The two broad categories of DR are nonproliferative diabetic retinopathy and proliferative diabetic retinopathy.

Appendix Figure 4 lists the ICD-9-CM classification of ocular complications of DM.

a. Nonproliferative Diabetic Retinopathy (NPDR)

Nonproliferative diabetic retinopathy is characterized by retinal Ma, intraretinal hemorrhages (blot, dot, or flame), hard exudates, soft exudates (cotton wool spots), IRMA, venous looping, and/or venous beading. VB, IRMA, and moderate to severe hemorrhage or microaneurysm (H/Ma) are significant risk factors for progression to PDR.\(^{31}\)

By definition, in mild NPDR there is at least one retinal H/Ma; however, the severity of H/Ma is less than is depicted in standard photograph 2A of the modified Airlie House classification of DR.\(^{12,29,31}\) No other diabetic retinal changes are present. When there is no ME and no H/Ma in the macular area, mild NPDR does not present a threat to vision. Mild NPDR has a 5 percent risk of progressing to PDR in 1 year and a 15 percent risk of progression to high-risk PDR within 5 years.

Moderate NPDR differs from mild NPDR in that in one to three retinal photographic fields the severity of H/Ma exceeds those in standard photograph 2A, or cotton wool spots, VB, or IRMA of mild degree are present. Moderate NPDR has a 12–27 percent risk of progressing to PDR in 1 year and a 33 percent risk of progressing to high-risk PDR within 5 years.\(^{29,31}\) Careful examination with the indirect ophthalmoscope, fundus contact lens, or fundus lens with the biomicroscope is needed to establish the diagnosis.

Severe NPDR is defined as H/Ma more severe than in standard photograph 2A in four retinal quadrants or photographic fields, or as VB (exemplified by that in standard photograph 6B) in two quadrants, or as moderate IRMA (greater than or equal to those in standard photograph 8A) present in at least one retinal
quadrant, in the absence of frank neovascularization. This "4-2-1" rule is an important clinical tool for determining when DR is at risk of progressing to proliferative disease. Severe NPDR has a 52 percent risk of progressing to PDR in 1 year and a 60 percent risk of progressing to high-risk PDR within 5 years.

In very severe NPDR, two or more criteria for severe NPDR are met. Very severe NPDR carries a substantial risk for progression to PDR in 1 year and to high-risk PDR within 5 years.

b. Proliferative Diabetic Retinopathy (PDR)

The most severe form of DR is PDR. Most patients with PDR are at significant risk for vision loss. Characteristics of the disease include NVD, NVE, fibrous proliferation on or within one disc diameter of the optic disc (FPD) or elsewhere on the retina (FPE), PRH, and/or vitreous hemorrhage (VH). PDR that has not reached the high-risk level has a 75 percent likelihood of becoming high risk within a 5-year period.

c. Macular Edema

Defined as the collection of intraretinal fluid in the macular area of the retina, with or without lipid exudates or cystoid changes, ME can occur at any stage of retinopathy. When macular edema involves or threatens the center of the macula, it is considered "clinically significant." Whether present in NPDR or PDR, this edema results from Ma or other focal or diffuse vascular leakage within or near the macula. Visual acuity is generally compromised when the ME affects the fovea.

3. Early Detection and Prevention

Duration of DM is a risk factor for onset and progression of DR; therefore, early diagnosis of DM and DR is essential. Early treatment of DR with photocoagulation surgery reduces the risk of severe vision loss by at least 50-60 percent.
II. CARE PROCESS

This Guideline describes the optometric care provided a patient diagnosed with or suspected of having DM. The components of patient care described are not intended to be all-inclusive; professional judgment and individual patient symptoms and findings may have a significant impact on the nature, extent, and course of the services provided. The optometrist may delegate some components of care.

A. Diagnosis of Ocular Manifestations of Diabetes Mellitus

The first diagnosis of the patient who is unaware of having a diabetic condition may be based on an eye examination. Ocular examination of a patient suspected of having undiagnosed DM should include all aspects of a comprehensive eye examination. Particular attention should be paid to the ocular and systemic signs and symptoms of DM, as discussed in this section.

Patients with DM need regular eye examinations. The examination should include all aspects of a comprehensive eye examination, with supplementary testing as indicated to detect and thoroughly evaluate ocular complications. The frequency of examination is determined on the basis of several factors, including the type of DM, duration of the disease, age of the patient, level of patient compliance, concurrent medical status, and both nonretinal and retinal ocular findings. Due to the risk for progression of DR during pregnancy, a diabetic woman should have a baseline examination prior to a planned pregnancy or early in the first trimester of pregnancy.81,82

1. Patient History

a. Patients With Undiagnosed Diabetes Mellitus

The history of a person suspected of having DM should include investigation of ocular and systemic
complaints and symptoms related to DM. Common ocular symptoms of undiagnosed DM include recent onset of blurred or fluctuating vision, or new-onset diplopia. Systemic symptoms may include polyuria, polydipsia, polyphagia, unexplained weight changes, dry mouth, pruritus, leg cramps or pains, impotence, delayed healing of bruises or wounds, and recurrent infections of the skin, genitalia, or urinary tract. Systemic complaints are more common in patients with type 1 diabetes. Patients with type 2 diabetes are frequently asymptomatic.

b. Patients with Diagnosed Diabetes Mellitus

The patient history should encompass both the ocular and systemic status of the patient, emphasizing in particular any new complaints or symptoms. The quality of the patient’s vision should be investigated to elicit symptoms such as blurred, distorted, or fluctuating vision; diplopia; night vision problems; and flashes or floaters. Questions about previous ocular disease or surgery that might exacerbate the ocular complications from DM should be included in the patient history.

The patient's medical history should be explored carefully to determine the type and duration of the DM. Studies confirm that the risks for ocular complications are closely related to the duration of the disease (Table 4). Age at the time of onset of DM is not as significant as the duration of the disease in the prediction of complications. The name, address, and telephone number of the patient's primary care physician should be noted in the record to facilitate communication and coordination of the patient's care.

A review of the patient’s medical management should encompass diet, oral medications, insulin type and dosage, recent laboratory values for HbA1c, the presence of microalbuminuria or overt proteinuria, lipid

* Refer to the Optometric Clinical Practice Guideline for Comprehensive Adult Eye and Vision Examination.
values, and method, frequency, and results of self-monitoring of blood glucose. This information provides insight into patient compliance with therapeutic regimens and control of the DM, which may affect the development of ocular complications. Glycosylated hemoglobin values provide an indication of average blood glucose levels and control of the DM over the prior 6–8 weeks. The level of HbA1c at baseline examination has been shown to be a strong and independent predictor of incidence and progression of any retinopathy or progression to proliferative retinopathy. While laboratory values may vary, HbA1c values of 5.0–7.0 percent (normal, 4.0–6.0 percent) usually indicate adequate blood glucose control. The goal is to keep the HbA1c under 7 percent or as close to normal as is practically possible.

Additional information useful for patient assessment includes a review of other medical problems, medications, and allergy history. Patients diagnosed with DM may have their blood pressure measured at the time of the eye examination because hypertension is a known risk factor for the development and progression of diabetic retinopathy and nephropathy.

2. Ocular Examination

The ocular examination should include, but not be limited to, the following evaluations:

- Best corrected visual acuity
- Pupillary reflexes
- Ocular motility
- Visual field screening
- Refraction
- Biomicroscopy
- Tonometry
- Stereoscopic fundus examination with pupillary dilation.
Pupillary dilation with 0.5% or 1.0% tropicamide and 2.5% phenylephrine hydrochloride* is recommended, unless contraindicated, to achieve maximum visualization of the retina.

3. Examination Technique

The retina should be thoroughly examined for the presence of DR by binocular indirect ophthalmoscopy with an appropriate condensing lens. Diabetic maculopathy and optic disc changes are best evaluated with stereopsis by fundus biomicroscopy with an appropriate condensing lens, a Hruby lens, or a fundus contact lens, or by stereographic fundus photographs or validated retinal imaging. For maximum visualization of the retina, all examinations should be performed through a dilated pupil, unless contraindicated.

