EFFECTIVENESS OF ROUTINE TONOMETRY SCREENING
PERFORMED BY A NURSE IN A
GENERAL MEDICINE CLINIC

by

Cindy Lou Angiulo

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STATEMENT BY AUTHOR

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SIGNED: Cindy Argirolo

APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

Lois E. Prosser
LOIS E. PROSSER
Associate Professor of Nursing

5/22/81
Date
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ABSTRACT

This study proposed the following questions regarding screening for glaucoma: (1) What percentage of patients screened had increased intraocular pressure? (2) What percentage of patients referred were confirmed to have previously undiagnosed glaucoma? and (3) What percentage of patients screened had previously undiagnosed ophthalmologic problems causing decreased visual acuity? A sample of 305 general medicine clinic patients, 35 years of age or older, was screened by a nurse over a two week period.

Patients were screened for visual acuity utilizing the Snellen letter chart and for glaucoma by Schiotz tonometry. Any patient with a visual acuity less than 20/40 or an intraocular pressure greater than 24 mm. Hg was referred for ophthalmologic evaluation.

Analysis of the data revealed that 2.3 percent of this study population were found to have increased intraocular pressure. The percentage of patients referred for increased intraocular pressure that was confirmed to have previously undiagnosed glaucoma was 85.7 percent. The incidence of newly diagnosed glaucoma in this population was 2.0 percent. The incidence of previously undiagnosed ophthalmologic problems causing decreased visual acuity was 5.6 percent of patients screened.
These findings suggest that general medicine clinic patients 35 years of age or older should be screened for visual acuity and glaucoma. This confirms that the nurse using Schiotz tonometry can effectively screen for detection of early glaucoma.
CHAPTER 1

INTRODUCTION

Glaucoma is the second leading cause of irreversible blindness among adults in the United States (Burton, Smith and Nichols, 1980; Chandler, 1979). The National Society for the Prevention of Blindness (1980) estimates that two million Americans thirty-five years and older, or one in every fifty people in that age group, have glaucoma. Approximately 300,000 new cases of glaucoma are diagnosed each year. However, more than a million people have undetected glaucoma. Glaucoma is responsible for fifteen percent of all cases of blindness in adults (Rubenzik, 1980). Approximately 500,000 people, or 225 for every 100,000 of the population in the United States are legally blind. Annually 46,600 people become blind, at a rate of twenty-one per 100,000 population (National Society for the Prevention of Blindness, 1980). The high incidence of this chronic disease constitutes a serious health problem.

The population at greatest risk of the disease includes all adults thirty-five years and older; although it can occur at younger ages, particularly if glaucoma is present in one or more members of the family. Chandler
(1979) reports that both sexes are affected, men slightly more frequently than women. Persons at high risk include the elderly, the non-white population, those with a family history, those with diabetes and those with systemic hypertension (Gorin, 1977).

There has been no significant reduction in the morbidity rate of glaucoma in the past twenty years. Glaucoma is an asymptomatic insidious disease that cannot be prevented. Frequently, the individual is not aware of the problem until peripheral vision decreases or blindness occurs. However, it is known that early detection of glaucoma may afford successful control by medical and, if necessary, surgical intervention (Rubenzik, 1980; Portney, 1977).

Glaucoma may be defined as an ophthalmic disease characterized by persistent or repeated elevation of the intraocular pressure which, eventually, causes certain pathological changes in the eyes (Cope, 1975). There are two types of primary glaucoma in the adult: open-angle glaucoma and closed-angle glaucoma. Closed-angle glaucoma is less common and is not so important from the point of view of glaucoma screening because symptoms arise early in the disease and the individual usually seeks advice soon after they become manifest. For this reason, this investigation will focus on early detection of open-angle glaucoma.
Open-angle glaucoma is the most important type of glaucoma from the point of view of screening, as changes in intraocular pressure may occur within a year and the symptoms are few until irreversible damage has taken place. At least ninety percent of the primary glaucoma cases are of the open-angle glaucoma type (Boyd-Monk, 1979). Open-angle glaucoma is a chronic disease that may originate in one eye before the other; but it is usually bilateral.

Chronic open-angle glaucoma is due to a defect in the drainage mechanism of the eye, resulting in an unstable intraocular pressure which, over the course of months and years, rises to levels above that of the normal intraocular pressure and slowly interferes with the blood supply to the optic nerve (Leydhecker, 1977). Most of the evidence indicates that it is this increased intraocular pressure that results in visual field defects and optic atrophy. The initial damage from glaucoma is only to those reginal fibers responsible for peripheral vision; and, therefore, results in visual field loss (Schwartz, 1978). In the final stages of the disease, the elevated intraocular pressure causes permanent damage to all the reginal nerves, which permits central vision, and blindness results (Chandler, 1979).

Tonometry, a screening method for glaucoma, is the direct measurement of intraocular pressure (Robertson, 1977). Since increased intraocular pressure may be the first sign
of glaucoma, tonometry screening is essential for the early diagnosis of the disease. The Schiotz tonometer measures intraocular pressure by indentation of the cornea by slight pressure (French, 1977). Schiotz tonometry is relatively easy to perform, takes only a few seconds, is accurate and is painless (National Society for the Prevention of Blindness, 1980). However, tonometry screening is rarely a part of the routine physical examination.

Abrahamson (1978) reports that many physicians are reluctant to employ routine glaucoma screening due to lack of experience performing tonometry. Even the conscientious general practitioner or ophthalmologist, with the desire to provide routine tonometry screening, is often too busy with other demands to take on the extra work. In spite of the relatively low cost of the Schiotz tonometer, the medical profession continues to exclude tonometry from the routine physical examination.

The National Society for the Prevention of Blindness (1980) believes that other factors leading to the lack of regular tonometry screening include lack of public awareness about glaucoma and the lack of regular eye care by the population at risk.

Many studies reveal that health professionals, such as registered nurses and nurse practitioners can be effectively utilized to alleviate many of these health care
delivery problems of glaucoma screening (Hirschfield and Boyce, 1977; French, 1977; Boyd-Monk, 1979). Nurses in ambulatory care settings are in an ideal position to perform glaucoma screening provided there is planned referral for ophthalmological evaluation. The adult general medicine clinic population has a relatively large percentage of patients at high risk of the disease.

Individual and group health care education is included in the role of many ambulatory care nurses. This setting yields excellent nursing opportunities for patient education to increase awareness about glaucoma, interpretation of glaucoma screening results and effective follow-up care. In many ambulatory care settings, patients receive continuity of care and are more likely to follow recommendations for referral and follow-up care.

This study attempted to evaluate the effectiveness of tonometry screening performed by nurses in adult ambulatory care general medicine settings. The goal of the glaucoma screening is to prevent irreversible visual field loss and blindness rather than to treat the disease after damage has occurred.

**Purpose of the Study**

The purpose of this study was to determine that an ambulatory care nurse using a Schiotz tonometer can effectively screen patients to detect early glaucoma. The study
also identified those patients in need of diagnosis and treatment for ophthalmologic problems that were previously undetected.

Statement of the Problem

The questions that were investigated in this study were the following:

1. What percentage of patients screened were found to have increased intraocular pressure?

2. What percentage of patients referred for ophthalmological examination were confirmed to have previously undiagnosed glaucoma?

3. What percentage of patients screened were found to have previously undiagnosed ophthalmological problems causing decreased visual acuity?

Significance

This investigation is relevant to nursing education and practice and is significant to the nursing profession. The nurse in an ambulatory care general medicine setting has frequent contact with patients at greatest risk for glaucoma. Since chronic open-angle glaucoma is usually asymptomatic, nurses that incorporate tonometry screening into their practice may provide early detection of the disease.

Studies reveal that if health professionals screen every patient by tonometry during clinic visits, the
diagnosis of glaucoma is made at a much earlier stage with a better prognosis (Leydhecker, 1977; Abrahamson, 1978). Even though two to three percent of patients screened will be found upon examination to have glaucoma or be a glaucoma suspect, general population screening by nurses is not routinely performed.

Kuehn (1975) has shown that nurses can be readily instructed in the technique of Schiotz tonometry. Incorporation of this procedure into nursing education hopefully will lead to practical application. Adequately educated nurses are capable of conducting screening in ambulatory care clinics or during home visits.

This study is significant to the patient because of the deleterious effects and economic impact of blindness secondary to glaucoma. Due to the limited employment capabilities of the patient with blindness, community costs are increased in an attempt to maintain the patient's life and life of his family.

Recognition of glaucoma in the early stages, arresting its development, and preventing blindness are the major objectives of a screening program. Only with early detection of the disease can effective treatment preserve the vision of the individual with glaucoma.
Conceptual Framework

The conceptual framework for this study is based on Wilson's (1968) model for early disease detection and McVay's (1977) model for early detection of open-angle glaucoma.

Wilson bases the model for early disease detection on the belief that "early detection aims at discovering and curing conditions which have already produced pathological change but which have not so far reached a stage at which medical aid is sought spontaneously" (1968, p. 14).

The model in Figure 1 represents the framework for this study. This screening model outlines the preventive approach to health care based on placement on a health continuum. Primary prevention includes specific measures to prevent occurrence of disease (Sharp, 1968). Equal to the status of "wellness" on the health continuum, primary prevention, seeks to abolish disease by protecting the individual and the population from the disease, and, hopefully, providing immunity before pathological change occurs.

Screening techniques for early diagnosis are, therefore, primarily a form of secondary prevention and, in some instances, tertiary prevention, as lapsed cases and those in which complications have occurred are finally detected. Secondary prevention represents a midposition on the health continuum by providing prevention of progress and
Figure 1. Diagramatic representation of model for early disease detection (Wilson, 1968).
continuation of a very early disease/morbid process by early diagnosis (Wilson, 1968). At this point on the continuum, pathology is usually reversible, the individual is presymptomatic or with minimal symptoms and secondary prevention will avert "illness."

Tertiary prevention involves prevention of deterioration, relapse, disability and dependency from advanced disease (Sharp, 1968). Irreversible pathological change is usually present at the time of tertiary prevention and is represented on the health continuum by the "illness" stage.

Since the exact etiology of glaucoma is unknown, a primary prevention program is not possible at the present time. If glaucoma is diagnosed early and treated, progress of the disease can be evaluated. However, any loss of vision cannot be restored. It has been recognized that control of blindness due to glaucoma is in early detection and treatment (Robertson, 1977; Rubenzik, 1980). Therefore, secondary prevention screening programs are practical and feasible (Abrahamson, 1978; Boyd-Monk, 1979).

McVay's (1977) proposed model for primary open-angle glaucoma detection plays a significant role in the secondary prevention of glaucoma and in the primary prevention of blindness due to this disease. He includes a broad screening component with specific diagnostic criteria in conjunction with preventive eye care education and follow-up on
referrals. Figure 2 shows the components of this model system.

The model focuses on those components of an effective glaucoma screening program. These include: (I) preventive eye care education, (II) screening for glaucoma, (III) referral of glaucoma suspects, (IV) follow-up referrals, and (V) permanent screening programs. The first component of preventive eye care education concerns the dissemination of information to health care providers and to people in the high risk population. Louria et al. (1976) believes health education programs will have to be effective if secondary prevention by routine tonometry screening is to occur. This component should include education for: (1) all nursing and medical personnel, particularly general practitioners, internists and nurses working in ambulatory care settings; (2) optometrists and ophthalmology technicians; and (3) the lay public, particularly those over thirty-five years of age.

Screening for glaucoma is the second component and involves the performance of tonometry for all individuals over thirty-five years of age. Several authors believe that trained nurses, technicians and paramedical personnel would be beneficial to screening programs, reducing the time and work load of the physician incurred because of additional
Figure 2. Diagramatic representation of model for early detection of open-angle glaucoma.

Routine screening facilitates the referral of glaucoma suspects (component III) for thorough diagnostic examination. In this model, McVay (1977) suggests ophthalmic examination should include, at minimum, ophthalmoscopy and visual field examination to confirm the diagnosis of glaucoma. Note that diagnosis and treatment are provided by ophthalmologists and are not included as a specific component in the screening program.

The fourth component of the model is follow-up on referrals of glaucoma suspects. The main objective of follow-up, aside from the simple gathering of information about the patients' status, is to insure that the patient did see an ophthalmologist, or at least their general practitioner, about the increased intraocular pressure found on screening.

The final component is the institution of permanent screening programs to assure continued early detection of open-angle glaucoma. Repeated screening every one to five years for those individuals over thirty-five years of age is the final goal of the secondary screening model, with the frequency of future screenings dependent upon the specific findings from the initial screening.
CHAPTER 2

REVIEW OF THE LITERATURE

A thorough review of the literature necessitates discussion of published studies relating to three major areas. First, a survey of articles and studies related to the concept of screening for disease will be discussed. Second, a summary of the reported studies of glaucoma screening will be presented. Third, articles specifically related to the role of the ambulatory care nurse in glaucoma screening will be cited.

Screening for Disease

Early detection of disease is far superior to diagnosis made late in the natural course of a disease process. This is a widely held belief within the health care community (Holland, 1974; Breslow and Somers, 1977; Spitzer, 1979). This is based on the assumption that treatment is more likely to be effective if it can be instituted while the primary pathological process is still fully reversible and before complications have developed (Sharp, 1968). The interest in screening for disease arose out of the concept that early detection at the asymptomatic state is somehow better than symptomatic diagnosis.
The Commission on Chronic Illness defines screening as "the presumptive identification of unrecognized disease or defect by the application of tests, examinations or other procedures which can be applied rapidly" (1957, p. 320). Screening tests sort out apparently well persons who probably have a disease from those who probably do not. A screening test is not intended to be diagnostic. Persons with positive or suspicious findings must be referred to their physician for diagnosis and necessary treatment.

In order to justify screening for a given disease, several criteria must be met. The first criteria is that the disease must have a significant effect on the quality or quantity of life (Holland, 1974). This is dependent upon the resultant severity of the disease and its prevalence. Glaucoma is an important health problem and is clinically a serious disease leading to visual field loss or blindness if not treated. Frame and Carlson (1975) reported there was wide variation among prevalence data for chronic open-angle glaucoma due partly to differences in criteria for diagnosing the disease. Estimates of prevalence ranged from one to three percent of the population over age thirty-five (Leske and Rosenthal, 1979).

