavior change modification models such as the Integrated Theory of Health Behavior Change (Ryan, 2014) and the Biobehavioral Model (Brown *et al*., 2004). Demonstrate that the interaction between patient personality, intensive education, regular clinical monitoring, and family/community support can enhance motivation, medication adherence, and discipline in disease control, thereby slowing DR progression even in vulnerable populations in remote areas.

However, in Kapuas District, the implementation of specialized eye care programs has not been optimal. Limitations in the number of specialists, the significant distance between sub-districts, and the prioritization of primary care services at health centers towards acute issues rather than screening for chronic complications have led to patients with diabetes often missing the opportunity for early detection of DR. Meanwhile, patients' knowledge about the importance of eye screening varies significantly, influenced by education and access to information. This study employs a quasi-experimental approach by comparing clinical outcomes and socio-economic characteristics of diabetes patients who received direct clinical support from ophthalmologists with those who did not receive similar services in Kapuas District. The study aims to provide scientific and practical contributions to evidence-based policy for diabetes complication management at both the regional and national levels.

Method

This quasi-experimental quantitative study with a pre-test–post-test design was conducted from March to July 2024 at several community health centers (Puskesmas) and the

referral hospital (RSUD) in Kapuas District, Central Kalimantan. The intervention group received clinical support from ophthalmologists through regular consultations, education, and DR monitoring, while the control group received standard care. Data collection was through interviews, electronic medical records, and clinical examinations, including variables such as age, gender, distance to health facilities, diabetes duration, and DR severity based on Indonesian Ophthalmologist Association (PERDAMI) standards. The study involved 52 type 2 diabetes patients with varying stages of DR, selected proportionally from different villages. Inclusion criteria were patients aged > 18 years, diagnosed with mild, moderate, or severe DR, living in Kapuas, and willing to participate. Exclusion criteria included severe mental disorders, systemic complications, or refusal to follow up. Clinical mentoring followed a validated Standard Operating Procedure (SOP) for ophthalmologist support, covering education, early detection, regular eye exams, multidisciplinary care, and treatment adherence. Evaluations were conducted monthly for the intervention group and twice for controls group over six months. Data were analyzed using SPSS 26 with normality and homogeneity tests. Then by Paired t-test, Wilcoxon, Mann-Whitney, and McNemar tests ($p < 0.05$). Ethical approval was obtained from the Health Research Ethics Committee, Faculty of Medicine and Health Sciences, Lambung Mangkurat University (No. 088/KEPK-FKIK ULM/EC/VII/2024).

Results and Discussion

Before analyzing the statistical associations between variables, it is crucial to describe the baseline characteristics of patients included in this study. Patient characteristics were presented based on the severity level of diabetic retinopathy (DR) and differentiated by the presence or absence of specialist clinical support. These characteristics provide an overview of the demographic and clinical profiles that may influence the progression of DR and the effectiveness of support interventions. The detailed distribution is shown in Table 1.

Table 1. Patient Characteristics

Variables	DR Severity Level Mild		Moderate DR Severity Level		Severe DR Severity Level	
	Support	Non-Support	Support	Non-Support	Support	Non-Support
Age (years)	61.2 ± 8.1	60.3 ± 10.4	64.2 ± 10.0	63.5 ± 9.1	55.1 ± 5.5	65.8 ± 13.1
Distance to healthcare facility (km)	11.8 ± 8.3	11.6 ± 12.8	89.1 ± 51.7	6.1 ± 0.8	24.6 ± 14.8	10.3 ± 10.2
Treatment Duration (months)	52.3 ± 44.9	35.6 ± 33.6	49.0 ± 42.1	49.4 ± 41.6	48.3 ± 44.2	72.4 ± 45.5
Age (years)	0.788	-	0.877	-	0.033*	-
Distance to Health Facility (km)	0.965	-	0.045*	-	0.395	-
Treatment Duration (months)	0.000*	-	0.990	-	0.209	-

Source: Primary Data, 2025

Note: *$p < 0.05$ significant; DR: diabetic retinopathy

Table 1 shows the baseline characteristics of diabetic patients with diabetic retinopathy (DR) by severity levels and treatment groups. In patients with mild DR, the group receiving clinical counseling had a longer average duration of diabetes (52.3 months) compared to the non-counseling group (35.6 months), with a statistically significant difference (p = 0.000). It indicates that despite longer duration of diabetes, the severity of DR can remain controlled with specialist counseling. Previous studies have consistently shown that the duration of diabetes and poor glycemic control are strong predictors of DR development and progression. The 10-year *Beijing Eye Study* confirmed that longer diabetes duration and higher HbA1c level were significantly associated with an increased risk of DR (Xu *et al*., 2014). At moderate severity, a significant difference in the distance between patients' residences and healthcare facilities. The support group came from farther locations (average 89.1 km) compared to the non-support group (6.1 km), with p = 0.045. It suggests that support interventions enable patients from remote areas to receive monitoring and early detection of complications.