Stereoscopic color fundus photography through a dilated pupil is helpful in detecting and classifying DR. Photographic grading of DR compares favorably to clinical examination by ophthalmoscopy in this process. Stereoscopic photography is particularly useful for identifying clinically significant macular edema (CSME) and for documenting retinal status.

Proper documentation of retinal status, including the use of drawings or color photographs in the patient's record, is valuable for determining any progression or stability of the retinopathy at future examinations. Use of the standard protocol for color-coding retinal drawings is recommended. It is advisable to note the presence or absence (and the severity) of neovascularization on the iris (rubeosis iridis [NVI]), retinal H/Ma, VB, IRMA, retinal neovascularization, and hard exudates or thickening in the macula. The presence of these lesions helps to determine the level of retinopathy and to diagnose ME.

When VH prevents adequate visualization of the retina or when scatter (panretinal) photocoagulation is ineffective, early vitrectomy may be indicated. In such cases, patients need to be referred promptly for

* Every effort has been made to ensure that the drug dosage recommendations are accurate at the time of publication of the Guideline. However, as recommendations change due to continuing research and clinical experience, clinicians should verify drug dosage schedules on product information sheets.
evaluation, which may include ultrasound examination, and treatment. The Diabetic Retinopathy Vitrectomy Study has shown that early vitrectomy is of benefit in preserving vision in some patients.

4. Supplemental Testing

The use of additional procedures for the diagnosis and evaluation of DR may be indicated. Such procedures include, but are not limited to:

- Color vision assessment
- Contrast sensitivity testing
- Fundus photography or validated retinal imaging
- Gonioscopy
- Macular function assessment.

The patient suspected of having DM may have his/her blood pressure measured at the time of the eye examination. Hypertension is more prevalent in persons with DM and is a known risk factor for the development and progression of DR.

B. Management of Ocular Manifestations of Diabetes Mellitus

1. Basis for Treatment

Treatment decisions depend upon the extent and severity of the patient's ocular condition. Appendix Figure 1 presents a flowchart for the management of the patient with undiagnosed DM. Appendix Figure 2 presents a flowchart outlining the optometric management of the patient diagnosed as having DM.

a. Patients with Undiagnosed Diabetes Mellitus
Patients suspected of having DM should be screened for high blood glucose levels. The optometrist should refer the patient to a physician for evaluation or request a fasting blood glucose analysis. Patients with fasting blood glucose values of greater than or equal to 110 mg/dl but less than 126 mg/dl have IFG and should be retested. All patients with fasting blood glucose values of 126 mg/dl or greater should be referred to physicians for further evaluation or treatment. Most pregnant women should be screened for glucose intolerance. Because a pregnant patient is usually under medical care, her obstetrician should coordinate this examination.

Patients with undiagnosed DM who present with DR during the initial examination must be referred for treatment of their DM. The DR should be managed in accordance with accepted protocols, as outlined in section II.B.1.c of this Guideline, which focuses on retinal complications.

b. Patients with Nonretinal Ocular Complications

Management of nonretinal ocular complications of DM should be consistent with current recommendations of care for each condition. Although a comprehensive discussion of these therapy regimens is beyond the scope of this Guideline, Table 5 briefly outlines the management of nonretinal ocular complications. Treatment protocols should always include patient education and recommendations for follow-up visits. As part of the proper management of DM, referrals to other appropriately licensed practitioners for concurrent care should be made when indicated.

---------

INSERT TABLE 5 HERE

---------

c. Patients with Retinal Complications
Five major clinical trials provide the scientific basis for standards for clinical management of DR:

- The Diabetic Retinopathy Study (DRS, 1971–1975)\textsuperscript{5–18}
- The Early Treatment Diabetic Retinopathy Study (ETDRS, 1979–1990)\textsuperscript{19–41}
- The Diabetic Retinopathy Vitrectomy Study (DRVS, 1977–1987)\textsuperscript{42–46}
- The Diabetes Control and Complications Trial (DCCT, 1983–1993)\textsuperscript{3,54–58}
- The United Kingdom Prospective Diabetes Study (UKPDS, 1977–1999)\textsuperscript{61,91}

The DRS, ETDRS, and DRVS definitively established the efficacy of laser surgery for PDR and diabetic ME and have provided guidelines concerning the most opportune time for intervention with laser surgery and vitrectomy. The DCCT and UKPDS established the benefits of intensive control of blood glucose levels to reduce the risks of onset and progression of DR and other complications of diabetes for type 1 and type 2 DR, respectively.

The ETDRS modified and extended the Airlie House classification of DR\textsuperscript{29,31} to assess the severity and extent of the various lesions of DR. This modification forms the basis of an overall DR severity scale\textsuperscript{29} that ranges from the absence of DR to severe VH. Clinical approximations of these levels provide practical guidelines for the clinical diagnosis and management of DR (Table 6). The retinopathy severity scale is valuable as a description of baseline retinopathy levels and identifies the risk for progression of DR.

When indicated (generally for levels of moderate NPDR or worse, any PDR, any macular edema, neovascularization of the iris, or unexplained vision loss), the optometrist should refer the person with DM to an ophthalmologist skilled in treating diseases of the retina or a retina specialist.

\textsuperscript{INSERT TABLE 6 HERE}
2. Available Treatment Options

a. Nonproliferative Diabetic Retinopathy

An annual dilated eye examination and fundus photographs, if indicated, are generally sufficient for the patient with mild NPDR, as long as there is neither ME nor a coincident medical condition, such as hypertension, renal disease, or pregnancy. The patient's primary care physician should be informed of eye examination results, even when retinopathy is minimal or not present.

For patients with moderate NPDR, fundus photography is strongly suggested, and repeat evaluation in 6–12 months is appropriate in the absence of ME or complicating medical or risk factors. Although the patient with mild or moderate NPDR generally is not a candidate for scatter (panretinal) laser treatment, the presence of ME requires more frequent evaluation, consultation with a retina specialist, and, in the presence of CSME, probably focal laser photocoagulation. Misdiagnosis of moderate NPDR is hazardous because of significant underestimation of a patient's risk for progression to proliferative retinopathy.

Follow up every 2–3 months in consultation with a retina specialist is advisable for patients with severe or very severe NPDR. Scatter laser photocoagulation may be indicated, depending on the clinical judgment of the retina specialist. Studies also suggest that type 2 diabetic patients are more likely to benefit from scatter photocoagulation prior to the development of high-risk PDR. \(^{36,93}\) Severe and very severe NPDR (as well as PDR that is not high risk) may require early scatter laser surgery, particularly when neovascularization of the disc has occurred or elevated new vessels are present.

Patients with moderate NPDR or worse should be considered for focal laser treatment of ME, whether the ME is clinically significant or not, in preparation for the possible future need for scatter photocoagulation. Focal laser surgery for CSME is strongly indicated for patients with severe NPDR because of the risk for the development of PDR and high-risk PDR. \(^{90}\) Consultation with a retina specialist is indicated. \(^{94}\)
b. **Proliferative Diabetic Retinopathy**

Proliferative diabetic retinopathy is marked by new vessel growth on the optic disc or elsewhere on the retina, or by the proliferation of fibrous tissue. Proliferative retinopathy that has not reached the high-risk level has a 75 percent likelihood of becoming high-risk PDR within a 5-year period. Scatter laser photocoagulation may be indicated, and even when ME is not clinically significant, the patient with PDR may benefit from treatment. Prompt referral to a retina specialist is indicated.

The DRS and ETDRS conclusively demonstrated that scatter (panretinal) laser photocoagulation surgery significantly reduces the risk for severe vision loss from PDR. Furthermore, these studies identified specific retinal lesions that pose a significant threat of vision loss.  