The next criteria that must be met in screening for disease is that there should be acceptable methods of treatment available for patients with recognized disease (Whitby,
1974). It is clearly useless to diagnose a disease where no effective treatment can be offered. If after the screening process, the individual is labeled with a disease for which treatment may not be effective and/or the side effects of the intervention may be high, the benefits from the screening are limited. As described by Schwartz (1978), chronic open-angle glaucoma can usually be treated effectively with medication, and surgical intervention is rarely indicated.

Closely associated with effective treatment is that there must be a community resource available in order to confirm the diagnosis of disease and for treatment (Sharp, 1968). In other words, it would be of limited benefit to diagnose a chronic disease with little or no access to medical services which would be provided on a continuing long-term basis. It is clearly established that multiple clinical facilities are available for definitive diagnosis of glaucoma and provision of adequate treatment.

Another criteria for screening of disease is that the condition must have an asymptomatic period during which detection and treatment significantly reduces morbidity and/or mortality (Frame and Carlson, 1975). Clearly, for early detection, there has to be a reasonable period when disease can be detected while symptoms are still absent or are at least not obtrusive. According to Spitzer (1979),
treatment in the asymptomatic phase must yield a therapeutic result superior to that obtained by delaying treatment until symptoms appear. Data on the progression of glaucoma with or without treatment is surprisingly limited considering the high incidence of the disease. Robertson (1977) reported that the destruction of peripheral vision results as glaucoma progresses and central vision is usually retained until the disease is advanced. No specific data on the natural course of glaucoma after the visual field loss occurs could be found in the literature review, but general statements were made about the usual gradual progression to blindness in many cases (Portney, 1977; Chandler, 1979). To substantiate this screening criteria, more critical evaluation of the natural course of glaucoma and benefit from therapy is needed.

The next criteria for screening of disease is that a suitable test or examination must be available at a reasonable cost to detect the condition in the asymptomatic period (Sharp, 1968). In early and presymptomatic diagnosis, the screening tests used on an apparently well population must be applied simply and rapidly. Schiotz tonometry is a suitable screening test for glaucoma since it is easy to perform, takes only a few seconds and is relatively inexpensive (National Society for the Prevention of Blindness, 1980).

Finally, the cost of the screening must be economically balanced in relation to the total expenditure on
medical care (Holland, 1974). It is sometimes considered that detecting disease by screening is an economical form of health care. As described by Sharp (1968), previously undetected disease will be discovered and brought to treatment at an earlier and, therefore, less costly state.

Current thought on screening for disease has been revised to selective screening. Whitby (1974) defines selective screening as the determination of individuals at high risk for a singular risk factor. According to Holland (1974), selective screening rather than mass screening is both a more effective and economical utilization of resources.

Frame and Carlson (1975) published a lengthy four-part series on specific screening recommendations according to physiological subsystems for adults. In the paper they correlated the subsystem with the diseases occurring most frequently within the subsystem. The authors concluded with definite guidelines for periodic screening for each disease and the appropriate interval for examination. In relation to glaucoma screening they stated, "it has a high prevalence, a long asymptomatic course, significant morbidity and treatment is effective in changing the course of the disease if started early" (1975, p. 284). Their recommendations included tonometry plus ophthalmoscopy every four years after the age of forty.
Breslow and Somers (1977) developed a proposal for a periodic lifetime screening program. The authors used clinical and epidemiologic criteria to determine these various examinations, treatments and counseling during an individual's lifetime. In their specific recommendations they excluded glaucoma screening as a procedure for the older middle age group (forty to sixty years). The authors based this on their belief that the reliability of the existing screening procedures and value of treatment before the onset of visual field loss are now being questioned.

In response to the lifetime health monitoring program proposed by Breslow and Somers (1977), Vinger (1977) polled New England ophthalmologists, and his evaluation failed to reveal one physician who agreed that tonometry should be eliminated as a routine screening program. Vinger believes that Breslow and Somers did not have controlled studies to substantiate their statement that treatment before the onset of visual field loss is of no value.

The Canadian Task Force Report on periodic health examination is the most recent and comprehensive evaluation of the data on screening for disease (Spitzer, 1979). Specific recommendations for screening in relation to age and sex were described and a statement of the effectiveness of prevention and treatment, the quality of the evidence supporting specific tests or procedures and a rating of the
strength of their recommendation on a five-point scale.
According to the report, early treatment of open-angle
glaucoma prevents symptomatic visual loss. Ophthalmoscopy,
visual field testing and measurement of intraocular pres­
sure are the specific screening procedures recommended based
on professional consensus. However, at this time the task
force believes there is poor evidence regarding the inclu­
sion of the condition in a periodic health examination and
further research is strongly indicated.

Glaucoma Screening

Most of the literature demonstrates the value of
early glaucoma detection in the prevention of visual field
loss and blindness. The incidence of glaucoma was discussed
in the introduction (Burton, Smith and Nichols, 1980;
Chandler, 1979; Robertson, 1980; National Society for the
Prevention of Blindness, 1980). In spite of variations in
criteria, between one to three percent of the apparently
normal population over the age of forty have been found to
have glaucoma (Sharp, 1968; Kini et al., 1978).

The necessity for glaucoma screening for the high
risk population cannot be overemphasized. The ambulatory
care general medicine setting has a higher population of
individuals with multiple risk factors. Age is a signifi­
cant risk factor in the acquisition of glaucoma. According
to Chandler (1979), glaucoma is widely recognized to occur
with greatest frequency in aged populations and is uncommon in young people. The literature revealed that asymptomatic patients aged thirty-five to forty and older are usually involved in screening programs.

Kini et al. (1978) reported on the overall prevalence of open-angle glaucoma in the Framingham Eye Study. They found that prevalence rates for men were much higher than they were for women and that this difference was statistically significant at the .05 level.

Another high risk group includes the non-white population. As described by Boyd-Monk (1979), glaucoma-related blindness occurs approximately eight times more frequently in blacks than in whites. The etiology of this increased prevalence is unclear, but is possibly due to poor preventive health care.

Becker (1971) reported a number of interesting correlations between diabetes mellitus and open-angle glaucoma. Diabetes occurs more frequently in patients who have open-angle glaucoma than in nonglaucomatous populations matched for age and sex. Glaucoma is found to have a greater prevalence in diabetic than nondiabetic populations similarly matched. Open-angle glaucoma occurs approximately three times more frequently in diabetics and visual field loss appears to develop at a lower pressure in diabetics (Boyd-Monk, 1979).
It has been established that open-angle glaucoma is genetically determined although the exact mode of inheritance is unknown (Chandler, 1979). According to Becker (1971), patients with glaucoma have a family history of the presence of the disease in up to twenty-five percent of the cases.

Vascular hypertension alone is not a risk factor in the development of glaucoma. However, Gorin (1977) reported that there is a risk that patients who have some degree of increased intraocular pressure will have a reduction of the perfusion to the optic nerve and damage may result if the vascular pressure is reduced by hypotensive therapy.

A number of interesting relationships between intraocular pressure and certain medications have been described in the literature. The medications most often prescribed for ambulatory care general medicine patients affecting intraocular pressure can be divided into two groups: medications increasing intraocular pressure and medications decreasing intraocular pressure.

The common medications known to increase intraocular pressure include anticholinergic agents, corticosteroids and nitrates. In the eye, anticholinergic agents block the responses of the sphincter of the iris and the ciliary muscles to cholinergic impulses, thus producing mydriasis and cycloplegia (Green and Spencer, 1969). Lazenby (1970)
reported that these agents have little affect on the intraocular pressure of normal eyes, but mydriatics in general tend to elevate the pressure when above normal because the iris interferes with the drainage of the aqueous humour.

Ocular side effects due to systemic or ocular administration of corticosteroids are common and have significant clinical importance. Adrenal corticosteroid preparations can produce increased intraocular pressure by mydriasis and can cause steroid glaucoma (Fraunfelder, 1976). Ophthalmic administration is more often implicated with drug-induced glaucoma. Miller (1979) reported that a number of patients using cortisone eyedrops for several months developed rapid onset open-angle glaucoma with visual field loss. The mechanism by which ocular steroid therapy produces glaucoma is unknown, but about one-third of all patients on chronic oral and/or topical steroids develop elevated intraocular pressures (Miller, 1979). According to Gorin (1977), the majority of patients with open-angle glaucoma sustain a marked elevation of intraocular pressure if corticosteroid preparations are topically applied to the eye. In contrast, most people with normal eyes have a minimal, if any, change in intraocular pressure in response to prolonged administration of topical ophthalmic corticosteroids.

Fraunfelder (1976) reported that nitrates have the potential to precipitate increased intraocular pressure and
glaucoma. Ocular side effects due to nitrates are uncommon, transient and reversible, and patients with glaucoma taking nitrates should be closely followed.

There are five frequently prescribed medications for the general medicine population known to decrease intraocular pressure. These medicines include propranolol, digoxin, diuretics, insulin and benzodiazepines. Fraunfelder (1976) described that systemic or topical administration of propranolol, a beta-adrenergic blocking agent, produces a decrease in intraocular pressure. Topical ocular use of beta-adrenergic blocking agents is currently under investigation for glaucoma therapy. Timolol, a beta-blocker analogous to propranolol, is often effective in decreasing intraocular pressure with topical administration (Rubenzik, 1980).

Ocular side effects due to the administration of diuretics occur only occasionally and are usually transient. According to Peczon and Grant (1968), a minimal reduction in intraocular pressure may occur with these agents. Diuretics are one of the most commonly prescribed medications in the ambulatory care general medicine setting.

Decreased intraocular pressure has also been reported with systemic administration of digoxin, insulin and benzodiazepines (Green and Spencer, 1969). The possibility of ocular side effects from these medications is of interest
and should be evaluated during examination of general medicine patients.

Since primary open-angle glaucoma is usually an asymptomatic disease process, routine screening has received increasing emphasis in recent years. A number of authors have asserted that routine tonometry be included as part of a standard physical examination for the detection of glaucoma. As described by Hodes and Choromokos (1978), tonometry should be included in every routine physical examination in persons over forty years of age, for this is often the only means of detecting chronic open-angle glaucoma before vision is irretrievably lost. To measure intraocular pressure, they proposed the Schiotz tonometer as the instrument of choice for primary care physicians because of its acceptable accuracy, portability, and limited cost. With routine screening, Hodes and Choromokos believe that most cases of glaucoma can easily be detected.

Abrahamson (1978) recommended that the family physician should include the measurement of intraocular pressure in routine examinations. Other than a mass screening program, he considers this is one of the best methods for the early detection of glaucoma. Abrahamson stated that Schiotz tonometry is the best method for general use and it can be performed by the physician or the nurse.
In a well designed study by Spector et al. (1975) a trained technician screened 768 medical clinic patients utilizing Schiotz tonometry. They found the prevalence of frank glaucoma to be 1.8 percent and suspected glaucoma to be 2.5 percent. From these findings, they concluded that all clinic patients forty years or older should be screened for glaucoma.

A two-year screening program for glaucoma on a general medicine service was reported by Robertson (1977). In this study, screening was performed by Schiotz tonometry on 456 patients over forty-five years of age. Five and one-half percent of the patients screened were found to have increased intraocular pressure and were referred for ophthalmologic evaluation. Diagnosis of glaucoma was confirmed in 44 percent of those referred. Based on the results of the study, Robertson supported routine screening by Schiotz tonometry.

According to Vinger (1977), periodic tonometry associated with ophthalmoscopy are the best screening procedures at the present time for early glaucoma detection. Schwartz (1978) recommended that training primary care providers in the recognition of glaucomatous changes on routine ophthalmoscopy, as part of the physical examination, would be of immense benefit in detection of undiagnosed cases of glaucoma.
Hammond and Begley (1979) studied 219 eye clinic patients and compared ophthalmoscopy to tonometry to determine if they were equal predictors of glaucoma. They hypothesized that the better screening method would be the more accurate, efficient and safer procedure that would require the least amount of time for both the examiner and the patient. In their study they found no statistically significant difference (at the .05 level) between tonometry and ophthalmoscopy. Even though they concluded that the sensitivity and specificity of both screening methods were the same, they advocated ophthalmoscopy because it is less invasive, requires no medication and is more effective in long-term screening.

Role of Ambulatory Care Nurses

Traditionally, the physician has been the primary provider of care. This role has created a drain on physician time, has increased costs, and has contributed to even longer waiting periods for patients trying to seek preventive health care. Health professionals, such as ambulatory care registered nurses and nurse practitioners can be utilized effectively to alleviate some of these health care delivery problems and provide preventive health care (Lewis and Resnik, 1967; Greenfield et al., 1978).

Screening for disease, with an emphasis on early detection, has been found to have a significant effect on
disease states (Wilson, 1968). Previous studies suggest that the ambulatory care nurse plays a vital role in early detection of glaucoma.

Preventive health care should include ophthalmologic evaluation. Nurses in ambulatory care settings routinely perform screening for visual acuity and color discrimination. Hammond and Begley (1979) recommended the inclusion of glaucoma screening in the role of the nurse.

Boyd-Monk (1979) proposed that glaucoma screening could easily be incorporated into nursing practice. As stated in her article, "Schiotz tonometry is no more complicated or difficult to learn than dozens of other demanding skills" (1979, p. 43).

In spite of these specific nursing recommendations for routine glaucoma screening, the review of the literature failed to reveal current nursing screening programs.

One of the first major glaucoma screening programs by nurses was reported by Adler in 1969. This program was initiated by the Durham County Health Department in North Carolina and consisted of a nurse-run glaucoma screening clinic. Screening for visual acuity and Schiotz tonometry were performed by public health nurses. Over a three-year period, 10,264 persons were screened, 177 (1.7 percent) were referred for ophthalmologic evaluations, and 94 cases of unknown glaucoma and 83 suspicious cases were diagnosed.
Kuehn (1975) reported on a tonometry training program for nurses in Vermont. Registered nurses, nurse practitioners and student nurses were instructed by other registered nurses in Schiotz tonometry techniques, and they experienced supervised practice in nurse-run community screening programs. The author concluded that very few nurses were unable to master the technique of Schiotz tonometry and usually only a two-hour supervised practice was necessary. The study documented that there were no incidences of untoward effects as a result of nurse-run screening utilizing the Schiotz tonometer.

