APPENDIX K

MEDICAL SCREENING MANUAL

FOR LAW ENFORCEMENT OFFICERS

PREPARED FOR:

PRINCE GEORGE'S COUNTY
Office of Human Resources Management
1400 McCormick Drive
largo, Maryland 20774

PREPARED BY:

MED-TOX Health Services
3350 Shelby Street, Suite 200
Ontario, California 91764
www.med-tox.com

Novemeber 1, 2009

TABLE OF CONTENTS

MEDICAL SCREENING UNDER THE AMERICANS WITH DISABILITIES ACT

1.0 THE PRE-PLACEMENT MEDICAL EXAMINATION

The purpose of the pre-placement examination is to assess an individual's health status prior to employment or assignment to a position with new or different physical demands or environmental exposures. The examination should identify any health problems that could be substantially aggravated by the physical demands or environmental hazards known to exist in the job. The examination also can provide baseline medical information that can be compared to subsequent examination results to assess whether the individual has any significant health trends.

Another purpose for the pre-placement physical is preventive. If the screening physician discovers during the medical examination a condition that does not impede the individual's ability to perform the job in question but that may be a health problem of which he should be aware, the employee may be advised of this fact. This information should not be conveyed to the employer, however, as it has no bearing on the hiring decision.

The medical examination should be performed by a physician qualified to make functional assessments of individuals. This is very different from making clinical determinations of disease or disability (i.e., diagnoses). In order to be effective, the screening physician should have in-depth knowledge of the demands of the job for which the screening is conducted. This includes a detailed listing all (essential *and* marginal) of the tasks necessary to perform the job including measures of their frequency and importance.

The pre-placement medical examination is not intended to replace the regular medical examination by the individual's personal physician. It is intended only to determine and correlate each individual's medical status with employment requirements. Therefore, definitive diagnosis of the conditions that may not affect employment and treatment of medical conditions discovered during the pre-placement examination process is the responsibility of the individual and his personal physician.
All personal risk factors should be considered in assessing risk for the individual applicant. In complex cases it may be necessary to collect medical, surgical, past employment, hospitalization and military disability

records. Other factors such as the nature and extent of recent and current medical treatment, time off work, previous or recurrent gaps in employment, social and family medical histories may provide important clues as to the individual's current medical status. Previous workers' compensation records should be assessed including any objective examination findings and functional capacity evaluation reports. Documentation from treating physicians, rehabilitation counselors, physical or occupational therapists, or others with specific experience with the disability may require further review.

If the individual has any significant symptoms or conditions, it is important that an accurate diagnosis of the condition be made prior to placement to ensure that the final hiring decision is based upon an assessment of both the individual's medical status and his functional ability. In some cases this may mean that the individual may need to be seen by a specialist for evaluation or may need to seek medical treatment prior to placement to ensure that an unstable condition is brought under control.

It is often advisable for the screening physician to consult with the individual's personal or treating physician who may be able to provide important information useful during the individual determination. While treating physicians may have good knowledge of their patients, they are more likely than not to lack detailed information about the nature of specific job under consideration.

Treating physicians should be provided with detailed information about the physical demands and environmental hazards of the job when asked to assess their patients. Assessments by treating physicians must be as comprehensive as it is possible and specific questions should be prepared in advance by the screening physician in order to obtain complete information. Reference to job demands and environmental hazards by treating physicians is critical in obtaining a full and complete patient evaluation.

At times, it may be appropriate (and cost efficient) to refer the individual to a specialist for evaluation. This is especially true in cases were: (1) the individual displays a relatively rare medical condition, or a relatively unique manifestation of a common condition; (2) the evaluation requires physical examination skills and tests that are beyond the specific expertise of the screening physician; or (3) when there is disagreement between the screening physician and the individual's treating physician. The added weight of an additional medical opinion, particularly that of a specialist, may also prove useful in defending the employment

decision.

Because medical specialists may not be familiar with all of the employer's occupations, it is incumbent upon the employer to provide these physicians with as much detailed information as possible about the physical demands and the environmental hazards of the job. If panels or individual specialists are repeatedly used, each should be given an orientation to the job by the department and have made available clear and detailed job information describing the nature of the work. If possible, the specialist should have made at least one site visit to observe the workplace.