Patients with high-risk PDR require immediate referral to a retina specialist for scatter laser photocoagulation. High-risk PDR is characterized by any one or more of the following lesions:

- NVD approximately one-fourth to one-third disc area (DA) or more in size (i.e., ≥ NVD in standard photo 10A)

- NVD less than one-fourth DA in size when fresh VH or PRH is present

- NVE greater than or equal to one-half DA in size when fresh VH or PRH is present.

To identify high-risk PDR, the examiner must pay attention to the presence or absence of retinal neovascularization, the location and severity of any neovascularization, and the presence or absence of preretinal or vitreous hemorrhages. The risk for severe vision loss can be reduced by at least 50 percent by initiating scatter laser surgery for eyes with high-risk PDR; consequently, any patient who demonstrates high-risk PDR should be referred immediately (within 24–48 hours) to a retina specialist.
Eyes in which PDR has not advanced to the high-risk stage should be considered analogous to eyes with high-risk PDR. Many retina specialists perform scatter laser photocoagulation in eyes with less than high-risk PDR, particularly when there are extenuating circumstances, such as patient noncompliance, the development of cataracts, difficulty in managing DM or associated medical conditions (e.g., hypertension, nephropathy), or pregnancy. These same considerations pertain to patients with severe or very severe NPDR. Patients with type 2 diabetes or type 1 diabetes of long duration may benefit from earlier laser treatment, prior to the development of high-risk PDR.

The goal of laser surgery is to induce regression of neovascularization without VH or fibrovascular proliferation that results in traction retinal detachment or macular dragging. Any patient with PDR should be referred to a retina specialist promptly for further evaluation and photocoagulation treatment, as clearly supported by the DRS and ETDRS. Timely and appropriate laser and vitrectomy surgery can significantly reduce the 5-year risk for severe vision loss from PDR. In the ETDRS, 4 percent of eyes with PDR that were treated had severe vision loss within 5 years, and 1 percent of patients had such loss. Only 5 percent of ETDRS patients with PDR became legally blind.

c. Macular Edema

Management of patients with ME involves consideration of both the significance of the edema and the nature of any other retinopathy present. ME is divided into two categories, the less severe of which, nonclinically significant ME, usually does not require laser surgery. Such patients should be re-examined within 3–4 months in consultation with a retina specialist. Followup can be more frequent if required for proper management of the retinopathy. Referral for fluorescein angiography (FA) may be indicated to identify treatable lesions, although FA generally is not needed for diagnosis.

As defined by the ETDRS, clinically significant macular edema includes any one of the following lesions:
- Retinal thickening at or within 500 microns (one-third DD) from the center of the macula, or

- Hard exudates at or within 500 microns (one-third DD) from the center of the macula, if there is thickening of the adjacent retina, or

- An area or areas of retinal thickening at least 1 DA in size, at least part of which is within 1 DD of the center of the macula.

Patients with CSME should be referred promptly for FA and focal laser photocoagulation treatment. If the retina consultant defers treatment, the retina consultant’s follow-up examination generally occurs within 3 months.

The management of diabetic papillopathy and ischemic optic neuropathy may require consultation with a neuro-ophthalmologist or neurologist to rule out all other potential etiologies, such as space-occupying lesions.

The clinical appearance of the nerve fiber layer may be affected by scatter (panretinal) photocoagulation to treat the microvascular complications of DR; however, no significant change in the optic disc contour or cup-to-disc ratio has been documented. Optic disc pallor without increased cup-to-disc ratio may result from quiescent PDR, whether occurring spontaneously or following scatter (panretinal) laser photocoagulation.

3. Patient Education

Virtually all patients with DM will develop some form of DR at some point during the course of the disease. Therefore, it is important for them to learn about the disease process and the risks for developing ocular signs and symptoms that may result in vision loss. Optometrists should inform patients that retinopathy may exist even when vision is good. Patients should be encouraged to report all ocular symptoms (e.g., blurred vision, flashes, and floaters), inasmuch as DM may be the underlying etiology. Optometrists should help
patients understand that timely follow-up examinations and management are critical for early diagnosis and intervention, when indicated, to reduce the risk of vision loss from DR. Patients also should be informed about their higher risk for other nonretinal ocular complications, such as cataracts, neovascular glaucoma, and open angle glaucoma. 

Optometrists should inform their patients about the relationship between the level of control of diabetes and the subsequent development of ocular and other medical complications. Specific emphasis should be placed on the benefit of any reduction in elevated HbA\textsubscript{1c} in lowering the risk of damage. A 1 percent rise in HbA\textsubscript{1c} (from 7 to 8 percent) increases the progression of nonproliferative retinopathy by 44 percent over a 10-year period. For the patient with proliferative retinopathy, the same 1 percent increase in HbA\textsubscript{1c} results in 145 percent progression over 10 years. Special care is needed in the approach to elderly patients; because their risks and benefits may be different, the discussion and instruction will have to be individualized.

Patients should be informed that diabetic nephropathy, as manifested by microalbuminuria, requires aggressive early treatment. Treatment modalities include improved glycemic control and the timely use of the angiotensin converting enzyme (ACE) inhibitors. The captopril type 1 diabetes study showed that ACE inhibitors reduce by 50 percent the progression to end-stage renal disease, which necessitates dialysis or kidney transplantation, and can result in death. Similar data are now available for type 2 diabetes. Proper monitoring and timely treatment can result in subsequent saving of sight for persons with diabetes mellitus.

Finally, all patients should be advised about organizations that provide resources and support for patients with DM. (A list of organizations is available from the AOA Clinical Care Group.)

4. **Prognosis and Followup**
All patients with DM are at risk for the development of ocular-related complications. Compliance with treatment recommendations to maintain close control of their blood glucose levels is a significant factor in slowing the development and progression of ocular complications of DM.

Diabetic patients who do not have DR should be re-examined annually. The follow-up examination of patients with DR should be scheduled in accordance with the clinical trials protocols. Proper diagnosis is crucial because misdiagnosis by just one level underestimates a patient's risk of developing PDR in 1 year by 50 percent or more (Appendix Figure 3).

Focal laser photocoagulation for CSME reduces the risk of moderate vision loss (i.e., a doubling of the visual angle) from nearly 30 percent to approximately 12 percent. Scatter (panretinal) laser photocoagulation reduces the risk of severe vision loss (best visual acuity ≤ 5/200) to less than 2 percent. Laser surgery, therefore, greatly improves the prognosis for maintaining useful vision.

Following successful treatment, patients with PDR should be re-examined every 2–4 months. A peripheral visual field examination may be performed approximately 6 months after treatment. Color photography also may be useful in monitoring post-treatment status. The management of patients with PDR needs to be coordinated with the recommendations of the retina specialist.

Appropriate communication with the patient's primary care physician (as with any referral consultant) is critical for proper coordination of the patient's care. Due to the nature of DM, a multidisciplinary approach to patient management is essential. All health care personnel involved with the patient's care should be aware of the patient's overall medical status. Written letters or reports are useful in accomplishing this task. These letters also provide permanent documentation for the patient's record. The patient's primary care physician must be involved in all aspects of the health care.

The patient with diabetic ME, or with suspected diabetic ME, should be referred promptly, usually within 2–4 weeks, to a retina specialist for evaluation. The patient with high-risk PDR should be referred to a retina
specialist immediately, usually within 24-48 hours, for consideration of scatter (panretinal) laser surgery. Patients whose PDR is less than high risk or who have signs of severe or very severe NPDR should be referred for consultation with retina specialists because they may require laser surgery. The optometrist should communicate with the diabetic patient's primary care physician following each eye examination.

5. Management of Patients with Severe, Irreversible Vision Loss

Patients with DR are at risk for both permanent loss of visual acuity and loss of functional vision, including:

- Reduced central visual acuity and central scotoma from diabetic maculopathy

- Loss of peripheral visual field

- Difficulty with vision in dim light, secondary to retinal ischemia or panretinal laser photocoagulation

- Vision loss secondary to residual effects from vitreous hemorrhage, preretinal hemorrhage, or traction retinal detachment.