According to Spector et al. (1975), because many physicians are reluctant to routinely screen for glaucoma, possibly due to limited training or experience or time restraints, there are a large number of false positive tests by those who perform tonometry episodically. Therefore, he proposed that nurses or technicians in ambulatory care settings who perform tonometry routinely are more likely to obtain true positive results.

One of the factors leading to the success of any glaucoma screening program is the patient's awareness about the disease process. French (1977) suggested that, with a thorough understanding of the pathophysiology of glaucoma, the nurse is in an ideal position to provide education about the disease and its potential to cause blindness. The role
of the ambulatory care nurse cannot be limited to only
detection of possible glaucoma cases, but must include
patient education, counseling glaucoma cases and suspects
and providing thorough follow-up on screening referrals.

**Summary of Literature Review**

The review of the literature demonstrated that early
detection of glaucoma by screening programs can assure treat­
ment in the early stages of the disease process before com­
plications have developed. Since chronic open-angle glaucoma
is asymptomatic until late in its course, only by routine
screening can the incidence of irreversible visual loss due
to this disease be reduced. Screening for chronic open-
angle glaucoma does meet the specific criteria necessary to
justify a selective screening program.

Current recommendations for screening for glaucoma
are varied and further research is needed in this area.
Screening in the ambulatory care general medicine setting
is ideal due to the higher percentage of individuals with
multiple risk factors. Performance of routine glaucoma
screening by nurses will hopefully more effectively utilize
health care resources and provide a higher quality of pre­
ventive health care.
CHAPTER 3

METHODOLOGY

This chapter describes the design of the study, the sample population and the setting, the measurement instruments, and analysis of the data.

Design of the Study

This was a descriptive study designed to: (1) identify the percentage of patients that had increased intraocular pressure, (2) identify the percentage of patients that had confirmed previously undiagnosed glaucoma, and (3) identify the percentage of patients that had previously undiagnosed ophthalmologic problems decreasing visual acuity.

The Study Population and the Setting

The population for this study was a convenient sample of general medicine clinic patients who were: (1) thirty-five years of age or older, and (2) willing to participate in this study. A sample of 305 subjects was obtained.

The setting for this study was a large urban university based general medicine clinic. The clinical area is a 5,271 square foot ambulatory care center divided into two
patient care modules. Each module has eight examination rooms and one minor surgical procedure room. This facility has a capacity of approximately 30,000 patient visits per year and there were approximately 18,000 patient visits in twelve months. The general medicine clinic is a major site for clinical training of physicians, nurse practitioners and health educators. Written permission was obtained from the director of the general medicine clinic where the investigation was conducted.

The Measurement Instruments

The two instruments selected for use in this study were the Snellen letter chart to determine visual acuity and Schiotz tonometry to measure intraocular pressure.

Snellen Letter Chart

Visual acuity screening with the Snellen letter chart was determined for every subject prior to the performance of Schiotz tonometry. The purpose of this test was to detect any subject who had poor vision and needed ophthalmologic evaluation. As revealed in the review of the literature, visual acuity testing was also recommended as a precautionary measure to offset any claims for vision problems resulting from the instillation of eye drops or from the tonometry procedure itself (National Society for the Prevention of Blindness, 1980; Kuehn, 1975).
The Snellen letter chart was placed on a light-colored wall in a well-lighted area. The subject stood exactly 20 feet from the chart. A subject who wore glasses for distance vision or contact lenses was always tested with glasses or contact lenses in place. The objective was to test each subject with the best corrected distance vision.

Screening for visual acuity with the Snellen letter chart has been well established in current preventive health care practice. When performed correctly, the Snellen letter chart is considered reliable (Kini et al., 1978; National Society for the Prevention of Blindness, 1980).

Schiotz Tonometry

The purpose of Schiotz tonometry was to detect intraocular pressure. The Schiotz tonometer measured the resistance of the eye to the corneal indentation of a plunger. The resistance was registered on a scale of the tonometer. By comparing the scale reading to a calibration table (see Table 1), the intraocular pressure was accurately determined (Abrahamson, 1978).

Schiotz tonometry is well established in ophthalmology and numerous articles have commented on the reliability of this screening procedure (Spector et al., 1975; Abrahamson, 1978; Chandler, 1979). Robertson (1977) reported that Schiotz tonometry was reliable and when it was compared
Table 1. Calibration scale for Schiotz tonometers

<table>
<thead>
<tr>
<th>Reading</th>
<th>5.5 Gm.</th>
<th>7.5 Gm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>41.5</td>
<td>59.1</td>
</tr>
<tr>
<td>0.5</td>
<td>37.8</td>
<td>54.2</td>
</tr>
<tr>
<td>1.0</td>
<td>34.5</td>
<td>49.8</td>
</tr>
<tr>
<td>1.5</td>
<td>31.6</td>
<td>45.8</td>
</tr>
<tr>
<td>2.0</td>
<td>29.0</td>
<td>42.1</td>
</tr>
<tr>
<td>2.5</td>
<td>26.6</td>
<td>38.8</td>
</tr>
<tr>
<td>3.0</td>
<td>24.4</td>
<td>35.8</td>
</tr>
<tr>
<td>3.5</td>
<td>22.4</td>
<td>33.0</td>
</tr>
<tr>
<td>4.0</td>
<td>20.6</td>
<td>30.4</td>
</tr>
<tr>
<td>4.5</td>
<td>18.9</td>
<td>28.0</td>
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<tr>
<td>5.0</td>
<td>17.3</td>
<td>25.8</td>
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<tr>
<td>5.5</td>
<td>15.9</td>
<td>23.8</td>
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<tr>
<td>6.0</td>
<td>14.6</td>
<td>21.9</td>
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<tr>
<td>6.5</td>
<td>13.4</td>
<td>20.1</td>
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<td>7.0</td>
<td>12.2</td>
<td>18.5</td>
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<tr>
<td>7.5</td>
<td>11.2</td>
<td>17.0</td>
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<tr>
<td>8.0</td>
<td>10.2</td>
<td>15.6</td>
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<tr>
<td>8.5</td>
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<td>9.0</td>
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<td>9.5</td>
<td>7.8</td>
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<td>10.5</td>
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<td>11.0</td>
<td>5.9</td>
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<tr>
<td>11.5</td>
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<td>12.0</td>
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<td>5.0</td>
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<td>15.0</td>
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<td>4.0</td>
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</table>
to Goldmann applanation tonometry, the standard of glaucoma reference for ophthalmologists, the findings agreed fairly well.

The nurse investigator was trained in the use of the Schiotz tonometer and demonstrated proficiency by obtaining equal pressures with the tonometer in comparison to an ophthalmologist during practice sessions. To increase reliability of the tonometry, the nurse investigator performed all the tonometry testing, decreasing investigator differences in scale reading preference. Only one Schiotz tonometer was used for data collection in this study.

Insel (1974) reported that the adequacy and frequency of cleaning of the Schiotz tonometer was the major reason for testing errors. In this study, the adequacy of cleaning was assured by ultraviolet light sterilization before each subject was tested.

Another frequent cause of unreliability in the use of the Schiotz tonometer was inaccurate calibration. The tonometer used in this study was recently purchased and calibrated. To test for accuracy before each screening, the base of the Schiotz tonometer was rested on the model test block in the tonometer case. A zero reading was noted when the plunger was flush with the metal plate which indicated accurate calibration.
Another frequent cause of errors in tonometry related to the methodology of the investigator. An artificially high reading resulted from excessive pressure applied by the examiner's fingers in separation of the lids (Insel, 1974). In this study, the investigator lifted the lids gently in separation so as to avoid pressure on the globe.

 Decreased reliability in Schiotz tonometry was reported if the non-tested eye was covered by the investigator's hand (Robertson, 1977). Fixation of the non-tested eye was not interfered with in this study because the investigator approached each eye from a temporal position.

 Insel (1974) reported that methodology problems related to the subject included excessively tight clothing and anxiety, from which resulted elevated intraocular pressure. In this study, tight clothing was loosened (for example; collars, ties, scarfs, hair combs), and the subject was encouraged to relax to increase reliability of the tonometry results.

 The validity of screening tests has been determined by specificity and sensitivity. Holland (1974) defined sensitivity as the ability of the test to give a positive finding when the person truly has the disease under study. Schiotz tonometry has been ascertained to be sensitive in the measurement of intraocular pressure (Abrahamson, 1978). The definition of specificity is the ability of the test to
give a negative finding when the person tested is free of
disease under study (Holland, 1974). According to Chandler
(1979), with the Schiotz tonometer there was relatively
slight chance for mistakingly diagnosing glaucoma in the
normal eye.

**Methods of Data Collection**

Data collection occurred over a two-week period.
Subjects were approached in the waiting room by the re­
searcher while awaiting their regular clinic appointment.
They voluntarily participated in the study before or after
their clinic visit based on the recommendation for screening
by ten staff members in the general medicine clinic.

The initial category of data collection included the
identification of risk factors in the acquisition of glau­
coma for each subject. The researcher questioned each
subject in regards to: (1) sex, (2) age, (3) race, (4) history
of diabetes, (5) history of hypertension, and (6) family
history of glaucoma. All responses were recorded on page
one of the data collection form. A copy of this form is
found in Appendix B. In addition, the researcher questioned
each subject in regards to all medications that they were
currently taking and recorded their responses on the data
collection form. The name of the subject's general medicine
physician was recorded on the data collection form in order
to report abnormal findings on examination. This assured
direct communication of the screening results to the appropriate physician and, hopefully, increased continuity of health care.

After completion of the initial interview with the subject, visual acuity was tested using the Snellen letter chart. Both eyes were tested separately, first the right eye followed by the left eye. The eye not being tested was properly covered with a 3 x 5 inch file card. The subject was instructed to read the top line on the Snellen letter chart, beginning with the first letter of the line and proceeding until reaching the end of the line. If that line was read correctly, the subject proceeded to the next lower line. To have read correctly a given line of letters, the subject had to be able to identify correctly one more than half of the letters on the line.

Results were recorded for each eye of the data collection form by entering the smallest line of letters which the subject was able to read correctly. Visual acuity was recorded as a fraction; the numerator represented the distance from the chart (always 20 feet) and the denominator indicated the line which the subject could read correctly. 20/20 represented normal vision for distance, indicating the individual tested was able to read the 20-foot line on the Snellen letter chart at 20 feet.
Any visual acuity of 20/50 (which indicated the subject tested read at 20 feet the line which should be read normally at 50 feet) or less was referred for ophthalmologic evaluation. This referral criteria was selected from the literature review (Kini et al., 1978; National Society for the Prevention of Blindness, 1980).

Next, Schiotz tonometry was performed to determine intraocular pressure. The purpose and procedure of Schiotz tonometry was explained for a second time to each subject immediately prior to the test. The test was not performed on any subject with a known allergy to topical ocular anesthetic. Prior to the performance of Schiotz tonometry, the subject was questioned regarding contact lenses and requested to remove them if applicable. For those subjects wearing contact lenses, they were instructed that the lenses must not be reinserted for an hour after the test as the eyes would be anesthetized for approximately that long.

If the subject denied known hypersensitivity to topical ocular anesthetic, instillation of one drop of proparacaine hydrochlorine ophthalmic solution 0.5 percent was performed in each eye while the subject was supine. All subjects were instructed not to rub their eyes for one hour after the test since the topical anesthetic would last approximately that long.
Ultraviolet light sterilization of the Schiotz tonometer was performed prior to testing of each subject.

To standardize the testing procedure, tonometry was always performed with the subject supine, and always first in the right eye and then in the left eye. Once the eyes are anesthetized (approximately 15 seconds after the instillation of the drops), the lids were held open with the fingers of the left hand, while the right hand held the tonometer. The left index finger was placed on the skin of the upper lid and the left thumb on the skin of the lower lid. The researcher then separated the lids, widening the palpebral fissure as much as possible without putting pressure on the eyeball.

The right hand held the tonometer, with the thumb on one arm of the instrument and the middle finger on the opposite arm, leaving the index finger free to rotate the scale into proper position for viewing. As the patient looked at a fixation object on the ceiling, the tonometer was brought in from the temporal side, gently placed perpendicularly on the cornea, and the tonometer scale was read.

For the initial tonometry screening, a 5.5 gram weight was used. Normal intraocular pressure was represented by a range between 14 and 21 mm Hg which must have registered on the tonometer with a scale reading of 3.5 or greater (Abrahamson, 1978; National Society for the
Prevention of Blindness, 1980; Chandler, 1979). If the intraocular pressure was elevated, a scale reading of 3.0 or under in either eye, a second testing was performed using a 7.5 gram weight to increase reading accuracy. A retest was also obtained if there was a difference of 2 scale units, or more in intraocular pressure between the eyes. Waiting time between the second testing was at least 15 minutes, and the eyes were reanesthetized.

Results were recorded for both eyes on the data collection form indicating the plunger weight and the tonometry scale reading. A subject with a scale reading of 5.5 or under in either eye, on a second testing with a 7.5 gram weight on the tonometer, was referred for further ophthalmologic evaluation (Abrahamson, 1978; National Society for the Prevention of Blindness, 1980; Hodes and Choromokos, 1978).

Upon completion of the testing, each subject was given written results for both the visual acuity and tonometry screening. Copies of these interpretation forms are found in Appendices C through F.

Follow-up ophthalmologic referral was established by the investigator within three weeks after the initial data collection. This was accomplished by telephone contact with the referral ophthalmologist or by a written summary of evaluation findings. Copies of the ophthalmologist's report forms are found in Appendices G through H. Each subject
that was referred for further evaluation signed a consent form to obtain medical information from the referral physician.

If the investigator failed to receive an ophthalmologist's report for a patient referred for further evaluation due to increased intraocular pressure, a letter was sent to the patient. This letter restated the seriousness of glaucoma and the importance of further ophthalmologic evaluation. A copy of the follow-up letter for a glaucoma suspect is found in Appendix I.

**Analysis of the Data**

All test scores for each subject were recorded on the data collection form. The data were coded and submitted for computer analysis. Data analysis was conducted using descriptive statistics and included frequency distribution and percentages for each item. The subjects were divided into two groups: those with normal findings on examination and those referred for ophthalmologic evaluation. Differences and similarities between groups were examined.