2.0 AMERICANS WITH DISABILITIES ACT

The screening physician must be familiar with the requirements of the Americans with Disabilities Act as amended (ADA). The Act is very specific in its provisions and closely resembles the substantive clauses of the Vocational Rehabilitation Act of 1973. The Equal Employment Opportunity Commission (EEOC) has provided *Interpretive Guidelines*, a *Technical Assistance Manual* and has made available several *Enforcement Guidance* documents to apprize employers of their responsibilities under the Act. In 2008 the Americans with Disabilities Amendments Act (ADAAA) was signed into law. This act overturned a series of U.S. Supreme Court decisions and EEOC interpretations that had severely restricted coverage of the original ADA. The Act took effect in January of 2009. As a result, the EEOC is revising its guidelines to ensure compliance.

The Americans with Disabilities Act permits pre-placement medical examinations only after a conditional job offer has been made. At this point an employer may conduct an unrestricted medical inquiry or medical examination, including inquires about previous workers' compensation claims and other injuries or illness. Although a post-offer inquiry or examination need not be job-related, and consistent with business necessity, any refusal to hire a qualified individual with a disability based on the results of such inquires must be job-related and consistent with business necessity.

Several technical terms and definitions from the ADA are of particular importance in interpreting the Act. These terms include:

2.1 Discrimination Prohibited

The ADA prohibits discrimination against qualified individuals with disabilities in regard to any employment practice or terms, conditions, and privileges of employment. The prohibition covers all aspects of the employment process, such as job application, testing, hiring, assignment, training, promotion, medical examination, compensation, leave, and benefits. Under other laws that prohibit employment discrimination, inclusion with a protected class, such as race, gender, national origin, or age, is often more obvious or objective. By contrast, protection of individuals under the ADA involves a case-by-case analysis to determine if that person meets the act's definitions of "disability" and "qualified individual."

2.2 Impairments Covered by the ADA

The ADA, as amended, defines a disability as a "physical mental impairment that *substantially limits* one or more of the major life activities." The phrase "substantially limits" must be viewed broadly to the maximum extent permitted by the terms of the Act. For example, an impairment need only substantially limit one major life activity to be considered a disability. Previously, the U.S. Supreme Court had held that an individual must be unable to work in a broad class of jobs in order to be considered "substantially limited." This is no longer the case. Medical conditions, even if they are in episodic, in remission or well-controlled are considered a disability as long as that impairment - in its active state - would be substantially limiting.

Mitigating measures such as medications or prosthetic devices cannot be considered when determining if a person has a disability. If a condition such as diabetes is well-controlled, that individual must be considered *without regard* to the medication. One exception is that an individual's visual disability may be considered with regard to corrective measures such as spectacles and contact lenses. In practice, this would mean that a person who wears glasses or contact lenses would need to demonstrate that he or she is substantially limited in the major life activity of seeing even while wearing the corrective device in order to be considered a qualified person with a disability.

Prior to the 2008 amendment, major life activities include "caring for oneself, performing manual tasks, seeing, hearing, eating, sleeping, walking, standing, lifting, bending, speaking, breathing, learning, reading, concentrating, thinking, communicating and working."

Additional major life activities encompass "operation of major bodily functions," such as the "immune system, normal cell growth, digestive bowel, bladder, neurological, brain, respiratory, circulatory, endocrine, and reproductive functions."

2.3 Temporary Disabilities and the ADA

Impairments that are minor or transitory (i.e., an actual or expected duration of six months or less) are not protected under the ADAAA. Temporary conditions such as fractures, sprains, concussions, appendicitis, common cold, or influenza typically would not constitute disabilities. Conditions that last only for a few days or weeks and that have no permanent or long-term effects are typically not substantially limiting impairments. On the other hand, conditions lasting of indefinite and unknowable duration may be substantially limiting.

2.4 Qualified Individual with a Disability

It is the applicant's burden to establish that he or she is a qualified individual with a physical or mental impairment who can perform the essential functions of the job.