Because standard corrective eyeglasses and contact lenses may not alleviate the functional vision problems associated with DR, patients with DR may need low vision rehabilitation entailing orientation and mobility training, nonoptical aids, and other independent living aids or devices. For example, optical aids alone may be inadequate for patients who need to manage their medication regimens or to self-monitor blood glucose. Due to acquired color vision defects, diabetic patients have particular difficulty using color-comparison systems for self-monitoring blood glucose levels, and may require a self-monitoring system with a digital display meter or voice response. Another problem for the DM patient is loss of tactile sensation related to peripheral neuropathy. This loss may affect the patient's ability to perform routine tasks safely, such as meal preparation, dialing the telephone, and writing.
When a standard corrective prescription or a less complex low vision device cannot satisfy the visual requirement, the patient's rehabilitation may necessitate a specialized low vision consultation or appropriate patient counseling. Patients should be evaluated to determine their potential to benefit from comprehensive low vision rehabilitation that would reduce the debilitating effects of vision loss.

Patients with significant reduction of visual acuity or functional vision loss may be unable to continue their usual employment. Occupational or vocational rehabilitation may help patients achieve more fulfilling, self-sustaining lifestyles. Referrals should be made only after discussion with the patients regarding their willingness to participate in such consultations.

The fear of vision loss associated with DR can result in a high level of anxiety for any patient with retinopathy, including the patient with good functional vision. Even patients without retinopathy or other ocular complications may have personal concerns about DM (e.g., problems accepting the disease, adapting to it, and adjusting to emotional and social changes). Referral for psychosocial counseling is indicated for any patient who may have difficulty dealing with the issues associated with DM or DR. An early counseling visit may be beneficial for a family with a child who has DM. Educational literature and a list of support agencies and other resources should be made available to the patient.

* Refer to the Optometric Clinical Practice Guideline on Care of the Patient with Low Vision.
CONCLUSION

Until modalities are in place to prevent or cure DR and other complications of DM, emphasis must be placed on identification, careful followup, and timely treatment, including laser photocoagulation, for patients with DR and diabetic eye disease. Proper care will result in reduction of personal suffering for those involved, and a substantial cost savings for the involved individuals, their families, and the country as a whole. Therefore, strict guidelines have been established for the ocular care of people with diabetes.

Optometrists should inform all diabetic patients of the possibility of developing retinopathy, with or without symptoms, and of the associated threat of vision loss. The results of the DCCT and UKPDS should be discussed and patients should be encouraged to see their diabetes care providers to work toward achieving the goals for control published by the American Diabetes Association. The natural course and treatment of DR should be discussed with the patient, and the importance of routine eye examinations should be stressed.
III. REFERENCES


38


Figure 1
Optometric Management of the Patient with Undiagnosed Diabetes Mellitus: A Brief Flowchart

Patient assessment

Suspect undiagnosed diabetes

No ocular manifestations

Request fasting blood glucose or refer

Fasting blood glucose < 110 mg/dl

Schedule follow-up eye examination

Fasting blood glucose 110-126 mg/dl

Retest fasting blood glucose

Fasting blood glucose ≥ 126 mg/dl

Refer to physician for evaluation

Non-retinal abnormality

Non-proliferative retinopathy

Manage or refer per Guideline

Proliferative retinopathy

Refer to physician for treatment of diabetes
Figure 2
Optometric Management of the Patient
With Diagnosed Diabetes Mellitus: A Brief Flowchart

Patient assessment

Patient known to have

No ocular manifestations
- Schedule follow-up eye examination
- Counsel patient regarding risk for ocular manifestations
- Communicate with physician treating patient's diabetes

No retinal manifestations

Non-proliferative retinopathy
- Manage or refer per Guideline

Proliferative retinopathy

Diabetic macular edema
- Communicate with physician treating patient's diabetes
## Figure 3

**Frequency and Composition of Evaluation and Management Visits for Retinal Complications of Diabetes Mellitus**

<table>
<thead>
<tr>
<th>Severity of Condition</th>
<th>Natural Course Rate of Progression to</th>
<th>Frequency of Followup</th>
<th>Composition of Follow-up Evaluations</th>
<th>Management Plan*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PDR (1 year)</td>
<td>HRC (5 years)</td>
<td>Fundus Photography</td>
<td></td>
</tr>
<tr>
<td>Mild NPDR</td>
<td>5%</td>
<td>15%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Macular edema</td>
<td>12 mos</td>
<td>4-6 mos</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>CSME</td>
<td>2-4 mos</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[Macular edema](not CSME)</td>
<td></td>
<td>[Yes](not CSME)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[CSME](not CSME)</td>
<td></td>
<td>[Yes](not CSME)</td>
<td></td>
</tr>
<tr>
<td>Moderate NPDR</td>
<td>12-27%</td>
<td>33%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Macular edema</td>
<td>6-8 mos</td>
<td>4-6 mos</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>(not CSME)</td>
<td>2-4 mos</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>CSME</td>
<td>[Macular edema](not CSME)</td>
<td>[Macular edema](not CSME)</td>
<td>[Yes](not CSME)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[CSME](not CSME)</td>
<td>[CSME](not CSME)</td>
<td>[Yes](not CSME)</td>
<td></td>
</tr>
<tr>
<td>Severe NPDR</td>
<td>52%</td>
<td>60-75%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Macular edema</td>
<td>3-4 mos</td>
<td>2-3 mos</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>(not CSME)</td>
<td>2-3 mos</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>CSME</td>
<td>[Macular edema](not CSME)</td>
<td>[Macular edema](not CSME)</td>
<td>[Yes](not CSME)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[CSME](not CSME)</td>
<td>[CSME](not CSME)</td>
<td>[Yes](not CSME)</td>
<td></td>
</tr>
</tbody>
</table>

**Referral for Consultation and/or Treatment**
- Communicate with patient's physician
- Obtain retinal consult in 2-4 wks
- Obtain retinal consult in 2-4 wks

**Scatter Laser Treatment**
- No
- No
- No

**Focal Laser Treatment**
- No
- Yes

*Figures reflect the natural course and rate of progression to severity of PDR HRC condition (1 year) and (5 years).

<table>
<thead>
<tr>
<th>Severity of Condition</th>
<th>Natural Course Rate of Progression to</th>
<th>Frequency of Followup</th>
<th>Composition of Follow-up Evaluations</th>
<th>Management Plan*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PDR (1 year)</td>
<td>HRC (5 years)</td>
<td>Fundus Photography</td>
<td></td>
</tr>
<tr>
<td>Mild NPDR</td>
<td>5%</td>
<td>15%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Macular edema</td>
<td>12 mos</td>
<td>4-6 mos</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>CSME</td>
<td>2-4 mos</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[Macular edema](not CSME)</td>
<td>[Macular edema](not CSME)</td>
<td>[Yes](not CSME)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[CSME](not CSME)</td>
<td>[CSME](not CSME)</td>
<td>[Yes](not CSME)</td>
<td></td>
</tr>
<tr>
<td>Moderate NPDR</td>
<td>12-27%</td>
<td>33%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Macular edema</td>
<td>6-8 mos</td>
<td>4-6 mos</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>(not CSME)</td>
<td>2-4 mos</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>CSME</td>
<td>[Macular edema](not CSME)</td>
<td>[Macular edema](not CSME)</td>
<td>[Yes](not CSME)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[CSME](not CSME)</td>
<td>[CSME](not CSME)</td>
<td>[Yes](not CSME)</td>
<td></td>
</tr>
<tr>
<td>Severe NPDR</td>
<td>52%</td>
<td>60-75%</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Macular edema</td>
<td>3-4 mos</td>
<td>2-3 mos</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>(not CSME)</td>
<td>2-3 mos</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>CSME</td>
<td>[Macular edema](not CSME)</td>
<td>[Macular edema](not CSME)</td>
<td>[Yes](not CSME)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[CSME](not CSME)</td>
<td>[CSME](not CSME)</td>
<td>[Yes](not CSME)</td>
<td></td>
</tr>
</tbody>
</table>