**Human Subjects**

This study was approved by the Human Subjects Committee of the University of Arizona. A copy of the subject consent form is found in Appendix A. Due to the large number of aged individuals in this study sample, the subject consent
form was typed in upper case letters to enhance the readability of the form.
CHAPTER 4

PRESENTATION AND ANALYSIS OF DATA

This study proposed the following questions:
(1) What percentage of patients screened were found to have increased intraocular pressure? (2) What percentage of patients referred for ophthalmologic evaluation were confirmed to have previously undiagnosed glaucoma? (3) What percentage of patients screened were found to have previously undiagnosed ophthalmologic problems causing decreased visual acuity? This chapter presents the findings and analyses of the data that were collected to answer the questions proposed in this study. To facilitate systematic description of the data, the study population was divided into three groups according to their results of visual acuity and tonometry screening: (1) normal visual acuity and intraocular pressure, (2) decreased visual acuity, and (3) increased intraocular pressure with or without decreased visual acuity. The data for each of these groups will be compared with the findings of the total population studied.

Evaluation of the data that were collected in this study did not lend itself to inferential statistical analysis since there were only a small number of the total
patients screened who were referred for increased intraocular pressure. After consultation with four statisticians, a conclusion was drawn that the data analysis would be in terms of measurement of central tendency and frequency distribution.

**Characteristics of the Sample**

The findings were based on a sample of 305 subjects who met preselected criteria. They were patients attending a general medicine clinic who were 35 years of age or older and willing to participate in the study. The initial data collected regarding the study population included sex, age and race. In addition, pertinent information about history of diabetes and hypertension along with data of last eye examination was gathered.

The distribution of the sample according to sex is presented in Table 2. Of the total population screened, there were 107 males (35.1 percent) and 198 females (64.9 percent). Two out of three patients were female in both the normal visual acuity and intraocular pressure and decreased visual acuity groups. Six out of seven patients (85.7 percent) who had increased intraocular pressure were females.

The subjects ranged in age from 35 to 91 years with a mean age of 60 years of the total patients screened. The mean age of the patients with normal visual acuity and intraocular pressure was 59 years and the mean age of the
Table 2. Distribution of patients attending a general medicine clinic who had visual acuity and tonometry screening by sex

<table>
<thead>
<tr>
<th></th>
<th>Normal Visual Acuity and Intraocular Pressure</th>
<th>Decreased Visual Acuity&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Increased Intraocular Pressure With/Without Decreased Visual Acuity&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Total Screened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Number</td>
<td>Percent</td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>Male</td>
<td>94</td>
<td>35.1</td>
<td>12</td>
<td>40.0</td>
</tr>
<tr>
<td>Female</td>
<td>174</td>
<td>64.9</td>
<td>18</td>
<td>60.0</td>
</tr>
<tr>
<td>Total</td>
<td>268</td>
<td>100.0</td>
<td>30</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<sup>1</sup>Visual acuity less than 20/40 in either eye

<sup>2</sup>Intraocular pressure greater than 24.0 mm Hg in either eye
patients with decreased visual acuity was 67 years. In comparison, the mean age of those patients with increased intraocular pressure was 70 years.

Table 3 identifies the age range of the patients screened. Of the patients in the normal visual acuity and intraocular pressure group, there was a higher percentage of younger people than older people. For example, of the people with normal screening results, 64 percent (117) of the patients were under the age of 65, as compared with only 40 percent (95) of that age range for patients with decreased visual acuity and 29 percent of patients with increased intraocular pressure.

The distribution of patients screened by race is represented in Table 4. Approximately 54 percent of the total population were minorities (black, oriental, Spanish). In the normal visual acuity and intraocular pressure group, 26.1 percent were black and 45.1 percent were white. In comparison, 57.1 percent of the patients with increased intraocular pressure were black and 28.6 percent were white from a total sample of seven. The data indicates that of the 305 individuals screened, seven had increased intraocular pressure. Of these patients, two were white, four were black, and there was one Spanish person.

Table 5 reveals the number and percent of patients with diabetes. Of the 305 people screened, 80 patients
Table 3. Age range of patients attending a general medicine clinic who had visual acuity and tonometry screening

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Normal Visual Acuity and Intraocular Pressure</th>
<th>Decreased Visual Acuity¹</th>
<th>Increased Intraocular Pressure With/Without Decreased Visual Acuity²</th>
<th>Total Screened</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-44</td>
<td>41 15.3</td>
<td>2 6.7</td>
<td>0 0.0</td>
<td>43 14.1</td>
</tr>
<tr>
<td>45-54</td>
<td>59 22.0</td>
<td>2 6.7</td>
<td>1 14.3</td>
<td>62 20.3</td>
</tr>
<tr>
<td>55-64</td>
<td>73 27.2</td>
<td>8 26.7</td>
<td>1 14.3</td>
<td>82 26.9</td>
</tr>
<tr>
<td>65-74</td>
<td>71 26.5</td>
<td>11 36.7</td>
<td>2 28.6</td>
<td>84 27.5</td>
</tr>
<tr>
<td>75-84</td>
<td>22 8.2</td>
<td>5 16.7</td>
<td>2 28.6</td>
<td>29 9.5</td>
</tr>
<tr>
<td>85 &amp; over</td>
<td>2 0.7</td>
<td>2 6.7</td>
<td>1 14.3</td>
<td>5 1.6</td>
</tr>
<tr>
<td>Total</td>
<td>268 100.0*</td>
<td>30 100.0*</td>
<td>7 100.0*</td>
<td>305 100.0*</td>
</tr>
</tbody>
</table>

¹Visual acuity less than 20/40 in either eye
²Intraocular pressure greater than 24.0 mm Hg in either eye
*The figures do not add up to 100 percent due to rounding
Table 4. Distribution of patients attending a general medicine clinic who had visual acuity and tonometry screening by race

<table>
<thead>
<tr>
<th>Race</th>
<th>Normal Visual Acuity and Intraocular Pressure</th>
<th>Decreased Visual Acuity&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Increased Intraocular Pressure With/Without Decreased Visual Acuity&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Total Screened</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>White</td>
<td>121</td>
<td>45.1</td>
<td>12</td>
<td>40.0</td>
</tr>
<tr>
<td>Black</td>
<td>70</td>
<td>26.1</td>
<td>9</td>
<td>30.0</td>
</tr>
<tr>
<td>Oriental</td>
<td>5</td>
<td>1.9</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Spanish</td>
<td>68</td>
<td>25.4</td>
<td>7</td>
<td>23.4</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>1.5</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Total</td>
<td>268</td>
<td>100.0</td>
<td>30</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<sup>1</sup>Visual acuity less than 20/40 in either eye
<sup>2</sup>Intraocular pressure greater than 24.0 mm Hg in either eye
Table 5. Number and percent of patients attending a general medicine clinic who had diabetes who had visual acuity and tonometry screening

<table>
<thead>
<tr>
<th>Diabetes</th>
<th>Normal Visual Acuity and Intraocular Pressure</th>
<th>Decreased Visual Acuity(^1)</th>
<th>Increased Intraocular Pressure With/Without Decreased Visual Acuity(^2)</th>
<th>Total Screened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>66    24.6</td>
<td>10   33.3</td>
<td>4      57.1</td>
<td>80   26.2</td>
</tr>
<tr>
<td>No</td>
<td>201    75.0</td>
<td>20   66.6</td>
<td>3      42.9</td>
<td>224  73.4</td>
</tr>
<tr>
<td>No Answer</td>
<td>1      0.4</td>
<td>0    0.0</td>
<td>0      0.0</td>
<td>1    0.3</td>
</tr>
<tr>
<td>Total</td>
<td>268    100.0</td>
<td>30   100.0*</td>
<td>7      100.0</td>
<td>305 100.0*</td>
</tr>
</tbody>
</table>

\(^1\)Visual acuity of less than 20/40 in either eye
\(^2\)Intraocular pressure greater than 24.0 mm Hg in either eye
*The figures do not add up to 100 percent due to rounding
(26.2 percent) reported having diabetes. Contrasting the percentage of patients in the normal visual acuity and intraocular pressure group with the percentage of patients with increased intraocular pressure, the percent of patients reporting diabetes was 24.6 and 57.1, respectively. Of the ten patients found to have decreased visual acuity, they were slightly more likely to report a history of diabetes than those patients in the group with normal screening results (33.3 percent as compared to 24.6 percent).

The number and percent of patients with hypertension is shown in Table 6. Interestingly, 63.3 percent (194) of the study population (305) reported having hypertension. There was a tendency that those patients in both the decreased visual acuity (73.3 percent) and increased intraocular pressure groups (71.4 percent) were slightly more likely to report a history of hypertension.

Table 7 displays the mean number of years since the patient's last eye examination. Of the total patients screened, the mean number of years since an eye examination was 3.5 years. There was almost no difference in the length of time since previous eye examination between the group with normal screening results and the decreased visual acuity group. Surprisingly, the patients with increased intraocular pressure were seen more recently for an eye examination in comparison to the patients in the other groups.
Table 6. Number and percent of patients attending a general medicine clinic who had hypertension who had visual acuity and tonometry screening

<table>
<thead>
<tr>
<th>Hypertension</th>
<th>Normal Visual Acuity and Intraocular Pressure</th>
<th>Decreased Visual Acuity(^1)</th>
<th>Increased Intraocular Pressure With/Without Decreased Visual Acuity(^2)</th>
<th>Total Screened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>167 62.3</td>
<td>22 73.3</td>
<td>5 71.4</td>
<td>194 63.6</td>
</tr>
<tr>
<td>No</td>
<td>100 37.3</td>
<td>8 26.7</td>
<td>2 28.6</td>
<td>110 36.1</td>
</tr>
<tr>
<td>No Answer</td>
<td>1 0.4</td>
<td>0 0.0</td>
<td>0 0.0</td>
<td>1 0.3</td>
</tr>
<tr>
<td>Total</td>
<td>268 100.0</td>
<td>30 100.0</td>
<td>7 100.0</td>
<td>305 100.0</td>
</tr>
</tbody>
</table>

\(^1\)Visual acuity less than 20/40 in either eye  
\(^2\)Intraocular pressure greater than 24.0 mm Hg in either eye
Table 7. Mean number of years since last eye examination of patients attending a general medicine clinic who had visual acuity and tonometry screening

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Years Since Last Eye Examination</th>
<th>Number of Patients Screened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Visual Acuity and Intraocular Pressure</td>
<td>3.7</td>
<td>268</td>
</tr>
<tr>
<td>Decreased Visual Acuity&lt;sup&gt;1&lt;/sup&gt;</td>
<td>3.8</td>
<td>30</td>
</tr>
<tr>
<td>Increased Intraocular Pressure With/Without Decreased Visual Acuity&lt;sup&gt;2&lt;/sup&gt;</td>
<td>2.3</td>
<td>7</td>
</tr>
<tr>
<td>Total Screened</td>
<td>3.5</td>
<td>305</td>
</tr>
</tbody>
</table>

<sup>1</sup> Visual acuity less than 20/40 in either eye
<sup>2</sup> Intraocular pressure greater than 24.0 mm. Hg in either eye
Findings Related to Increased Intraocular Pressure

Table 8 identifies the number and percent of patients who were previously examined for glaucoma. Fifty percent of the patients with normal visual acuity and intraocular pressure had previously been examined for glaucoma and 60.0 percent of the patients in the decreased visual acuity group reported previous examination. However, 71.4 percent of the patients referred for increased intraocular pressure had previously been examined for glaucoma.

The number and percent of patients screened for glaucoma who had a family history of the disease is represented in Table 9. Of the seven patients found to have increased intraocular pressure, only one person reported a family history of glaucoma. Approximately 10.0 percent (29) of the patients in the group with normal intraocular pressure reported a family history of the disease, although five percent (15) of the patients in that group did not respond to the question because they had no knowledge of family history.

Table 10 reveals the mean intraocular pressure for patients who had tonometry screening. Of the total population (305) screened, the mean intraocular pressure was 15.4 mm Hg in both eyes. Of the 30 patients with decreased visual acuity, the mean intraocular pressure was 14.2 mm Hg. Seven patients were found to have increased intraocular
Table 8. Number and percent of patients attending a general medicine clinic who were previously examined for glaucoma who had visual acuity and tonometry screening.

<table>
<thead>
<tr>
<th>Past Glaucoma Examination</th>
<th>Normal Visual Acuity and Intraocular Pressure</th>
<th>Decreased Visual Acuity&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Increased Intraocular Pressure With/Without Decreased Visual Acuity&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Total Screened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>134 50.0</td>
<td>18 60.0</td>
<td>5 71.4</td>
<td>157 51.5</td>
</tr>
<tr>
<td>No</td>
<td>114 42.5</td>
<td>9 30.0</td>
<td>1 14.3</td>
<td>124 40.6</td>
</tr>
<tr>
<td>No Answer</td>
<td>20 7.5</td>
<td>3 10.0</td>
<td>1 14.3</td>
<td>24 7.9</td>
</tr>
<tr>
<td>Total</td>
<td>268 100.0</td>
<td>30 100.0</td>
<td>7 100.0</td>
<td>305 100.0</td>
</tr>
</tbody>
</table>

<sup>1</sup>Visual acuity less than 20/40 in either eye

<sup>2</sup>Intraocular pressure greater than 24.0 mm Hg in either eye
Table 9. Number and percent of patients attending a general medicine clinic who had a family history of glaucoma who had tonometry screening.