Retroactivity

The 2008 amendment to the ADA became effective on January 1, 2009. The amendments only apply to employment actions performed after the law took effect. Employment actions performed prior to January 1, 2009 must be assessed under the law and the court decisions that were in effect at the time.

2.4 Medical Tests

The Equal Employment Opportunity Commission has defined what constitutes medical procedures or tests that seek information about an "individual's physical or mental impairment or physical health or psychological health" (EEOC, 1994, p. iii). Tests and procedures with the following factors indicate a particular test is medical:

- The test is administered by a health care professional;
- The results of the test are interpreted by a health care professional;

- The test is designed or given for a purpose of revealing an impairment or the state of physical or psychological health;
- The test is invasive;
- The test measures physiological or psychological responses as opposed to performance of a task;
- The test is normally performed in a medical setting;
- Medical equipment is used for the test.

2.5 Medical Records

The ADA does not contain specific requirements for the handing of a confidential medical record. Importantly, there is no requirement that medical personnel maintain custody of the records. However, medical information, including history, must be maintained on separate forms and in separate files than personnel records. According to the Act, the information must be kept confidential except to:

- Inform supervisors of necessary restrictions on work or necessary accommodations;
- Inform, where appropriate, first aid and safety personnel if the disability might require emergency treatment; and
- Provide relevant information upon request by government officials investigating ADA compliance.

It is essential that all candidates for employment sign a release of medical records that is consistent with the current state privacy requirements. The release should be broad enough to permit both the screening physician and the employer to gain access to the records. Employers may need these records when investigating workers' compensation cases or to comply with the Americans with Disabilities Act. Medical release forms should be reviewed by legal counsel to ensure they are consistent with state law.

2.6 Benefits of Medical Screening under the ADA

Despite the regulatory burdens and intricate and changing legal

technicalities that encompass the pre-placement medical examination process under the ADA, it is important to recognize that medical screening plays an important role not only for the employer, currently employed workers, and the public, but for the individual candidates as well. The examination helps to ensure that:

- The individual's health and safety are not placed at risk or impaired as a result of employment in the new job.
- The individual is medically and emotionally able to perform the demands of the job.
- The employment of qualified persons with disabilities is facilitated by valid and reliable information concerning both the existing environmental hazards and the physical demands of the job.
- The public and currently employed workers are protected from medically incapable persons unable to perform the job.
- The employer's exposure to financial liability arising from medically identifiable deficiencies and improper job placement is minimized to the greatest extent feasible.

Because of these important objectives, employers have sought guidance in establishing medical screening criteria that are job-related (Letz, et al., 2007). Some public agencies have relied on lower level court decisions to establish medical screening requirements, a practice that is contrary to the spirit of the ADA which states that decisions must be made on a case-by-case basis. Even in the event that two cases have similar facts, the quality of evidence presented at trial and the potential for contradictory outcomes makes this practice a poor one. In addition, as Congress amends the law to modify previous U.S. Supreme Court decisions as it did in 2008, many previous legal judgments are no longer applicable under current law.

The model for conducting the pre-placement medical examinations presented in this document requires an individualized assessment of the entering candidate's physical capabilities in relation to the specific physical tasks of the job. In making this assessment, function is more important than diagnosis and individual determination with regard to the specific job is more important than particular legal outcomes in other jurisdictions.

3.0 EVALUATING RISK

Evaluating job risk "involves defining the relationship between the worker and the work environment to determine the 'fit' between them" (Johns, Bloswick, et al., 1996, p. 538). A poor fit can aggravate the disability, unfavorably affecting the individual through job-related injuries and illnesses and further disability. A poor fit may also adversely affect the public safety and increase the threat of harm and serious injury to other workers who must rely each other during dangerous situations. The fit between the individual and the job can be enhanced by increasing the capabilities of the individual through, physical conditioning or training, or by decreasing the physical requirements of the job through ergonomic modification or reasonable accommodation (Johns, Elegante, et al., 1996, p. 593).

3.1 Direct Threat and Evaluation of Risk

The identification and evaluation of risk is imposed by the ADA. According to the statute, an employer may require that an individual with a disability not pose a "direct threat" to the health or safety of others. The ADA states that the "term 'direct threat' means a significant risk to the health or safety of others that cannot be eliminated by reasonable accommodation" (ADA).