**Referral for Consultation and/or Treatment**
- Communicate with patient's physician
- Obtain retinal consult in 2-4 wks
- Obtain retinal consult in 2-4 wks

**Scatter Laser Treatment**
- No
- No
- No

**Focal Laser Treatment**
- No
- Yes

*Figures reflect the natural course and rate of progression to severity of PDR HRC condition (1 year) and (5 years).
<table>
<thead>
<tr>
<th>Non-high-risk PDR No macular edema Macular edema CSME</th>
<th>75%</th>
<th>No 2-3 mos Yes 2-3 mos Yes 2-3 mos Yes</th>
<th>No Occ. Yes</th>
<th>Obtain retinal consult in 2-4 wks Obtain retinal consult in 2-4 wks Obtain retinal consult in 2-4 wks</th>
<th>Occ.,*** Occ. after focal*** Occ. after focal***</th>
<th>No Occ. Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-risk PDR No macular edema Macular edema CSME</td>
<td>2-3 mos Yes 1-2 mos Yes 1-2 mos Yes</td>
<td>No 2-3 mos Yes 1-2 mos Yes 1-2 mos Yes</td>
<td>Yes Yes Yes</td>
<td>Obtain retinal consult in 24-48 hrs Obtain retinal consult in 24-48 hrs Obtain retinal consult in 24-48 hrs</td>
<td>Yes Yes Yes</td>
<td>No Usually Yes</td>
</tr>
</tbody>
</table>

* Patient education and written communication with patient’s primary care physician are integral to management of DM.

** Consider scatter laser treatment (PRP), especially if severe NPDR (see levels of DR), significant medical complication, or type 2 DM

*** Consider scatter laser treatment (PRP), especially if moderate PRD (see levels of DR), significant medical complication, or type 2 DM.

HRC = High risk category; Occ. = Occasionally

Table copyright L.M. Aiello, M.D.: Used with permission
Diabetes mellitus

Excludes: gestational diabetes (648.8)
hyperglycemia NOS (790.6)
neonatal diabetes mellitus (775.1)
nonclinical diabetes (790.2)

The following fifth-digit subclassification is for use with category 250:

0 type II [non-insulin dependent type][NIDDM type][adult-onset type] or unspecified type, not stated as uncontrolled

Fifth-digit 0 is for use for type 2, adult-onset, diabetic patients, even if the patient requires insulin

1 type I [insulin dependent type][IDDM type][juvenile type], not stated as uncontrolled

2 type II, [non-insulin dependent type][NIDDM type][adult-onset type] or unspecified type, uncontrolled

Fifth-digit 2 is for use for type II, adult-onset, diabetic patients, even if the patient requires insulin

3 type I [insulin dependent type][IDDM][juvenile type], uncontrolled

Diabetes with ophthalmic manifestations

Use additional code, if desired, to identify manifestation, as:

diabetic:
   blindness (369.00-369.9)
   cataract (366.41)
   glaucoma (365.44)
   retinal edema (362.83)
   retinopathy (362.01-362.02)

Diabetic retinopathy

Code first diabetes (250.5)

Background diabetic retinopathy

Diabetic macular edema
Diabetic retinal edema
Diabetic retinal microaneuysms
Diabetic retinopathy NOS

Proliferative diabetic retinopathy

362.02

Retinal microaneuysms NOS

362.14

Retinal telangiectasia

362.15

Retinal neovascularization NOS

Neovascularization
   choroidal
   subretinal
Other intraretinal microvascular abnormalities

Retinal varices 362.17

Retinal hemorrhage

Hemorrhage:
preretinal
retinal (deep) (superficial)
subretinal 362.81

Retinal exudates and deposits 362.82

Retinal edema

Retinal:
cotton wool spots
edema (localized) (macular) (peripheral) 362.83

Retinal ischemia 362.84

Rubeosis iridis
Neovascularization of iris or ciliary body 364.42

Glaucoma associated with systemic syndromes

Code first associated disease 365.44

Glaucoma associated with vascular disorders
Use additional code for associated disorder 365.63

Diabetic cataract

Code first diabetes (250.5) 366.41

Transient refractive change 367.81

Diplopia

Double vision 368.2

Visual field defect, unspecified 368.40

Tritan defect
Tritanomaly 368.53
Tritanopia

Recurrent erosion of cornea 371.42

Tear film insufficiency, unspecified
Dry eye syndrome 375.15

Ischemic optic neuropathy 377.41

Vitreous hemorrhage 379.23
## Abbreviations of Commonly Used Terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACE</td>
<td>Angiotensin converting enzyme</td>
</tr>
<tr>
<td>ADA</td>
<td>American Diabetes Association</td>
</tr>
<tr>
<td>BMI</td>
<td>Body mass index</td>
</tr>
<tr>
<td>CSME</td>
<td>Clinically significant macular edema</td>
</tr>
<tr>
<td>DA</td>
<td>Disc area</td>
</tr>
<tr>
<td>DCCT</td>
<td>Diabetes Control and Complications Trial</td>
</tr>
<tr>
<td>DD</td>
<td>Disc diameter</td>
</tr>
<tr>
<td>DM</td>
<td>Diabetes mellitus</td>
</tr>
<tr>
<td>DNA</td>
<td>Deoxribonucleic acid</td>
</tr>
<tr>
<td>DR</td>
<td>Diabetic retinopathy</td>
</tr>
<tr>
<td>DRS</td>
<td>Diabetic Retinopathy Study</td>
</tr>
<tr>
<td>DRVIS</td>
<td>Diabetic Retinopathy Vitrectomy Study</td>
</tr>
<tr>
<td>ETDRS</td>
<td>Early Treatment Diabetic Retinopathy Study</td>
</tr>
<tr>
<td>FA</td>
<td>Fluorescein angiography</td>
</tr>
<tr>
<td>FDA</td>
<td>Food and Drug Administration</td>
</tr>
<tr>
<td>FPD</td>
<td>Fibrous proliferations on or within 1 DD of disc margin</td>
</tr>
<tr>
<td>FPE</td>
<td>Fibrous proliferations elsewhere, not FPD</td>
</tr>
<tr>
<td>FPG</td>
<td>Fasting plasma glucose</td>
</tr>
<tr>
<td>GAD65</td>
<td>Glutamic acid decarboxylase</td>
</tr>
<tr>
<td>GDM</td>
<td>Gestational diabetes mellitus</td>
</tr>
<tr>
<td>HbA1c</td>
<td>Glycosylated hemoglobin</td>
</tr>
<tr>
<td>HDL</td>
<td>High density lipoprotein(s)</td>
</tr>
<tr>
<td>HLA</td>
<td>Human leukocyte antigen(s)</td>
</tr>
<tr>
<td>H/Ma</td>
<td>Hemorrhage(s) and/or microaneurysm(s)</td>
</tr>
<tr>
<td>IAA(s)</td>
<td>Insulin autoantibodies</td>
</tr>
<tr>
<td>ICA(s)</td>
<td>Islet cell antibodies</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>IDDM</td>
<td>Insulin dependent diabetes mellitus</td>
</tr>
<tr>
<td>IFG</td>
<td>Impaired fasting glucose</td>
</tr>
<tr>
<td>IGT</td>
<td>Impaired glucose tolerance</td>
</tr>
<tr>
<td>IRMA</td>
<td>Intraretinal microvascular abnormality</td>
</tr>
<tr>
<td>LDL</td>
<td>Low density lipoproteins</td>
</tr>
<tr>
<td>Ma</td>
<td>Microaneurysms</td>
</tr>
<tr>
<td>ME</td>
<td>Macular edema</td>
</tr>
<tr>
<td>MODY</td>
<td>Maturity-onset diabetes of the young</td>
</tr>
<tr>
<td>NIDDM</td>
<td>Non-insulin dependent diabetes mellitus</td>
</tr>
<tr>
<td>NPDR</td>
<td>Nonproliferative diabetic retinopathy</td>
</tr>
<tr>
<td>NVD</td>
<td>New vessels on or within 1 DD of disc margin</td>
</tr>
<tr>
<td>NVE</td>
<td>New vessels elsewhere in the retina outside of disc and 1 DD from disc margin</td>
</tr>
<tr>
<td>NVI</td>
<td>New vessels on the iris; rubeosis iridis</td>
</tr>
<tr>
<td>OGTT</td>
<td>Oral glucose tolerance test</td>
</tr>
<tr>
<td>PAI-1</td>
<td>Plasminogen activator inhibitor</td>
</tr>
<tr>
<td>PDR</td>
<td>Proliferative diabetic retinopathy</td>
</tr>
<tr>
<td>PRH</td>
<td>Preretinal hemorrhage</td>
</tr>
<tr>
<td>UKPDS</td>
<td>United Kingdom Prospective Diabetes Study</td>
</tr>
<tr>
<td>VB</td>
<td>Venous beading</td>
</tr>
<tr>
<td>VH</td>
<td>Vitreous hemorrhage</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
</tbody>
</table>
Glossary