<table>
<thead>
<tr>
<th>Family History of Glaucoma</th>
<th>Normal Intraocular Pressure</th>
<th>Increased Intraocular Pressure&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Total Screened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>29 (9.7)</td>
<td>1 (14.3)</td>
<td>30 (9.8)</td>
</tr>
<tr>
<td>No</td>
<td>254 (85.2)</td>
<td>6 (85.7)</td>
<td>260 (85.2)</td>
</tr>
<tr>
<td>No Answer</td>
<td>15 (5.0)</td>
<td>0 (0.0)</td>
<td>15 (4.9)</td>
</tr>
<tr>
<td>Total</td>
<td>298 (100.0&lt;sup&gt;*&lt;/sup&gt;)</td>
<td>7 (100.0)</td>
<td>305 (100.0&lt;sup&gt;*&lt;/sup&gt;)</td>
</tr>
</tbody>
</table>

<sup>1</sup>Intraocular pressure greater than 24.0 mm Hg in either eye
<sup>*</sup>The figures do not add up to 100 percent due to rounding
Table 10. Mean intraocular pressure for right and left eye of patients attending a general medicine clinic who had tonometry screening

<table>
<thead>
<tr>
<th>Group</th>
<th>Right Eye</th>
<th>Left Eye</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Visual Acuity and Intraocular Pressure</td>
<td>15.3 mm. Hg</td>
<td>15.1 mm. Hg</td>
<td>268</td>
</tr>
<tr>
<td>Decreased Visual Acuity&lt;sup&gt;1&lt;/sup&gt;</td>
<td>14.2 mm. Hg</td>
<td>14.2 mm. Hg</td>
<td>30</td>
</tr>
<tr>
<td>Increased Intraocular Pressure With/Without Decreased Visual Acuity&lt;sup&gt;2&lt;/sup&gt;</td>
<td>24.3 mm. Hg</td>
<td>27.7 mm. Hg</td>
<td>7</td>
</tr>
<tr>
<td>Total Screened</td>
<td>15.4 mm. Hg</td>
<td>15.4 mm. Hg</td>
<td>305</td>
</tr>
</tbody>
</table>

<sup>1</sup>Visual acuity less than 20/40 in either eye
<sup>2</sup>Intraocular pressure greater than 24.0 mm. Hg in either eye
pressure greater than 24.0 mm Hg, with a mean pressure of 24.2 mm Hg in the right eye and a slightly higher pressure of 27.7 mm Hg in the left eye.

The number and percent of general medicine clinic patients who were currently taking five commonly prescribed medications known to decrease intraocular pressure are illustrated in Table 11. The patients found to have increased intraocular pressure were taking more medication known to decrease intraocular pressure in comparison to the number of patients on these medications in the group with normal screening results. There was no apparent difference in the mean intraocular pressure of patients who were currently taking benzodiazepines, digoxin, diuretics or insulin. The mean intraocular pressure of patients on propranolol was 13.3 mm Hg in the right eye and 13.1 mm Hg in the left eye. In contrast, the mean intraocular pressure of patients not taking propranolol was higher, with a pressure of 15.4 mm Hg in both eyes.

Three medications commonly prescribed for ambulatory care general medicine patients known to increase intraocular pressure include anticholinergic agents, corticosteroids and nitrates. Table 12 presents the number and percent of patients who were currently taking these medications. The number of patients found to have increased intraocular pressure who were taking these medications that could cause
Table 11. Number and percent of tonometry screened patients attending a general medicine clinic who were currently taking medications known to decrease intraocular pressure

<table>
<thead>
<tr>
<th>Medication</th>
<th>Normal Intraocular Pressure</th>
<th>Increased Intraocular Pressure</th>
<th>Total Screened</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
<td>Number</td>
</tr>
<tr>
<td><strong>Benzodiazepines</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>22</td>
<td>7.4</td>
<td>0</td>
</tr>
<tr>
<td>No</td>
<td>276</td>
<td>92.6</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>278</td>
<td>100.0</td>
<td>7</td>
</tr>
<tr>
<td><strong>Digoxin</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>32</td>
<td>10.7</td>
<td>2</td>
</tr>
<tr>
<td>No</td>
<td>266</td>
<td>89.3</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>298</td>
<td>100.0</td>
<td>7</td>
</tr>
<tr>
<td><strong>Diuretics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>159</td>
<td>53.4</td>
<td>5</td>
</tr>
<tr>
<td>No</td>
<td>139</td>
<td>46.6</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>298</td>
<td>100.0</td>
<td>7</td>
</tr>
<tr>
<td><strong>Insulin</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>35</td>
<td>11.7</td>
<td>3</td>
</tr>
<tr>
<td>No</td>
<td>263</td>
<td>88.3</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>298</td>
<td>100.0</td>
<td>7</td>
</tr>
<tr>
<td><strong>Propranolol</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>70</td>
<td>23.5</td>
<td>0</td>
</tr>
<tr>
<td>No</td>
<td>228</td>
<td>76.5</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>298</td>
<td>100.0</td>
<td>7</td>
</tr>
</tbody>
</table>

\(^1\)Intraocular pressure greater than 24.0 mm. Hg in either eye
<table>
<thead>
<tr>
<th>Medication</th>
<th>Normal Intraocular Pressure</th>
<th>Increased Intraocular Pressure&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Total Screened</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
<td>Number</td>
</tr>
<tr>
<td>Anticholinergic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>10</td>
<td>3.4</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>288</td>
<td>96.6</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>298</td>
<td>100.0</td>
<td>7</td>
</tr>
<tr>
<td>Corticosteroids</td>
<td></td>
<td></td>
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<tr>
<td>Yes</td>
<td>12</td>
<td>4.0</td>
<td>0</td>
</tr>
<tr>
<td>No</td>
<td>286</td>
<td>96.0</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>298</td>
<td>100.0</td>
<td>7</td>
</tr>
<tr>
<td>Nitrates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>31</td>
<td>10.4</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>267</td>
<td>89.6</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>298</td>
<td>100.0</td>
<td>7</td>
</tr>
</tbody>
</table>

<sup>1</sup>Intraocular pressure greater than 24.0 mm Hg in either eye.
increased intraocular pressure was less than the number of patients on medication with normal intraocular pressure. Only one patient in the increased intraocular pressure group was taking both an anticholinergic agent and a nitrate preparation. That was the only patient in the increased intraocular pressure group known to have glaucoma and, on tonometry screening, that patient had lower intraocular pressures than the other patients in that group. It is of interest to note that none of the patients referred for increased intraocular pressure were taking corticosteroids which can cause drug-induced glaucoma.

There was a total five patients in both the group with normal screening results and the group with decreased visual acuity that reported previous treatment for glaucoma. Four of those people were currently on eye drops to control intraocular pressure. All five of those patients reporting past or present treatment were found to have normal intraocular pressure on tonometry screening.

Of the patients found to have increased intraocular pressure, one person was currently on eye drops for glaucoma. That patient had not been examined for nearly one year, and was found to have increased intraocular pressure on screening; therefore, further ophthalmologic examination was recommended.
The percentage of total patients screened who were found to have increased intraocular pressure and who were referred for further ophthalmologic evaluation was 2.3 percent. All of the patients referred for increased intraocular pressure were examined by an ophthalmologist and a written report of the examination results was received. The percentage of the total study population screened and examined by an ophthalmologist who were found to have glaucoma was 2.3 percent, indicating that 100 percent of those patients referred were confirmed to have the disease. Criteria for the diagnosis of glaucoma included increased intraocular pressure, visual field defects and changes in the optic disc. Six of the seven patients (85.7 percent) referred for increased intraocular pressure were confirmed to have previously undiagnosed glaucoma. The incidence of newly diagnosed glaucoma in this study population was 2.0 percent.

The distribution of diagnoses on ophthalmologic evaluation for the seven patients referred for increased intraocular pressure with or without decreased visual acuity is shown in Table 13. Overall, there were eleven newly diagnosed ophthalmologic problems in this group of patients. As described above, six patients were found to have newly diagnosed glaucoma. Four of the patients with increased intraocular pressure were also referred for decreased visual acuity, and these findings were confirmed on subsequent
Table 13. Distribution of diagnoses on ophthalmologic evaluation for seven patients attending a general medicine clinic who were referred for increased intraocular pressure with/without decreased visual acuity\(^1\) \(^2\)

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Newly Diagnosed</th>
<th>Known Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>6</td>
<td>54.5</td>
</tr>
<tr>
<td>Refraction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>2</td>
<td>18.2</td>
</tr>
<tr>
<td>Cataract(s)</td>
<td>2</td>
<td>18.2</td>
</tr>
<tr>
<td>Diabetic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retinopathy</td>
<td>1</td>
<td>9.1</td>
</tr>
<tr>
<td>Hypertensive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retinopathy</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Macular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degeneration</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Retinal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesions</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>11</td>
<td>100.0</td>
</tr>
</tbody>
</table>

\(^1\) Intraocular pressure greater than 24.0 mm. Hg in either eye
\(^2\) Visual acuity less than 20/40 in either eye
*The figures do not add up to 100 percent due to rounding
ophthalmologic examination. Three of these patients with decreased visual acuity had newly diagnosed problems including refraction errors, cataracts and/or diabetic retinopathy.

**Findings Related to Decreased Visual Acuity**

The mean visual acuity of general medicine patients who had visual acuity screening is identified in Table 14. Of the patients in the group with normal screening results and in the total population screened, the mean visual acuity was quite similar; 20/20 and 20/30 in both eyes, respectively. Thirty patients were found to have decreased visual acuity less than 20/40 in either eye, with a mean visual acuity of 20/80 in the right eye and 20/70 in the left eye. The seven patients referred for increased intraocular pressure had a mean visual acuity of 20/60 in both eyes.

The percentage of total patients screened that were found to have decreased visual acuity and were referred for further ophthalmologic evaluation was 11.1 percent. Of the patients referred for decreased visual acuity, 85.3 percent were examined by an ophthalmologist. There was no report of ophthalmologic evaluation for five of the patients referred. The incidence of previously undiagnosed ophthalmologic problems causing decreased visual acuity was 5.6 percent of the total patients screened.
Table 14. Mean visual acuity for right and left eye of patients attending a general medicine clinic who had visual acuity screening

<table>
<thead>
<tr>
<th>Visual Acuity</th>
<th>Right Eye</th>
<th>Left Eye</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Visual Acuity and Intraocular Pressure</td>
<td>20/20</td>
<td>20/20</td>
<td>268</td>
</tr>
<tr>
<td>Decreased Visual Acuity^1</td>
<td>20/80</td>
<td>20/70</td>
<td>30</td>
</tr>
<tr>
<td>Increased Intraocular Pressure With/Without</td>
<td>20/60</td>
<td>20/60</td>
<td>7</td>
</tr>
<tr>
<td>Total Screened</td>
<td>20/30</td>
<td>20/30</td>
<td>305</td>
</tr>
</tbody>
</table>

^1Visual acuity less than 20/40 in either eye
^2Intraocular pressure greater than 24.0 mm. Hg in either eye
Table 15 displays the distribution of diagnoses on ophthalmologic evaluation for patients referred for decreased visual acuity. The breakdown of the 28 newly diagnosed ophthalmologic problems included ten people with refraction errors, nine people with cataracts, three people with diabetic retinopathy, three people with retinal lesions, two people with hypertensive retinopathy and one person with macular degeneration. Other known diagnoses causing decreased visual acuity reported on ophthalmologic examination were: branch artery occlusion, sarcoid uveitis, ocular trauma secondary to bullet penetration and cerebral tumor.

**Summary of Findings**

The findings of this study were presented in the following areas: characteristics of the sample, patients with increased intraocular pressure and patients with decreased visual acuity. The study population was divided into three groups according to their results of visual acuity and tonometry screening for data description and analysis: (1) normal visual acuity and tonometry screening, (2) decreased visual acuity, and (3) increased intraocular pressure with or without decreased visual acuity.

The sample for this study consisted of 305 general medicine clinic patients 35 years of age or older. The distribution of the patients based on sex was 35.1 percent (107) males and 64.9 percent (198) females. Six of the
Table 15. Distribution of diagnoses on ophthalmologic evaluation for 25 patients attending a general medicine clinic who were referred for decreased visual acuity\textsuperscript{1,2}

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Newly Diagnosed</th>
<th>Known Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>Refraction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>10</td>
<td>35.7</td>
</tr>
<tr>
<td>Cataract(s)</td>
<td>9</td>
<td>32.1</td>
</tr>
<tr>
<td>Diabetic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retinopathy</td>
<td>3</td>
<td>10.7</td>
</tr>
<tr>
<td>Hypertensive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retinopathy</td>
<td>2</td>
<td>7.1</td>
</tr>
<tr>
<td>Macular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degeneration</td>
<td>1</td>
<td>3.6</td>
</tr>
<tr>
<td>Retinal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lesions</td>
<td>3</td>
<td>10.7</td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>100.0*</td>
</tr>
</tbody>
</table>

\textsuperscript{1}Visual acuity less than 20/40 in either eye
\textsuperscript{2}For 5 of the 30 patients referred for decreased visual acuity, no data was obtained

*The figures do not add up to 100 percent due to rounding
seven patients found on screening to have increased intraocular pressure in this study population were females.

Of the total patients screened, the mean age was 60 years. There was a higher mean age (70 years) of those patients with increased intraocular pressure who were referred for further ophthalmologic evaluation.

The distribution of the patients according to race revealed that 54 percent of this population were minorities. Of the patients screened, four blacks and two whites were found to have increased intraocular pressure.

Approximately 26 percent of the patients screened reported having diabetes. This number doubled in the group found to have increased intraocular pressure, with 57.1 percent of the patients in this group reporting a history of diabetes.

The prevalence of hypertension in this study population was high, with 63.6 percent of the total patients screened reporting a history of the disease. The patients in both the decreased visual acuity and increased intraocular pressure groups were slightly more likely to report having hypertension.

The mean number of years since an eye examination was reported to be 3.5 years. There was little variation of time since the last eye examination between groups.
Fifty percent of the patients with normal screening results had previously been examined for glaucoma. The number of patients reporting previous eye examination for glaucoma increased in both the decreased visual acuity and the increased intraocular pressure groups to 60.0 percent and 71.4 percent, respectively.

The percentage of patients reporting a family history of glaucoma was 10.0 percent in the group with normal visual acuity and intraocular pressure. This percentage increased slightly to 14.3 percent for patients with increased intraocular pressure.