For severe DR, the support group tended to be younger (mean 55.1 years) compared to the non-support group (65.8 years), and this difference was significant (p = 0.033). This phenomenon underscores the importance of intensive intervention, especially for the productive age group, to prevent the progression of complications at an early stage. Younger age at diabetes onset has been identified as an independent risk factor for more severe DR. A recent study demonstrated that individuals diagnosed before age 40 had a fivefold higher risk of developing DR compared to those diagnosed after 60, regardless of disease duration (Chen *et al*., 2023). Another study confirmed that patients with early-onset diabetes and HbA1c ≥ 7% experienced faster progression of DR (Yuan *et al*., 2021). This reinforces the need for early, intensive counseling and specialist monitoring for younger, working-age diabetic patients who are at higher risk of rapid disease progression. From the distribution of DM treatment duration in moderate and severe severity, no significant differences were found between the support group and the non-support group. Overall, these results support the hypothesis that clinical support by eye specialists provides a primary protective effect, particularly in patients with a long history of DM, limited geographical access, and in younger age groups at higher risk of faster progression. A study in Central Java, Indonesia, identified diabetes duration, poor diet, and high HbA1c as significant determinants of DR among Indonesian patients (Casmuti *et al*., 2025). A descriptive analysis from RSUP Dr. Kariadi also showed that most DR patients with long-standing diabetes (>5 years) had poor glycemic control and presented with advanced disease stages (Casmuti *et al*., 2024). Although local studies have not yet specifically addressed DR-focused counseling, these results provide a strong theoretical foundation, that patient education and specialist support are effective in mitigating microvascular complications.

Table 2. Progression of Diabetic Retinopathy Severity in the Supported and Non-Supported Groups

Groups	**n**	**Progression to a Higher Stage**	**Stable**	**p value**
Support	26	0	26	1,000
Non-support	23	5	18	0.025

Source: Primary Data, 2025

Note: *p < 0.05 significant; DR: diabetic retinopathy

Based on Table 2, the impact of specialized ophthalmological clinical supervision on changes in the severity of diabetic retinopathy is evident. Group of patients who received supervision, all individuals (100%) showed stable severity of DR, with none experiencing a decrease. Conversely, in the non-supervised group, 5 patients (21.7%) experienced an increase in severity during the follow-up period, while the remainder remained stable. The McNemar statistical test revealed a significant result ($p = 0.025$) in the non-supervised group, indicating a real risk of progression without specialist intervention. These results confirm the effectiveness of clinical monitoring. Particularly, routine monitoring, education, and coordinated management by ophthalmologists slow the progression of DR even in high-risk populations. This model offers greater benefits, especially for patients in areas with limited access or younger age who are more prone to progression. Recent studies in DR screening and telemedicine show that integrating point-of-care screening and teleophthalmology improves screening adherence and early detection, which may mirror the protective effect of specialist supervision in preventing DR worsening (Salavatian *et al*., 2024).

This study comprehensively demonstrates that routine clinical follow-up by ophthalmologists can halt or even reverse the progression of DR severity in diabetic patients in Kapuas District. These findings are highly relevant, as in rural areas, the active role of specialists is often perceived as limited to therapy and interventions in cases of severe complications, whereas structured and continuous clinical monitoring demonstrates a highly significant protective impact on clinical outcomes and visual quality of patients. In the mild DR group, periodic clinical monitoring was proven effective in slowing progression, even in patients with long-standing diabetes. The fact that most patients under supervision had longer DM duration but stable severity reinforces the importance of early detection by specialists, regular fundus monitoring, personalized education on blood sugar control, blood pressure management, treatment adherence, and lifestyle modifications (Stratton, 2001). This success is further reinforced by active surveillance by specialists who can identify subclinical changes in the retina before visual symptoms appear (Vengadesan *et al.*, 2017). The study in Aceh, Indonesia, reports that many patients already present with vision-threatening diabetic retinopathy and proliferative DR, and knowledge about DR among patients is low. It suggests that late detection and lack of awareness contribute to worse outcomes, and underscores the importance of specialist supervision and frequent monitoring (Zaini *et al*., 2024).