Diabetes mellitus (DM) A group of metabolic disorders characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both.

- **Type 1 diabetes** The result of cell-mediated autoimmune destruction of the beta cells of the pancreas, formerly referred to as insulin dependent diabetes mellitus (IDDM).

- **Type 2 diabetes** A disease in which individuals can produce insulin but have cellular resistance to it, formerly referred to as non-insulin dependent diabetes mellitus (NIDDM).

Diabetic cataract A rapidly forming, sometimes reversible, bilateral cataract associated with diabetes mellitus.

Diabetic papillopathy A noninflammatory edema of the optic nerve head associated with diabetes mellitus.

High-risk proliferative diabetic retinopathy New vessels on or within 1 disc diameter of the optic nerve head greater than approximately \( \frac{1}{4} \) to \( \frac{1}{3} \) of the disc, or new vessels on or within 1 disc diameter of the optic nerve head less than \( \frac{1}{4} \) to \( \frac{1}{3} \) the disc area when accompanied by vitreous and/or preretinal hemorrhage, or new vessels elsewhere in the retina greater than \( \frac{1}{2} \) the size of the disc area.

Intraretinal hemorrhage A radially striated hemorrhage in the inner layers of the retina, especially in the nerve fiber layer (flame-shaped hemorrhage).

Intraretinal microvascular abnormality (IRMA) An abnormality that represents either new vessel growth within the retina or pre-existing vessels with endothelial cell proliferation.

Macular edema (ME) Collection of intraretinal fluid in the macular portion of the retina, with or without lipid exudates, and with or without cystoid changes.

Clinically significant macular edema (CSME) The case when there is retinal thickening at or within 500 microns of the center of the macular and/or hard exudates within 500 microns of the center of the macula associated with retinal thickening of the adjacent area of the retina and/or a zone or zones of retinal thickening 1 disc area in size, any part of which is within 1 disc diameter of the center of the macula.

Microaneurysm (Ma) As to the eye, a focal retinal capillary dilation.

Neovascularization Growth of abnormal new blood vessels.

Papilledema Noninflammatory edema of the optic nerve head from various causes, such as increased intracranial pressure, orbital tumor, or blood dyscrasias.

Proliferative diabetic retinopathy (PDR) A type of retinopathy associated with diabetes mellitus, characterized by proliferation of connective tissue and the formation of new blood vessels in the retina, and by hemorrhages into the vitreous.

Retinal hypoxia A deficiency of oxygen supply to the retinal tissue.

Rubeosis iridis Noninflammatory neovascularization of the iris occurring in diabetes mellitus, characterized by numerous, small intertwining blood vessels which anastomose near the sphincter region to give the appearance of a reddish ring near the border of the pupil. The vessels may extend from the root of the iris to the filtration angle to cause peripheral vascular synechiae and secondary glaucoma.
Venous beading (VB) A fragmented appearance of the bloodstream in the retinal veins subsequent to retinal artery occlusion.

Sources:


Table 1
Standards for Glucose Control

<table>
<thead>
<tr>
<th>Biochemical index</th>
<th>Nondiabetic</th>
<th>Diabetic goals</th>
<th>Intervention indicated in diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preprandial glucose (mg/dl)</td>
<td>&lt;110</td>
<td>80-120</td>
<td>&lt;80 or &gt;140</td>
</tr>
<tr>
<td>Bedtime glucose (mg/dl)</td>
<td>&lt;120</td>
<td>100-140</td>
<td>&lt;100 or &gt;160</td>
</tr>
<tr>
<td>Glycosylated hemoglobin ( (HbA_{1c}) )</td>
<td>&lt;6</td>
<td>&lt;7</td>
<td>&gt;8</td>
</tr>
</tbody>
</table>
**Table 2**

Duration of Diabetes Mellitus and Presence of Eye Disease

<table>
<thead>
<tr>
<th>Type 1 Diabetes</th>
<th>Ocular manifestations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration of disease</strong></td>
<td><strong>Ocular manifestations</strong></td>
</tr>
<tr>
<td>5 years</td>
<td>Possible ocular manifestations.</td>
</tr>
<tr>
<td>&gt;10 years</td>
<td>60% have some retinopathy.</td>
</tr>
<tr>
<td>&gt;15 years</td>
<td>Virtually all patients have some degree of retinopathy. 25% progress to proliferative diabetic retinopathy.</td>
</tr>
<tr>
<td>&gt;20 years</td>
<td>50% progress to proliferative retinopathy.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type 2 Diabetes</th>
<th>Ocular manifestations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration of disease</strong></td>
<td><strong>Ocular manifestations</strong></td>
</tr>
<tr>
<td>At diagnosis</td>
<td>20% have retinopathy.</td>
</tr>
<tr>
<td>&gt;4 years</td>
<td>4% progress to proliferative retinopathy.</td>
</tr>
<tr>
<td>&gt;15 years</td>
<td>60-80% have some retinopathy. Up to 20% progress to proliferative retinopathy.</td>
</tr>
</tbody>
</table>
Table 3
Ocular and Visual Complications of Diabetes Mellitus

<table>
<thead>
<tr>
<th>Functional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tritan color vision deficiencies</td>
</tr>
<tr>
<td>Refractive error changes</td>
</tr>
<tr>
<td>Accommodative dysfunction</td>
</tr>
<tr>
<td>Visual field defects</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Extraocular muscle anomalies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mononeuropathies involving third, fourth, or sixth cranial nerves</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pupillary reflexes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sluggish pupillary reflexes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conjunctiva</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulbar conjunctival microaneurysms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tear film</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tear film deficiencies resulting in dry eye syndrome</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cornea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced corneal sensitivity</td>
</tr>
<tr>
<td>Reduced corneal wound-healing ability</td>
</tr>
<tr>
<td>Basement membrane abnormalities resulting in increased frequency of abrasions or recurrent erosion syndrome</td>
</tr>
<tr>
<td>Descemet's membrane wrinkling</td>
</tr>
<tr>
<td>Endothelial cell morphology changes, often resulting in increased corneal thickness</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Iris</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depigmentation</td>
</tr>
<tr>
<td>Rubeosis iridis, possibly with associated ectropion uvea and peripheral anterior synechiae</td>
</tr>
<tr>
<td>Neovascular glaucoma</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher prevalence of cataracts</td>
</tr>
<tr>
<td>Reversible opacities and snowflake cataracts</td>
</tr>
<tr>
<td>(rarely seen in industrialized countries)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vitreous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemorrhage in proliferative retinopathy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Retina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonproliferative retinopathy</td>
</tr>
<tr>
<td>Proliferative retinopathy</td>
</tr>
<tr>
<td>Macular edema</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Optic nerve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Papillopathy</td>
</tr>
<tr>
<td>Ischemic optic neuropathy</td>
</tr>
<tr>
<td>Higher incidence of open angle glaucoma</td>
</tr>
</tbody>
</table>
Table 4
Incidence of Diabetic Retinopathy by Type and Duration of Diabetes