The mean intraocular pressure was 15.4 mm Hg in both eyes for this study population. Of the seven patients referred for increased intraocular pressure, the mean pressures were 24.2 mm Hg in the right eye and 27.7 mm Hg in the left eye. It was noted that there was no difference in the mean intraocular pressure of patients currently taking medications known to decrease intraocular pressure except for those patients taking propranolol. Patients on propranolol were found to have a mean intraocular pressure of approximately 13.2 mm Hg in both eyes. In this study, it was important to note that there was no apparent difference in the mean intraocular pressure of patients currently taking medications known to increase intraocular pressure.
The percentage of the study population screened who were found to have increased intraocular pressure and who were referred for ophthalmologic evaluation was 2.3 percent. All of the patients referred were examined by an ophthalmologist and the diagnosis of glaucoma was confirmed. The percentage of patients referred found to have previously undiagnosed glaucoma was 85.7 percent. Two percent of the total patients screened were newly diagnosed as having glaucoma. In this group of patients referred for increased intraocular pressure, besides six new cases of glaucoma, there were five other newly diagnosed ophthalmologic problems including refraction errors, cataracts and diabetic retinopathy.

The mean visual acuity of the patients found to have decreased visual acuity was 20/80 in the right eye and 20/70 in the left eye. Of these patients referred for ophthalmologic evaluation, 85.3 percent were examined and no report was received from 14.7 percent. The incidence of previously undiagnosed ophthalmologic problems causing decreased visual acuity was 5.6 percent of the patients screened. There were 33 new problems consisting of the following diagnoses: refraction errors, cataracts, diabetic and hypertensive retinopathy, retinal lesions and macular degeneration.
CHAPTER 5

DISCUSSION OF FINDINGS

The purpose of this study was to determine if an ambulatory care nurse using a Schiotz tonometer could effectively screen patients to detect early glaucoma. This chapter will discuss the findings of the study and relate the findings to the conceptual framework on which this investigation was based.

Characteristics of the Sample

Of the 305 general medicine clinic patients who had visual acuity and tonometry screening, there were 35.1 percent males and 64.9 percent females. In this sample, 85.7 percent of the seven patients found to have increased intraocular pressure were females. Kini et al. (1978) reported that the overall prevalence of open-angle glaucoma was much higher for men than women in the Framingham Eye study. Since this study population was composed of a disproportionate number of female as compared to male subjects, generalizations regarding the incidence of glaucoma in relationship to sex are not warranted from this study.

The mean age of the total patients screened was 60 years. In comparison, the mean age of patients with
increased intraocular pressure was 70 years. The literature revealed that age was a significant risk factor in the acquisition of glaucoma. Chandler (1979) described that glaucoma occurs with greatest frequency in aged populations and is uncommon in young people. More than 50 percent of the patients found to have increased intraocular pressure were 65 years of age or older in this study.

According to Boyd-Monk (1979), glaucoma-related blindness occurs approximately eight times more frequently in blacks than in whites. In this study, there was no difference between the groups with normal visual acuity and intraocular pressure and decreased visual acuity by race. However, the black population was at least two times more likely to have increased intraocular pressure than the white population based on the small sample of seven patients.

Approximately 56 percent of the patients screened were minorities (black, oriental, spanish). It is important to note that there is a large number of minority patients routinely seen in this setting due to medicaid reimbursement for health care services and the availability of clinical teaching funds.

Becker (1971) reported that glaucoma is found to have a greater prevalence in diabetic than non-diabetic populations similarly matched. Open-angle glaucoma occurs approximately three times more frequently in diabetics (Boyd-Monk,
Eighty patients (26.2 percent) of the total patients screened in this study reported having diabetes. Patients with decreased visual acuity were slightly more likely to report a history of diabetes than those patients with normal screening results (33.3 percent as compared to 24.6 percent). The patients found to have increased intraocular pressure on tonometry screening were more than twice as likely to have diabetes than the patients with normal intraocular pressure (57.1 percent as compared to 24.6 percent). As described in the literature, this study confirmed that a relationship exists between diabetes and a higher risk of increased intraocular pressure.

In this study population, 63.6 percent of the patients reported having hypertension. In both the decreased visual acuity and increased intraocular pressure groups, the patients were slightly more likely to report a history of hypertension. Although hypertension alone is not a documented risk factor in the acquisition of glaucoma, in this study the subjects with increased intraocular pressure did report a slightly greater incidence of hypertension, which is contrary to previous studies (Gorin, 1977; Chandler, 1979).

The increased incidence of decreased visual acuity and glaucoma in this sample was probably based on the higher percentage of aged patients attending this general medicine setting with multiple chronic diseases. The higher-than
average prevalence of diabetes and hypertension will become important in further discussion of the incidence of glaucoma and newly diagnosed ophthalmologic problems confirmed on referral evaluation.

According to the National Society for the Prevention of Blindness (1980), the lack of regular eye care by the population leads to a lack of tonometry screening and the early detection of glaucoma. The mean number of years since patients with normal screening results had had an eye examination was 3.5 years. Contrary to the recommendation for an eye examination every two years, this was too long a period between evaluations for patients found to have increased intraocular pressure in this study (National Society for the Prevention of Blindness, 1980). Of the seven patients referred for increased intraocular pressure, they reported having an eye examination within approximately two years, although they were confirmed to have increased intraocular pressure in this investigation.

In summary, this study population was older and had multiple medical problems with a high incidence of diabetes and hypertension. Two additional important characteristics of this sample were that the black population was more likely to have increased intraocular pressure and that the time since last eye examination for the majority of the patients was greater than 3.5 years.
Increased Intraocular Pressure

In this study, 71.4 percent of the 35 patients screened and found to have increased intraocular pressure reported they had previously been examined for glaucoma. In comparison, 50.0 percent of the patients with normal screening results reported past glaucoma screening. Unfortunately, a major problem with this question was the lack of a specific time reference in regards to glaucoma screening. Therefore, even though a larger percentage of patients with increased intraocular pressure reported previous screening, the exact period of time since the examination was unknown.

Upon questioning the patients as to previous glaucoma screening, many of them were unsure of the definition of the disease and/or exactly what was included in their ophthalmologic examination. One patient with increased intraocular pressure on screening was currently on eye drops for glaucoma, although, that patient had not been seen by an ophthalmologist for nearly one year. It was of interest to note, that the patient was not aware of the severity of the diagnosis nor the necessity of periodic follow-up. This lack of patient awareness and limited education regarding glaucoma will become important in further discussion of the implications for nursing practice.

Approximately 10.0 percent of the 298 patients in the group with normal intraocular pressure reported a family
history of glaucoma. Five percent of the patients in that group did not respond to the question. This percentage increased slightly to 14.3 percent for seven patients with increased intraocular pressure reporting a family history of the disease. In this study, there did not seem to be a difference between the groups with normal intraocular pressure and increased intraocular pressure and relationship to family history of glaucoma. In contrast, Becker (1971) reported that patients with glaucoma have a family history of the disease in up to 25.0 percent of the cases.

The mean intraocular pressure was 15.4 mm Hg in both eyes for this study population. Seven patients were found to have increased intraocular pressure, with a mean pressure of 24.2 mm Hg in the right eye and a slightly higher pressure of 27.7 mm Hg in the left eye. Although there was a slight difference in mean intraocular pressure between eyes for these seven patients, there was no corresponding difference in mean visual acuity between eyes.

As described by Boyd-Monk (1979), open-angle glaucoma may originate in one eye before the other, but in the majority of cases it is bilateral. Six of the seven patients found to have increased intraocular pressure were noted to have bilateral disease in this study.

Five frequently prescribed medications for the general medicine clinic population known to decrease intraocular
pressure included digoxin, diuretics, propranolol, insulin and benzodiazepines. A large percentage of this study population were taking one or more of these medications. The percentage of the total patients screened currently taking these medications were: digoxin, 11.1 percent; diuretics, 53.8 percent; propranolol, 23.0 percent; insulin, 12.5 percent; and benzodiazepines, 7.2 percent. As previously described, 68.3 percent of the sample reported a history of hypertension. The incidence of a large number of patients in this study taking digoxin, diuretics and propranolol most likely reflected the high prevalence of ischemic heart disease and hypertensive heart disease commonly seen in this aged general medicine clinic population.

Of the seven patients found to have increased intraocular pressure, 42.9 percent were currently taking insulin. In comparison, 12.7 percent of the total 305 patients screened were presently on insulin. The higher incidence of diabetes among patients with increased intraocular pressure (57.1 percent), in comparison to the incidence of diabetes in the total population (24.6 percent), explained the large number of insulin-dependent diabetics in the increased intraocular pressure group. Interestingly, only 12.5 percent of the diabetics in the total study population were taking insulin, with the other diabetics reporting
dietary management and/or oral hypoglycemic agents to control their disease.

The smallest percentage of patients reported taking a drug known to decrease intraocular pressure was with benzodiazepines. Only 7.2 percent of the total patients screened were taking this medication. None of the patients with increased intraocular pressure were taking benzodiazepines.

Of the patients found to have increased intraocular pressure, they were taking more medication known to decrease intraocular pressure in comparison with the number of patients on these medications with normal screening results. Contrary to the literature, there was no apparent difference in the mean intraocular pressure of patients who were currently taking digoxin, diuretics, insulin or benzodiazepines (Peczon and Grant, 1968; Green and Spencer, 1969).

The mean intraocular pressure of patients on propranolol was 13.3 mm Hg in the right eye and 13.1 mm Hg in the left eye. In contrast, the mean intraocular pressure of patients not taking propranolol was higher, with a pressure of 15.4 mm Hg in both eyes. These findings were in agreement to a report by Fraunfelder (1976), who described that systemic or topical administration of propranolol, a beta-adrenergic blocking agent, produced a decrease in intraocular pressure. In the recent scientific literature, topical
administration of beta-adrenergic blocking agents have been under clinical investigation for glaucoma therapy (Rubenzik, 1980). In order to analyze the decrease in intraocular pressure related to propranolol, further dose-specific studies would be needed.

The medications commonly prescribed for ambulatory care general medicine patients known to increase intraocular pressure include anticholinergic agents, corticosteroids and nitrates. Those patients found to have increased intraocular pressure were taking fewer medications known to increase intraocular pressure than were the patients with normal intraocular pressure. Only one of the seven patients in the increased intraocular pressure group was taking medication known to increase intraocular pressure; both an anticholinergic agent and a nitrate preparation. On tonometry screening, that patient had lower pressures than the other patients in the increased intraocular pressure group.

In this study population, there was no difference in the mean intraocular pressure of patients taking medication known to increase intraocular pressure. These findings are dissimilar to reports by Lazenby (1968) on anticholinergic agents and Fraunfelder (1976) on nitrates affecting intraocular pressure. Lazenby (1968) described that anticholinergic agents produce mydriasis and tend to elevate intraocular pressure when above normal due to interference
with aqueous humour drainage. According to Fraunfelder (1976), nitrates have the potential to precipitate increased intraocular pressure and glaucoma.

The literature revealed that systemic or ocular administration of adrenal corticosteroid preparations could produce increased intraocular pressure by mydriasis and cause drug-induced glaucoma (Miller, 1979; Gorin, 1977). None of the patients found to have increased intraocular pressure on tonometry screening were currently taking corticosteroids.

In this study, the effects of medication known to increase intraocular pressure were not confirmed as previously reported in the literature. As described earlier, a more thorough evaluation of the effects of medication known to increase intraocular pressure would necessitate dose-specific investigations.

Seven of the 305 patients (2.3 percent) screened were found to have intraocular pressure of greater than 24.0 mm Hg and were referred for further evaluation. All of the patients referred for increased intraocular pressure attended their scheduled ophthalmologic evaluation and a written record of the examination results was received for each patient. This high compliance rate was probably due to greater communication by the investigator with the patient. The appointment date of the ophthalmologic referral for each patient was noted and, as a reminder, the patient was
telephoned on the day prior to their appointment. Another way the investigator attempted to improve compliance was to involve the patient's family members in the explanation of the screening results and the importance of reexamination.

The percentage of the total study population screened and examined by an ophthalmologist who were found to have glaucoma was 2.3 percent. Of the seven patients referred for increased intraocular pressure, 100.0 percent were confirmed to have glaucoma. The criteria for the diagnosis of glaucoma in this study included increased intraocular pressure, visual field defects and optic atrophy, which are the current diagnostic standards in ophthalmologic practice (Swartz, 1978; National Society for the Prevention of Blindness, 1980). Six of the seven patients (85.7 percent) referred for increased intraocular pressure were found to have previously undiagnosed glaucoma. Two percent of the total patients screened in this study were newly diagnosed as having glaucoma.

The results of this investigation were consistent with the findings of previous studies in which the prevalence of glaucoma ranged from 1.0 percent to 3.0 percent of the population screened (Sharp, 1968; Kini et al., 1978; Leske, 1979). According to Spector et al. (1975), the prevalence of frank glaucoma was 1.8 percent and suspected glaucoma was 2.5 percent of 768 general medicine clinic
patients. In comparing the study by Spector et al. with this investigation, the intraocular pressure for referral was 20 mm Hg or greater and greater than 24 mm Hg, respectively; the prevalence of glaucoma was 1.8 percent and 2.3 percent, respectively.

In contrast, Robertson (1977) reported that 5.5 percent of 456 patients on a general medical service, aged 45 years or older, were referred for increased intraocular pressure greater than 20 mm Hg. Only 44.0 percent of those patients referred were confirmed to have glaucoma.

An important finding in this study was that there were no false-positive cases; all of the patients referred for increased intraocular pressure were confirmed to have glaucoma. In this investigation, the nurse using Schiotz tonometry was highly effect in detecting glaucoma. In contrast, Breslow and Somers (1977) excluded glaucoma as a screening procedure for people 40 to 60 years of age because they questioned the reliability of the screening method and the high number of false-positive cases. The lack of false-positive findings in this investigation may be due to several reasons: (1) the intraocular pressure referral criteria of greater than 24.0 mm Hg, (2) the demonstrated proficiency of the nurse investigator in comparison to the ophthalmologist during practice sessions, (3) accurate calibration of the tonometer prior to each
screening, and (4) adequate cleaning of the tonometer by ultraviolet sterilization before each subject was tested.

On ophthalmologic evaluation of the seven patients referred for increased intraocular pressure, intraocular pressure on applanation tonometry agreed fairly well with those obtained by Schiotz tonometry. There was not more than a difference of 2.0 mm Hg between intraocular pressures on Schiotz tonometry and applanation tonometry. These findings were consistent with reports in the literature regarding the reliability of Schiotz tonometry as a screening procedure (Abrahamson, 1978; Chandler, 1979). Rubenzik (1980) described that intraocular pressure readings by Schiotz tonometry were less accurate than those obtained by applanation tonometry and this was contradictory to the findings of this investigation.