Should a qualified disabled individual be medically considered, the employer must assess this individual in relation to the criteria for direct threat. This criteria means that the risk to the health and safety to others must be one that is significant. By significant it is meant that there is a "high probability of substantial harm if the individual were employed" (EEOC, 1992, p. IV-10). Such risk can be identified based on the duration of the risk, the nature and severity of the potential harm, the likelihood that the harm will occur, and the imminence of the potential harm (EEOC, 1992, p. IV-10). According to the EEOC, the risk must be one that is current and not remote. The risk must be one that relates to the specific disabled individual under consideration for employment.

The risk must be one that is based on objective medical or other evidence related to the individual (EEOC, 1992, p. IV-11). Not only must the risk assessment be based on objective medical evidence but the assessment must be based on the "best available objective evidence about this individual" (EEOC, 1992, p. VI-10).

The EEOC states that any identified risks must be determined to be a

"direct threat" if they result in nonaccommodation of the individual. Such a risk must be based on consideration of a specific risk and sufficient medical evidence or other evidence to rise to the level of "direct threat."

Very little case law or other information is available that provides guidance as to the degree of risk that must be tolerated before a direct threat defense can be used to justify the disqualification of an individual with a disability. Guidelines are provided to compensate for the lack of objective legal criteria. These guidelines are only suggestive since only the employer can determine how much additional or less risk is tolerable.

Danger to self: If, through performance of all relevant job functions, the disabled individual poses a danger only to him or herself, the employer needs to show that the danger is 1) more likely than not, 2) identifiable, and 3) in the EEOC's view, substantial and immediate in order to justify disqualification. More likely than not is synonymous with "reasonable medical probability" and has been defined as a likelihood of occurrence of 50 percent or more (Johns, Bloswick, et al., 1996, p. 543; Sacks, 1991, p. 295). "Substantial harm" is one involving death, permanent disability, major surgery or prolonged disability, "Immediate" in the context of law enforcement applicants is generally considered a period of two to three years (See Future Risk).

The "danger to self" defense had been challenged since nowhere in the actual text of the ADA, does this defense exist. In Chevron U.S.A v. Echazebal, the U.S. Supreme Court determined that Congress had meant to include this defense in the Act. The court did not rule on any of the substantive features of the case, such as whether the plaintiff's Hepatitis C actually constituted a danger to self.

Direct threat to others: To deny employment to a presently disabled individual who poses a threat to others, the employer must show that the disabled individual presently endangers the health and safety of others to a significantly greater extent than if a person without the disability performed the job. The term "significantly greater" is not legally defined. However, rather than use traditional statistical definitions which reflect the increase in relative risk, it is suggested that using an absolute risk of 1% per year or greater of the impaired worker causing serious injury to others is a useful rule-of-thumb. While precise quantitative assessments are difficult to achieve, the bench mark of 1% is helpful as a reasonable guide for physicians in their risk assessment.

In any given case whether 1% is reasonable depends on consideration of the duration of the risk, nature of the disability, and likelihood and imminence of the threat. Such considerations must include assessing how reasonable accommodation can eliminate or reduce the risk. According to the EEOC, "the risk need only be reduced to the level at which there no longer exists a significant risk of substantial harm" to the individual (29 CFR 1630.2 [r]).

3.2 Future Risk

Future risk involves a determination that the presently disabled individual, while capable of performing the job now, will not be able to perform the job, or perform safely, at some definable point in the future. Unless there is an overwhelming likelihood of the individual contracting an extremely serious disease from occupational exposure, disabilities with long latency periods should be disregarded in medical screening (Rothstein, 1989, p.137).

The individual should be able to perform the job for a reasonable length of time. Neither the ADA legislation nor the EEOC provides any guidance as to what is considered a reasonable length of time. The EEOC does provide a set of factors that need to be considered when determining a reasonable performed of time. These factors include:

- The nature of disability.
- The length of the training period relative to the length of time the employee is expected to be employed
- The type of time commitment routinely required of all employees for the job in question.
- The normal work force turnover for employees within the occupation.