<table>
<thead>
<tr>
<th>Duration of Type 1 Diabetes</th>
<th>Incidence of Diabetic Retinopathy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4 years</td>
<td>27%</td>
</tr>
<tr>
<td>5-9 years</td>
<td>71%</td>
</tr>
<tr>
<td>10-14 years</td>
<td>54%</td>
</tr>
<tr>
<td>15+ years</td>
<td>38%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration of Type 2 Diabetes</th>
<th>Incidence of Diabetic Retinopathy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4 years</td>
<td>31%</td>
</tr>
<tr>
<td>5-9 years</td>
<td>32%</td>
</tr>
<tr>
<td>10-14 years</td>
<td>38%</td>
</tr>
<tr>
<td>15+ years</td>
<td>51%</td>
</tr>
<tr>
<td>Category</td>
<td>Ocular complications</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Functional</td>
<td>Tritan color vision loss</td>
</tr>
<tr>
<td></td>
<td>Refractive error changes</td>
</tr>
<tr>
<td></td>
<td>Accommodative dysfunction</td>
</tr>
<tr>
<td></td>
<td>Visual field defects</td>
</tr>
<tr>
<td>Extraocular muscle anomalies</td>
<td>Mononeuropathies</td>
</tr>
<tr>
<td>Pupils</td>
<td>Sluggish pupillary reflexes</td>
</tr>
<tr>
<td></td>
<td>Afferent pupillary defects</td>
</tr>
<tr>
<td>Conjunctiva</td>
<td>Bulbar microaneurysms</td>
</tr>
<tr>
<td>Tear film</td>
<td>Dry eye syndrome</td>
</tr>
<tr>
<td>Cornea</td>
<td>Reduced corneal sensitivity</td>
</tr>
<tr>
<td></td>
<td>Basement membrane anomalies, recurrent corneal erosions</td>
</tr>
</tbody>
</table>

* Patient education is an integral part of management for all conditions.
<table>
<thead>
<tr>
<th>Category</th>
<th>Ocular Complications</th>
<th>Management*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cornea (continued)</td>
<td>Descemet's membrane wrinkling</td>
<td>Monitoring</td>
</tr>
<tr>
<td></td>
<td>Endothelial cell changes</td>
<td>Monitoring; all corneal injuries should be monitored carefully for secondary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>infection or evidence of delayed wound healing. This is particularly important</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in patients who wear contact lenses.</td>
</tr>
<tr>
<td>Iris</td>
<td>Depigmentation</td>
<td>Monitoring; routine gonioscopy and tonometry</td>
</tr>
<tr>
<td></td>
<td>Rubeosis iridis (neovascularization on</td>
<td>Gonioscopy to rule out anterior chamber angle involvement and neovascular</td>
</tr>
<tr>
<td></td>
<td>the iris)</td>
<td>glaucoma; dilated fundus examination to search for proliferative retinopathy;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>referral to retina specialist for possible laser surgery</td>
</tr>
<tr>
<td>Lens</td>
<td>Cataracts</td>
<td>Monitoring of both degree of lens opacification and status of any retinopathy;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cataract extraction after careful preoperative retinal evaluation; surgery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>indicated if adequate visualization of the retina is no longer possible</td>
</tr>
<tr>
<td>Vitreous</td>
<td>Hemorrhage</td>
<td>Dilated fundus examination; consultation with retina specialist</td>
</tr>
</tbody>
</table>

* Patient education is an integral part of management for all conditions.
Table 6
Levels of Diabetic Retinopathy

I. Nonproliferative Diabetic Retinopathy (NPDR)
   A. Mild NPDR
      • At least one Ma
      • One or more of the following:
         - Retinal hemorrhages
         - Hard exudates
         - Soft exudates
      • Definition not met for B, C and D (below) and PDR
   B. Moderate NPDR
      • H/Ma > standard photo 2A, or
      • Soft exudates, VB, and IRMA definitely present
      • Definition not met for C and D (below) and PDR
   C. Severe NPDR
      • One of the following:
         - H/Ma > standard photo 2A in all four quadrants
         - VB definitely present in at least two quadrants (see standard photo 6B)
         - IRMA > standard photo 8A in at least one quadrant
      • Definition not met for D (below) and PDR
   D. Very Severe NPDR
      • Two or more lesions of severe NPDR (C above)

II. Proliferative Diabetic Retinopathy (PDR)
   A. Mild PDR
      • One or more of the following:
         - NVE
         - FPD or FPE present; NVD and NVE absent
      • Definition not met for B and C (below)
   B. Moderate PDR
      • One or more of the following:
         - NVE elevated
         - NVD < standard photo 10A
         - VH/PRH and NVE < 1/2 DA; NVD absent
      • Definition not met for C (below)
   C. High-Risk PDR
      • One or more of the following:
         - NVD ≥ 1/4 to 1/3 DA (standard photo 10A)
         - NVD and VH/PRH
         - NVE ≥ 1/2 DA and VH/PRH

III. Clinically Significant Macular Edema (CSME)
    • One or more of the following:
      - Thickening of the retina ≤500 microns
        (1/3 DD) from the center of the macula
      - Hard exudates ≤ 500 microns (1/3 DD) from the center
of the macula with thickening of the adjacent retina
- A zone or zones of retinal thickening ≥1 DA in size, any portion of which is ≤1 DD from the center of the macula
Community Agencies for Initial Contact:
1 Champion Fitness
   Rockford Facility
   515 E Division
   Rockford, MI 49341
   phone: (616) 863-6800

2 Holland Home
   2100 Raybrook SE Suite 300
   Grand Rapids MI 49546
   616-235-5000

3 YMCA
   40 Monroe Ctr St NW ste 201
   Grand Rapids, MI 49503
   616-456-6898

4 Mars Hill
   3501 Fairlanes Ave
   Grandville, MI 49418

5 Kent County Health Department
   700 Fuller Ave NE
   Grand Rapids, MI 49503
   616-632-7100

Working Timeline Edition 1: Target dates

Establish initial contact with organizations via letter by June 18th, 2005. Anticipate receiving a response by July 2, 2005. Meeting cycle will begin within one week of matching with an organization.

Meeting:

2. Present research and data collection within one month of the first meeting or by August 16, 2005.

3. Present initial optometric solution within one month of second meeting or by September 16, 2005.

4. Present final sustainable product within two weeks of third meeting or by September 29, 2005.
Working Timeline Edition 2
Student Diabetic Exam Manual

1. Contact established with Cherry Street Health Services Kathy Sather by August 29, 2005.

2. Approval of Diabetic Exam Manual and Cherry Street Health Services by supervisor Rene Mika on September 6, 2005.

3. Confirmation letter sent to contact Kathy Sather. Set up date to meet with her or conduct a phone conference to discuss further specifics, format, and outline of diabetic exam manual by September 16, 2005.

4. Present research and data collection by October 14, 2005.

5. Present initial optometric solution/rough draft of manual by November 18, 2005.


Working Timeline Edition 3
Student Diabetic Exam Manual

1. Contact established with Cherry Street Health Services Kathy Sather on August 29, 2005.

2. Approval of Diabetic Exam Manual and Cherry Street Health Services by supervisor Rene Mika on September 6, 2005.

3. Confirmation letter sent to contact Kathy Sather. Set up date to meet with her or conduct a phone conference to discuss further specifics, format, and outline of diabetic exam manual on September 16, 2005.

4. Delay Project due to Boards on October 14, 2005.

5. Present updated Research and Development including table of contents to Kathy Sather by December 2005.


Phone Script:
Good afternoon,

My name is Nathan Johnson/Brian Weller, I am a fourth year optometry student at the Michigan College of Optometry. We are offering gratis optometric consulting services as part of our doctoral curriculum. Is there someone available for me to speak with regarding our mission and services?