Approximately 30 of the 305 patients screened complained of stinging or burning and/or experienced tearing lasting only a few seconds immediately after instillation of the topical ocular anesthetic, but no patient complained of residual side effects. None of the patients screened by Schiotz tonometry complained of symptoms consistent with corneal abrasions.

**Decreased Visual Acuity**

The mean visual acuity of the patients screened with normal visual acuity was 20/20 in both eyes. As expected,
the patients referred for decreased visual acuity had a mean visual acuity of 20/80 in the right eye and 20/70 in the left eye. Of the patients referred for increased intraocular pressure, they had a mean visual acuity of 20/60 in both eyes.

The percentage of the total population screened that had decreased visual acuity and were referred for ophthalmologic evaluation was 11.1 percent. The major reason for this high incidence of decreased visual acuity in this sample was most likely secondary to their age, the prevalence of diabetes and hypertension and lack of recent ophthalmologic examination. Another probable cause for this high referral rate could be due to lack of patient awareness of adult eye diseases and the necessity for routine ophthalmologic evaluation. The importance of health education will be discussed further in the presentation of nursing implications.

Of the total patients referred for ophthalmologic evaluation of decreased visual acuity, 85.3 percent were examined and no report was received from 14.7 percent. The compliance rate for reexamination was not as high for the patients referred for decreased visual acuity as it was for the increased intraocular pressure group. Since a finding of decreased visual acuity was not as emergent a problem as increased intraocular pressure, the waiting period for an
appointment with an ophthalmologist was longer. Data collection for results on ophthalmologic evaluation extended for a period of only three weeks after screening; therefore, not all reports of reexamination were received by the investigator. Due to the size of the referral group for decreased visual acuity, the investigator was unable to telephone the patient to remind them of their ophthalmologic appointment. The reduced compliance rate for this referral group could have been due to less communication by the investigator with the patient.

The incidence of previously undiagnosed ophthalmologic problems causing decreased visual acuity was 5.6 percent of the total patients screened. Of the patients in the total study population, there were 33 newly diagnosed ophthalmologic problems consisting of the following diagnoses: refraction errors, cataracts, diabetic and hypertensive retinopathy, retinal lesions and macular degeneration. The clinical importance of these newly diagnosed ophthalmologic problems causing decreased visual acuity should not be underestimated. Evaluation of this data requires further study of ophthalmologic problems causing decreased visual acuity and will be discussed in recommendations.

**Model for Early Detection of Glaucoma**

Wilson's (1968) model for early disease detection aims at discovering and curing conditions when pathology is
already present although health care has not been sought spontaneously. This screening model is based on a preventive approach to health care, primarily in the form of secondary prevention.

In screening for early diagnosis, pathology is usually reversible and the individual is presymptomatic or with minimal symptoms. In this study, none of the patients found to have increased intraocular pressure were symptomatic but all were confirmed to have glaucoma on ophthalmologic evaluation. As a result of this study, seven patients with increased intraocular pressure were discovered, all with detectable visual field defects and optic disc changes. As described in the literature, if the diagnosis of glaucoma is made at an earlier stage, the prognosis is much better (Leydhecker, 1977; Abrahamson, 1978).

Of the total population screened in this study, 5.6 percent of patients were newly diagnosed as having ophthalmologic problems causing decreased visual acuity. Hopefully, early diagnosis of these ophthalmologic problems increased the chances of controlling the ocular pathology and preventing blindness.

McVay's (1977) model for primary open-angle glaucoma detection focuses on secondary prevention with five components of a screening program. These include: (1) preventive eye care education, (2) screening for glaucoma, (3) referral
of glaucoma suspects, (4) follow-up on referrals, and (5) permanent screening programs. This investigation incorporated four of the five components proposed in this model. Preventive eye care education was disseminated by the investigator in several ways. Patient education included posters in the waiting rooms of each patient care module to increase awareness of the screening program. Pamphlets on glaucoma and written results of the visual acuity and tonometry screening were distributed to each patient. The medical and nursing personnel of the general medicine clinic were encouraged to observe the screening program and, if interested, instructed in the performance of visual acuity measurement using the Snellen letter chart and Schiotz tonometry.

The next three components of the model; screening for glaucoma, referral of glaucoma suspects and follow-up on referrals, were completed exactly as proposed by McVay, and were found to be essential factors of a successful screening program. In this investigation, modification of this model existed, since the institution of a permanent screening program (component five) was not included.

The findings of this study supported the retention of Wilson's model for early disease detection and McVay's model for early detection of open-angle glaucoma for inclusion into nursing practice. Both models lay the foundation
for nursing screening programs and could be generalized to early detection of many other chronic diseases.

Implications for Nursing Practice

The findings of this investigation revealed two important implications for nursing practice. First, since the nurse in the ambulatory care general medicine setting has frequent contact with patients at high risk for ophthalmologic problems, routine visual acuity and tonometry screening should be responsibilities of the nurse. Second, incorporation of preventive eye care education into nursing practice in the general medicine setting is essential if screening programs are to be successful.

Previous studies have recommended the inclusion of glaucoma screening in the role of the nurse (Boyd-Monk, 1979; Hammond and Begley, 1979). In this study, the ambulatory care nurse using Schiotz tonometry was highly effective in detecting glaucoma in asymptomatic patients. Of the total population screened, the incidence of glaucoma confirmed on ophthalmologic evaluation was 2.3 percent. Of the patients referred for increased intraocular pressure, 100.0 percent were confirmed to have glaucoma, indicating there were no false-positive screening results.

According to Spector et al. (1975), there were a large number of false-positive tests by those who perform tonometry episodically. Therefore, if nurses in general
medicine clinic settings performed tonometry on a regular basis, the number of false-positive results would be reduced.

In this study, Schiotz tonometry proved to be easy to perform and required only minimal time expenditure. As previously described in the findings of this study, the performance of Schiotz tonometry by a nurse was both a reliable and accurate measurement of intraocular pressure.

The incidence of previously undiagnosed ophthalmologic problems causing decreased visual acuity was 5.6 percent of the total patients screened. Inclusion of routine visual acuity screening in the role of the ambulatory care nurse should increase the chances of controlling ocular pathology by early diagnosis of these ophthalmologic problems.

Because the findings of this study identified certain characteristics of the population who were found to have increased intraocular pressure and/or decreased visual acuity, the ambulatory care nurse could perform screening of targeted groups: patients 65 years of age or older, patients with diabetes and/or hypertension and blacks. The performance of visual acuity and tonometry screening by nurses could be extended from the general medicine setting to such areas as geriatric day care or nutrition centers, extended care facilities, home visits or community clinics.
Health education is included in the role of many nurses in general medicine clinic settings. There are numerous opportunities for patient and family education to increase awareness of adult ophthalmologic diseases. As confirmed by French (1977), with a thorough understanding of the pathophysiology of glaucoma, the nurse is in an ideal position to provide education about the disease and its potential to cause blindness.

The methods for preventive eye care education in the general medicine clinic setting include direct patient and family teaching, the use of written materials and audiovisual programs. The ambulatory care nurse performing visual acuity and tonometry screening should incorporate education of nursing and medical personnel into nursing practice by instruction of the actual screening techniques and practice demonstration sessions.
CHAPTER 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this investigation was to determine if an ambulatory care nurse using Schiotz tonometry could effectively screen patients to detect early glaucoma. The study also identified those patients in need of diagnosis for ophthalmologic problems that were previously undetected.

This descriptive study was designed to: (1) identify the percentage of patients that had increased intraocular pressure, (2) identify the percentage of patients that had confirmed previously undiagnosed glaucoma, and (3) identify the percentage of patients that had previously undiagnosed ophthalmologic problems causing decreased visual acuity.

The conceptual framework for this investigation was based on Wilson's (1968) model for early disease detection and McVay's (1977) model for early detection of open-angle glaucoma. Wilson's model is based on a preventive approach to health care; aims at early diagnosis and treatment of disease when pathology is already present, but when health care has not been sought spontaneously. McVay's model for primary open-angle glaucoma detection focuses on secondary
prevention with five components of a glaucoma screening program. These components include: (1) preventive eye care education, (2) screening for glaucoma, (3) referral of glaucoma suspects, (4) follow-up referrals, and (5) permanent screening programs.

Screening of patients attending a general medicine clinic, 35 years of age or older, entailed performance of visual acuity screening examination and Schiotz tonometry on 305 patients over a period of two weeks. From the standpoint of the nurse investigator, this represented approximately 30 patients a day. Patients were screened for visual acuity utilizing the Snellen letter chart and any patient with a visual acuity of less than 20/40 in either eye was referred for further ophthalmologic evaluation. Schiotz tonometry was the method for glaucoma screening and any patient with an intraocular pressure greater than 24.0 mm Hg was referred for ophthalmologic examination.

A summary of the characteristics of the sample identified that this older population had multiple medical problems with a high prevalence of diabetes and hypertension. Two additional important characteristics of the population were that the black patients were more likely to have increased intraocular pressure and that the time since last eye examination for the majority of the patients was greater than 3.5 years.
Analyses of the data revealed that the percentage of total patients screened who were found to have increased intraocular pressure and who were referred for further ophthalmologic evaluation was 2.3 percent. All of the patients referred for increased intraocular pressure were evaluated by an ophthalmologist and a written report of the examination results for each patient was received. The percent of patients referred for increased intraocular pressure that were confirmed to have previously undiagnosed glaucoma was 85.7 percent. Two percent of this study population were newly diagnosed as having glaucoma.

Of the patients found to have increased intraocular pressure, there was no higher incidence of a family history of the disease. In this group of patients, there was no difference in the mean intraocular pressure of patients currently taking medications known to increase intraocular pressure. There was also no difference in the mean intraocular pressure of patients currently taking medications known to decrease intraocular pressure, except for patients taking propranolol, in which the intraocular pressure was slightly lower.

The incidence of previously undiagnosed ophthalmologic problems causing decreased visual acuity was 5.6 percent of the total population screened. In this study, there were 33 newly diagnosed ophthalmologic problems that
consisted of the following diagnoses: refraction errors, cataracts, diabetic and hypertensive retinopathy, retinal lesions and macular degeneration.

The findings of this study reinforced the value of screening for early detection of glaucoma and ophthalmologic problems that caused decreased visual acuity. Wilson's model for early disease detection and McVay's model for early detection of open-angle glaucoma were supported in this investigation.

Conclusions

The value of screening for glaucoma by Schiotz tonometry in the ambulatory care setting has been questioned recently because of a high incidence of false-positive results, a high cost per case of glaucoma discovered, and doubts concerning the accuracy of Schiotz tonometry (Robertson, 1977). With practice, greater accuracy can be achieved in the performance of tonometry. In this investigation, there was a high yield of true-positive test results. There were no false-positive findings in this screening and the results of Schiotz tonometry performed by the nurse investigator were very similar to the intraocular pressure determination on applanation tonometry.

This study was significant to the patients found to have increased intraocular pressure and/or decreased visual acuity on screening because of the deleterious effects
of blindness secondary to glaucoma and many of the ophthalmologic problems causing decreased visual acuity. Although this study was lacking specific findings on cost per patient screened or cost per newly diagnosed ophthalmologic problem, this investigator should be judged as being effective in view of the economic and psychological impact of blindness which could have resulted.

In addition to data collection, this visual acuity and tonometry screening provided a service for 305 general medicine patients. Because of the high percentage of asymptomatic patients confirmed to have newly diagnosed glaucoma in this ambulatory care setting, the low incidence of side effects of tonometry and the minimal amount of time required to perform the screening, this study supports the view that the nurse should perform routine screening using Schiotz tonometry.

Recommendations

Recommendations were made based on the following three areas: (1) improvement of methodology, (2) specific nursing actions based on the implications for nursing practice, and (3) future research investigations.

To improve the methodology of this study, the data collection tool should be expanded to include dose-specific medication information, identification of professional or facility performing the last eye examination and time-
specific information regarding past screening for glaucoma. Confirmation of history of diabetes and/or hypertension of the study sample could be accomplished through medical record audit.

Replication of this study using an equal number of male and female subjects could yield more conclusive findings regarding the distribution of sex in patients confirmed to have glaucoma. It would be clinically important to replicate this study in different health care settings, such as other general medicine or subspecialty clinics, for comparison of results.

The most significant nursing action based on the data from this study is the plan to develop a permanent visual acuity and tonometry screening program in this general medicine clinic. Another nursing action includes implementation of eye care education programs in the general medicine setting. At the present time, only written materials on glaucoma, cataracts, diabetic retinopathy and macular degeneration are available. Since the population desiring these materials may be already visually disabled, audio education materials need to be developed. Educational programs for nursing and medical personnel demonstrating the technique of visual acuity screening and Schiotz tonometry should be included in the role of the ambulatory care nurse.
Recommendations for future research investigations include: (1) a study to detect glaucoma in general medicine clinic patients with measurement of visual fields and ophthalmoscopy along with tonometry screening performed by the nurse, (2) a study to further evaluate the ophthalmologic problems causing decreased visual acuity and the impact of screening by nurses, and (3) a study to measure the effectiveness of preventive eye care education by the nurse in the general medicine setting.
APPENDIX A

SUBJECT CONSENT FORM
SUBJECT CONSENT FORM

YOU ARE BEING ASKED TO PARTICIPATE IN A STUDY ENTITLED "EFFECTIVENESS OF ROUTINE TONOMETRY SCREENING PERFORMED BY A NURSE IN A GENERAL MEDICINE CLINIC". THE PURPOSE OF THIS STUDY IS TO DETECT THE POSSIBILITY OF AN EYE DISEASE CALLED GLAUCOMA (INCREASED PRESSURE WITHIN THE EYE).

THE STUDY INVOLVES TAKING TWO TESTS WHICH WILL TAKE APPROXIMATELY FIFTEEN MINUTES OF YOUR TIME. THE FIRST TEST WILL EVALUATE YOUR DISTANCE VISION BY ASKING YOU TO READ A VISION CHART. THE SECOND TEST WILL EVALUATE THE PRESSURE WITHIN YOUR EYE AND ONE ANESTHETIC EYE DROP WILL BE PLACED INTO EACH EYE. AFTER THE EYE DROPS, A TONOMETER WILL BE PLACED ON EACH EYE FOR A FEW SECONDS. IF THE PRESSURE READING IS HIGH, YOU WILL BE ASKED TO WAIT AN ADDITIONAL FIFTEEN MINUTES FOR A RE-TEST.