In the moderate stage group, the study found that most patients were from remote rural areas far from hospital facilities. Such conditions often serve as risk factors for faster DR progression due to delayed access to care. However, proactive interventions such as specialist visits, telemedicine, and collaborative monitoring with community health centers successfully reduced the progression of severity in a meaningful way. This aligns with a study by Wu (2013), which noted that clinical outreach strategies and the integration of primary and secondary care services can overcome "geographical" barriers while building patient trust and awareness of the importance of routine screening (Wu, 2013). Community-based research in Greater Bandung, Indonesia, supports this finding — patients with longer diabetes duration, poor glycemic control, and elevated systolic blood pressure are more likely to have moderate-to-severe DR, highlighting the value of early and specialist-guided screening interventions (Halim *et al*., 2022). Moreover, digital and AI-based screening programs have been shown to enhance early detection rates and access to care in underserved populations, aligning with this study's emphasis on teleophthalmology and outreach strategies (Vujosevic *et al*., 2022).

Among severe DR patients, those receiving clinical support tended to be younger (of working age), and no new progression of severity was observed during the intervention period. It is noteworthy because in younger patients, DR progression is typically more aggressive due to prolonged exposure to hyperglycemia and high levels of "denial" behavior (Gross *et al*., 2005). Support from an eye specialist intensifies education

and strengthens control habits, improving individual risk perception so that patients of productive age are more aware and disciplined in undergoing treatment and long-term control (Sivaprasad *et al.*, 2017). Evidence from a pilot study in a resident-run clinic demonstrated that integrating ophthalmology partnerships increased DR screening rates, reinforcing the role of specialist-supervised interventions in improving monitoring adherence and outcomes (Mahoney & Toomey, 2024).

Statistical results also reinforce the benefits of this model. No increase in disease severity was observed in the specialist-supported group during the study period (p=1.000), whereas in the unsupported group, 21.7% of patients experienced worsening DR progression (p=0.025). These findings are consistent with the results of meta-analyses by Tricco *et al*. (2012) and Marechal *et al*. (2020), which demonstrate that specialist-based collaborative interventions are significantly more effective in managing chronic diabetes complications, especially when combined with community empowerment, digital health, and family peer support (Tricco *et al*., 2012; Marechal *et al.*, 2020). From an implementation perspective, the intensified education and screening approach by specialists helped patients better understand the importance of follow-up, thereby reducing the rate of treatment discontinuation and improving quality of life. This model also provides opportunities for primary healthcare workers to enhance their capacity for early detection of DR at the community health center level through mentoring or intensified supervision from specialists. The referral system becomes more efficient, enabling severe DR cases to receive timely interventions such as laser therapy, anti-VEGF injections, or vitrectomy before irreversible vision loss occurs (Futoma *et al.*, 2015).

The study recommends that the Health Department and local governments expand the coverage of active DR screening programs, based on collaboration between specialists, health workers, and telemedicine technology, particularly among the productive age group and populations with limited access to healthcare services. Involving families and community leaders in DR education is also necessary to improve health literacy and collective awareness. Overall, this study provides strong evidence that regular clinical follow-up by ophthalmologists is highly effective in reducing the risk of DR progression in patients with diabetes in Kapuas. This approach should be integrated into primary and secondary care services and adapted to other rural areas in Indonesia to mitigate the future impact of diabetes-related blindness. The limitations of this study include the limited timeframe, small sample size, and involvement of only one district.

Conclusion

Intensive clinical monitoring by ophthalmologists in Kapuas District has proven effective in preventing the progression of diabetic retinopathy (DR) severity among patients with type 2 diabetes, particularly in working-age groups and communities with limited access to healthcare services. In the supported group, all patients (100%) maintained stable DR severity, while in the unsupported group, 21.7% experienced an increase in severity. The Wilcoxon Signed Rank Test showed no significant difference between pre- and post-intervention scores in the supervised group (p = 1.000), indicating disease stability. Meanwhile, a considerable difference was observed in the control group (p = 0.025), reflecting disease progression. Furthermore, the duration of diabetes (p = 0.000), distance to healthcare facilities (p = 0.045), and age (p = 0.033) were found to influence DR severity. These results align with the research objective to analyze the effect of clinical supervision by ophthalmologists on changes in DR severity and its related factors. The collaborative model between general practitioners and ophthalmologists demonstrated both clinical and statistical effectiveness in maintaining disease stability and is recommended for implementation in other regions of Indonesia with similar demographic and healthcare access characteristics.

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