I would like to take just a minute of your time to educate you on our mission and service.

As you may be aware, optometry provides our health care communities vision and ocular health services, and optometrists are specialists in every aspect of vision care. We understand and have extensive knowledge of environmental vision, safety issues and eye ware, and ocular disease prevention and treatment.

We selected your organization based upon the particular population you serve and special services you provide. Our extensive knowledge of vision and eye care needs is at your disposal.

We would like the opportunity to meet with you and discuss any problem or need related to vision and your organization.

I’ll tell you how it works. Once your specific need is established, we will conduct epidemiological research to clearly define the problem. Optometric solutions will then be proposed to you. Finally, we will present you with a sustainable product for your future benefit.

We will meet with you to discuss your need/problem. We will research the possible product solutions and present them to you. We will produce and present to you a sustainable product that meets your need. We will provide you with feedback throughout the process via phone calls, email, and personal meetings when appropriate.

To reiterate, all of our services are offered to you gratis, we are doing this as a community service project and service learning experience. We are very passionate about eye care and would love the opportunity to work with your respected organization.

Do you have any questions?

You can reach us as (269) 274-4110 / (231) 349-1923 or via email at nathandjohnsonod@yahoo.com or blweller@yahoo.com.

We will follow up with you in a few days with a letter. Please do not hesitate to contact us with any concerns or questions. We are very excited to work with you.
Thank you for your time. Have a great day!
Initial community organization contact letter

Community Organization
123 State Street
Grand Rapids, MI 49351
(616) telephone #

Optometric Consultants
18943 Tall Timbers Drive
Howard City, MI 49329
(231) 349-1923
(269) 274-4110

June 4, 2005

Dear representative,

We are fourth year optometry student consultants at the Michigan College of Optometry seeking community organizations who can benefit from our services. Your organization was selected based upon the particular population you serve and special services you provide. Our extensive knowledge of vision and eye care needs is at your disposal. We encourage you to contact us with any problem or need related to vision and your organization. Once your specific need is established, we will conduct epidemiological research to clearly define the problem. Optometric solutions will then be proposed to you. Finally, we will present you with a sustainable product for your future benefit.

Community health and education is fundamental to our mission as optometric consultants serving our community. We are looking forward to establishing a relationship with you, working in a collaborative environment, and developing a product to serve your organization. If you are interested in speaking with us further, please contact us by July 2, 2005. Thank you for your important time.

Sincerely,

Nathan D. Johnson
Optometric Consultant
(269) 274-4110
nathandjohnsonod@yahoo.com

Brian Weller
Optometric Consultant
(231) 349-1923
blweller@yahoo.com
APPENDIX C
MISSION STATEMENT, OBJECTIVES, AND GOALS
Our Mission:

Perform role as primary eye care provider consultants and provide expertise to a community agency in eye care. Specifically, create a sustainable diabetic eye care manual for student interns specific to the Cherry Street Health Services optometry clinic protocol and patient base.
Goals and Objectives:

Connecting classroom and community: An optometric consultantship

Goals

• Understand optometry’s role in community health, specifically the social responsibility and multiple roles of optometrists as professionals, citizens, and experts in building community health
• Learn to connect the classroom with community service through the process and successful completion of an optometric consultantship
• Learn to work in a collaborative environment with a common purpose identified by the community agency
• Learn about the community context in which the service will be provided
• Learn to address a community-based need by creating an effective and sustainable product that serves to provide a viable solution to the identified need, whether or not the community agency decides to use it
• Create a portfolio which will include a highly efficient, relevant, and research-based (possibly web-based) journal detail meetings, decision making, process methods, outcomes, and recommendations for change

Rationale

• Publicly funded institution showing graduates are serving needs of community/state
• Practice preached reciprocity with community
• Strengthen presence in community; cannot afford to be perceived as insular
• Experiential learning, that is, making experience relevant by taking what is learned from the classroom into the community
• Why not incorporate the mission of college with the core philosophy of collaborative and service-based education and experience (e.g., “the education program and experiences of students will be grounded in service-based, primary-care focused, community practice that is collaborative with other health disciplines”)
• Need to connect consultantship to strategic issues faced by profession/school; i.e. lack of workforce diversity, shortages, demand for graduates with interdisciplinary and population-based competencies

Challenges

• Volume of community contacts
• Pass/fail; students may think they do not need to work as hard
• Element of self-direction; no specific hourly requirement; with overloaded student schedules may be perception of irrelevance and lack of interest
• Communication break-downs
  o Student and agency
  o Student and faculty
Methods

- Orientation and preparation of students (consultants), faculty, and community partner(s)
- Create project planning form (timeline)
- Consultants arrange to meet with community agency to assess needs regarding visual health, education, safety, of specific target population; need must be identified by the community agency and not the expert
- Agency representative sends letter to project supervisor stating the willingness to participate and collaborate with experts
- Consultants define the problem by presenting epidemiological data, the need for reform, and/or other relevant needs identified by community agency
- Consultants define a solution(s) to the problem that will have potential impact
- Consultants design sustainable project that addresses a well-defined need regarding the visual well-being of a particular group, population, served by community agency
- Critical reflection
  - Consultants maintain detailed journal (may be web-based) of processes and outcomes
  - Journal will detail meetings, decision making, process methods, outcomes, and recommendations for change
  - Journal will include relevant research conducted with citations to provide evidence for identification of problem(s), solution(s), methods, and the like
  - Supervisor will evaluate consultants based upon product effectiveness and sustainability.
- Community representative may agree to utilize product but the decision will have no bearing on consultant evaluations
- Consultants may be required to participate in peer review
- A professional portfolio and/or academic poster will be created using mixed media to present all methods and outcomes

Service Learning

Plan of Action

- Describe project. Include description of agency or organization you will be working for (i.e., what is their purpose? How big are they? What is their history? What is their mission? What are their goals?)
- Create a mission statement for your project/consultantship
  - What is the identified need?
  - How are you going to address the need?
  - Why are you needed?
- Create step by step plan to fulfill mission
  - Goal(s)
Measurable objectives to include:

- How are you going to assess findings?
- How will the findings be presented and to whom?
- How does this project tie in with your senior project requirements to obtain your doctorate of optometry degree?

Why Journal?

- To practice writing
- To analyze service situations
- To articulate your own reactions to your service experience
- To record the learning you are experiencing and document progress toward the learning objectives
- To develop recommendation for action or change

Journal questions

- How did you define the problem and what epidemiological evidence have you found?
- What did you do at their site since the last reflection entry?
- What have you done this week?
- What did you observe?
- What did you learn?
- How has it affected you?
- What worked?
- What hasn’t worked?
- What do you think is (will be) the most valuable service you can offer at your site?
- What has been particularly rewarding about your service?
- How could you improve your individual service contribution(s)?
- Have you taken any risks at your service site? If so, what did you do?
- What were the results?
- What would you change about your service assignment that would make it more meaningful for you (or for other students in the future)?
- What have you learned about yourself?
- What new skills have you learned since beginning your service?

Concluding questions

- How is this experience connected to your long-term goals, that is, how is it relevant to your future career as an optometrist?
- What have you learned about yourself?
- What have you learned about the community?
- What have you contributed to the community site?
- What values, opinions, beliefs have changed?
- What was the most valuable lesson learned?
- How have you been challenged?
- What impact did you have on the community?
• What attitudes or beliefs may be changed as a result of your service?
• What evidence do you have of this impact?
• What should others do about this issue?
• What characteristics make a community successful?

Forms of presentation

• oral
  o classroom, teleoptometric grand rounds, other…
• Written report
  o published manuscript
• Poster for AOA
  o Deadline August 1, year of submission
• Portfolio
  o May be used in lieu of paper
  o Must include journal with critical reflections (outline of project, details of defined problem, process, and measured outcomes)
  o Include evidence, photos, brochures