THE TWO TESTS SHOULD NOT PROVIDE ANY DISCOMFORT TO YOU. IF YOU WEAR CONTACT LENSES YOU WILL BE ASKED TO REMOVE THEM FOR THE GLAUCOMA TEST AND NOT RE-INSERT THE LENSES FOR ONE HOUR AFTER THE TEST. THIS IS BECAUSE FOR UP TO ONE HOUR AFTER THE ANESTHETIC EYE DROPS YOU MAY HAVE LESS FEELING IN THE EYE AND INSERTING THE LENSES COULD CAUSE SCRATCHING OF THE EYE. YOU WILL ALSO BE ASKED NOT TO RUB YOUR EYES FOR ONE HOUR AFTER THE TEST BECAUSE EXCESSIVE RUBBING COULD CAUSE SCRATCHING OF THE EYE. SIDE EFFECTS FROM THE EYE DROPS ARE VERY UNCOMMON
AND USUALLY MILD, BUT MAY INCLUDE LOCAL IRRITATION, STINGING OR TEARING. RARELY, AN ALLERGIC REACTION OCCURS, HOWEVER THERE WILL BE A PHYSICIAN AVAILABLE AT ALL TIMES TO MEET ANY EMERGENCY SITUATION. YOU MAY CONTACT ME AT ANY TIME AFTER THE TESTS AT THE PHONE NUMBER I WILL GIVE YOU.

THIS STUDY DOES NOT INVOLVE ANY COST TO YOU AND THERE IS NO MONETARY PAYMENT.

OF POSSIBLE BENEFIT TO YOU WILL BE THE EARLY DISCOVERY OF VISION PROBLEMS AND/OR THE POSSIBILITY OF GLAUCOMA WITH APPROPRIATE REFERRAL.

YOU ARE FREE TO DECIDE WHETHER OR NOT YOU WILL PARTICIPATE IN THIS STUDY AND YOU ARE FREE TO ASK ANY QUESTIONS YOU WISH AND WILL RECEIVE ANSWERS AT ANY POINT IN THE STUDY. YOU MAY REFUSE TO PARTICIPATE IN THIS STUDY OR WITHDRAW FROM THE STUDY AT ANY TIME AND THIS WILL IN NO WAY AFFECT THE CARE YOU RECEIVE.

YOU WILL BE GIVEN THE RESULTS OF THE TESTS IN WRITING. ALL INFORMATION FROM THIS STUDY WILL REMAIN STRICTLY CONFIDENTIAL AND NO NAMES OR ADDRESSES WILL BE USED. THE INFORMATION OBTAINED WILL BE USED FOR PURPOSES OF THE STUDY, AND MAY BE PUBLISHED IN A PROFESSIONAL JOURNAL OR BOOK.

THE NATURE, DEMANDS, RISKS AND BENEFITS OF THE PROJECT HAVE BEEN EXPLAINED TO ME AS WELL AS THE TYPE OF TREATMENT AS KNOWN AND AVAILABLE. I UNDERSTAND WHAT MY PARTICIPATION INVOLVES. THIS CONSENT FORM WILL BE FILED IN AN AREA DESIGNATED BY THE HUMAN SUBJECTS COMMITTEE WITH ACCESS RESTRICTED TO
THE PRINCIPAL INVESTIGATOR OR AUTHORIZED REPRESENTATIVES OF THE COLLEGE OF NURSING. A COPY OF THE CONSENT FORM WILL BE AVAILABLE TO YOU UPON REQUEST.

YOUR SIGNATURE INDICATES YOUR AGREEMENT TO PARTICIPATE IN THIS STUDY.

_________________________________________  __________________________
SUBJECT'S SIGNATURE                      DATE

_________________________________________  __________________________
WITNESS' SIGNATURE                      DATE

(INDIVIDUAL NOT INVOLVED IN PROJECT)

_________________________________________  __________________________
INVESTIGATOR'S SIGNATURE                  DATE
APPENDIX B

DATA COLLECTION FORM
Study Number _____________________
General Medicine Clinic Physician __________________________
Sex _________
Age _________
Race _________

Have you ever been checked for glaucoma?    __    __    __
Were you ever treated for glaucoma?        __    __    __
If YES, are you now on drops for glaucoma?  __    __    __
Do any of your blood relatives have    __    __    __
glaucoma?
Have you ever had diabetes?                __    __    __
Have you ever had high blood pressure?     __    __    __
Are you wearing contact lenses?            __    __    __
If applicable: Are you allergic to    __    __    __
    novacain?
Time since last eye examination:
    __ less than 1 year __ 3 years or more __ unknown
    __ 1-2 years          __ never examined
All drugs (including over the counter, such as aspirin,
    vitamins, diet pills, laxatives)_________________________
SCREENING RESULTS

VISUAL ACUITY

with glasses?  __ Yes  __ No

Right       Left
20/___       20/___

INTRAOCULAR PRESSURE

Weight
(for Schiotz) Right Left

First test _________ _______ _______
Retest _________ _______ _______

Time of day _______pm
Tension by ________________________________
Other findings ________________________________

DISPOSITION

Referred  Referred  Referred
__ Passed  __ Glaucoma  __ V.A.  __ Other.
FOLLOW-UP ON GLAUCOMA REFERRAL

### DIAGNOSIS - INTRAOCULAR PRESSURE

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>_ Glau.</td>
<td>_ New</td>
<td>_ Known</td>
<td>_ Suspect</td>
<td>_ Report</td>
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</table>

### DIAGNOSIS - VISUAL ACUITY

<table>
<thead>
<tr>
<th>Refraction Error</th>
<th>Cataracts</th>
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<tbody>
<tr>
<td>_ newly diagnosed</td>
<td>_ newly diagnosed</td>
</tr>
<tr>
<td>_ known diagnosis</td>
<td>_ known diagnosis</td>
</tr>
<tr>
<td>_ not diagnosed</td>
<td>_ not diagnosed</td>
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</table>

<table>
<thead>
<tr>
<th>Diabetic Retinopathy</th>
<th>Hypertensive Retinopathy</th>
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</thead>
<tbody>
<tr>
<td>_ newly diagnosed</td>
<td>_ newly diagnosed</td>
</tr>
<tr>
<td>_ known diagnosis</td>
<td>_ known diagnosis</td>
</tr>
<tr>
<td>_ not diagnosed</td>
<td>_ not diagnosed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Macular Degeneration</th>
<th>Retinal Lesions</th>
</tr>
</thead>
<tbody>
<tr>
<td>_ newly diagnosed</td>
<td>__ newly diagnosed</td>
</tr>
<tr>
<td>_ known diagnosis</td>
<td>__ known diagnosis</td>
</tr>
<tr>
<td>_ not diagnosed</td>
<td>__ not diagnosed</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Other</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>__ newly diagnosed</td>
<td>__ newly diagnosed</td>
</tr>
<tr>
<td>__ known diagnosis</td>
<td>__ known diagnosis</td>
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### FOLLOW-UP

<table>
<thead>
<tr>
<th>FOLLOW-UP</th>
<th>DATE</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Card/letter</td>
<td>_____</td>
<td>_______</td>
</tr>
<tr>
<td>Telephone</td>
<td>_____</td>
<td>_______</td>
</tr>
</tbody>
</table>

Ophthalmologist's report received:

---

(date) (from)
APPENDIX C

INTERPRETATION FORM:
NORMAL VISUAL ACUITY
VISION SCREENING

The results of the vision screening test which you have just had show that your visual acuity for distance is within the normal range in each eye.

This screening does not take the place of a complete eye examination which each person should have every two years. If it is two years or more since your last eye examination, it is recommended that you have one done.

Thank you.
APPENDIX D

INTERPRETATION FORM:

VISUAL ACUITY REFERRAL
VISION SCREENING

The results of the vision screening test you have just had show that your visual acuity for distance in one or both eyes was not as good as it should be.

We urge you to make an appointment at an eye clinic or with an eye doctor of your choice for a complete eye examination.

The visual acuity screening results, for the information of your eye doctor, are as follows:

Right eye ________
Left eye ________

☐ with glasses ☐ without glasses

Please show this report to your eye examiner.

Thank you.
APPENDIX E

INTERPRETATION FORM:

NORMAL TONOMETRY
GLAUCOMA SCREENING PROGRAM

This is not a complete eye exam.

You have just had a screening test for an eye disease called glaucoma. The pressure of each eye was taken. Our test shows that the pressures in both of your eyes were normal. However, a single negative finding from a screening test such as you have just had does not rule out the possibility of glaucoma. This screening does not replace a complete eye exam which each person should have every two years. Therefore, if you have not had a complete eye examination within the past two years, we recommend that you see an eye doctor. This is especially important for those over the age of 35.

Please remember that glaucoma frequently runs in families. Therefore, if any of your blood relatives have ever had glaucoma, you and other members of the family should be checked for glaucoma at least once a year. Early detection and treatment of glaucoma can save your vision.

Thank you.
APPENDIX F

INTERPRETATION FORM:

GLAUCOMA REFERRAL
GLAUCOMA SCREENING PROGRAM

IMPORTANT NOTICE

This is not a complete eye exam.

You have just had a screening test for an eye disease called glaucoma. The pressure of each eye was taken and found to be higher than normal. This does not necessarily mean that you have GLAUCOMA. It does mean that you must consult, as soon as possible, an ophthalmologist (medical eye doctor) for a complete eye examination, to establish whether you do or do not have this serious eye disease. Glaucoma can usually be controlled if detected early. Thus it is very important that you make and keep an appointment in a hospital eye clinic or with your own ophthalmologist. You have been provided with a form for your doctor to report the results of your eye examination directly to us. Please give this form and envelope to the doctor when you go for your eye examination.

Remember that glaucoma frequently runs in families. If you or another family member have ever had glaucoma, others in the family should be checked at least once a year. Please read the publication provided to learn more about glaucoma.

Thank you.
APPENDIX G

OPHTHALMOLOGIST'S REPORT:
VISUAL ACUITY REFERRAL
OPHTHALMOLOGIST'S
REPORT

NAME OF PATIENT ____________________________ AGE ______ SEX _____
ADDRESS ___________________________________________________________
SCREENING LOCATION ___________________________ DATE __________

DEAR DOCTOR:
This patient is being referred because of a decreased visual acuity for distance on a routine screening. To aid us in evaluating the effectiveness of this program your cooperation in providing results of your examination will be appreciated. Please return this report when you have completed your evaluation. This information is for statistical purposes only...and will be kept confidential.

SCREENING RESULTS
Visual Acuity                      Right Eye       Left Eye
__ with correction
__ without correction             20/___ 20/_____

EXAMINATION RESULTS
Visual Acuity Without correction OD OS
With Correction

Refraction Error
__ newly diagnosed
__ known diagnosis
__ not diagnosed

Cataracts
__ newly diagnosed
__ known diagnosis
__ not diagnosed

Diabetic Retinopathy
__ newly diagnosed
__ known diagnosis
__ not diagnosed

Hypertensive Retinopathy
__ newly diagnosed
__ known diagnosis
__ not diagnosed

Macular Degeneration
__ newly diagnosed
__ known diagnosis
__ not diagnosed

Retinal Lesions
__ newly diagnosed
__ known diagnosis
__ not diagnosed

Other
__ newly diagnosed
__ known diagnosis

SIGNATURE OF EXAMINING PHYSICIAN _________________________
ADDRESS ______________________________________________ PHONE _______
DATE OF REPORT ________________________________________
APPENDIX H

OPHTHALMOLOGIST'S REPORT:
GLAUCOMA REFERRAL
DEAR DOCTOR:

This patient is being referred because of increased intraocular pressure on a routine screening. To aid us in evaluating the effectiveness of this program your cooperation in providing results of your examination will be appreciated. Please return this report when you have completed your evaluation. This information is for statistical purposes only...and will be kept confidential.

SCREENING RESULTS:

Visual Acuity
--- with correction
--- without correction

Intraocular Pressure (Schiotz Tonometry)

EXAMINATION RESULTS:

Visual Acuity
--- With Correction
--- Without Correction

Intraocular Pressure
--- First
--- Second

Optic Discs
--- Normal
--- Not Done
--- Equivocal
--- Abnormal-Glaucoma
--- Abnormal-Not Glaucoma

Visual Fields
--- Normal
--- Not Done
--- Equivocal
--- Abnormal-Glaucoma
--- Abnormal-Not Glaucoma
Other Test
Results

Diagnosis
___ Not Glaucoma
___ New Glaucoma
___ Glaucoma Suspect
___ Known Glaucoma
___ No Report

SIGNATURE ___________________________ M.D.
ADDRESS __________________________ PHONE
DATE _______________________________
APPENDIX I

FOLLOW-UP LETTER
ON
GLAUCOMA SUSPECT
Dear ____________________:

During your recent glaucoma screening, we found the pressure in your eyes to be higher than normal. At that time it was suggested you consult an ophthalmologist, who is a medical eye specialist, for further examination. However, we have not yet received a report from an ophthalmologist.

Glaucoma is a leading cause of blindness. If proper medical treatment is started early, the progress of glaucoma can be stopped. However, sight destroyed by glaucoma cannot be restored. Therefore it is urgent that you have an eye examination.

Please complete the enclosed form and return it to this office in the envelope provided so we may keep our records up-to-date.

Thank you for your cooperation.

Sincerely,

___________________________, R.N.

Cindy Angiulo

Name __________________________ Telephone _________

Address ________________________________________________

City __________________________ State _____ Zip _____
1. I was examined by Doctor _____________ on ________. (date)

   The results showed that:
   ☐ I have glaucoma ☐ I do not have glaucoma
   ☐ I am under observation

2. I have an appointment to see Doctor ________________
   on ________. (date)

3. I need help in finding an eye doctor:
   ☐ Yes ☐ No
REFERENCES


Spector, Reynold, Johnson Lightfoote, Phin Cohen and Leo Chylack, Jr. "Should Tonometry Screening Be Done by Technicians Instead of Physicians?" Archives of Internal Medicine, 135:1260-1262, September 1975.