Experience suggests that the pre-placement medical evaluation should assess an individual's ability to safety perform the job for no more than a 2-3 year period of time. Given this framework, periodic reassessment may be required to monitor the health of individuals with conditions that may place them at risk if uncontrolled or uncorrected (Guidotti, et al., 1989, p. 240).

3.3 Physician & Employer's Roles in Assessing Risk

Screening physicians and employers also have complementary roles with regard to individual risk evaluation. The physician must determine if the individual can physically perform all of the duties of the position, as well as provide the employer with a description (and quantification), to the extent possible, of the individual's performance limitations and/or risks if the individual were to be placed in the job. Physicians may also evaluate the effectiveness of various medical devices, treatment regimens to mitigate risks (e.g., medications, hearing aids). Based on this information, the employer is then responsible for deciding whether the risks described by the physician constitutes a significant safety concern or a direct threat and whether they can be reasonably accommodated. Table 1 depicts the responsibilities of the screening physician and the employer.

Table 1: Roles of the Physician and the Employer

Area of Responsibility	Physician	Employer
Job Information	Be familiar with job information supplied by employer; ensure all considers and decisions are job relevant.	Defines/identifies job duties and environmental hazards for that agency
Risk Evaluation	Quantifies/describes risks in terms of likelihood, severity, imminence, etc.	Makes ultimate determination of whether risk(s) posed by individual constitute a "direct threat"
Reasonable Accommodation	Identifies work restrictions; suggest practices, aids, or devices that would allow individual to perform job; monitors compliance as necessary.	Working with individual and physician, chooses method of reasonable accommodation (or rejects due to undue hardship); monitors compliance as necessary.
Decision Making	Advises employer of individuals ability to perform specific job tasks and/or risks associated with job performance.	Makes ultimate decision as to whether to hire, disqualify, defer, or restrict.

Prior to making a hiring determination, however, available methods of reasonable accommodation that could serve to reduce this risk to a tolerable level must be considered.

4.0 REASONABLE ACCOMMODATION

Reasonable accommodation is a crucial component of the ADA's mandate to eliminate unnecessary barriers that restrict employment opportunities for otherwise qualified individuals with disabilities. The ADA requires reasonable accommodation in all major aspects of employment, including the application process, the performance of the essential (and nonessential) functions of a job, and the right to equal benefits and privileges of employment.

Reasonable accommodations are any modification or adjustment to a job, an employment practice, or the work environment that enables an individual with a disability to perform the functions of the job as well as someone without the disability in question. Reasonable accommodation must be individually determined and be based on the specific functional limitations of the particular individual and the specific functional requirements of a particular job.

In considering reasonable accommodation the following questions should be considered (Nylander & Carmean, 1987, p. II-32):

- Are accommodations possible for this person in this position? Would the modification of how the functions of the job are performed imperil public safety?
- What type of accommodation represents the most practical, cost effective and reasonable method?
- Will the proposed accommodation actually compensate for the disability in question?
- What medical and public safety-related implications are present in the proposed accommodation?
- Have management and supervision been informed and consulted in regard to the proposed accommodations?
- Can additional suggestions, information or other assistance be provided by the disabled individual and his treating physician?

- Has a written record of good faith efforts in devising a reasonable accommodation been maintained?

- Is the task that the disabled candidate has difficulty performing on that is essential or nonessential? Candidates may be excused from having to perform nonessential tasks.

Modification in how the essential functions of a job are performed is a challenging one, especially in the public safety setting. This is generally true because of the unpredictable nature of the public safety work. Situations and events can vary greatly from day to day making job modifications particularly demanding. Many of the most important physical and sensory demands of the job are also extremely dangerous, strenuous and unpredictable making them difficult to modify. Considerations for accommodating physically and sensory disabled persons into law enforcement occupations are often confounded by the fact that few, if any, entry-level law enforcement jobs exist that do not involve public safety and the need for emergency response.

An employer Is not required to provide an accommodation if it will impose an undue hardship on business operations (29 CFR 1630.13 [a]). An accommodation creates an undue hardship when it is unduly costly, extensive, substantial, disruptive, or would fundamentally alter the nature or operation of the business. Factors in determining undue hardship include the nature and cost of the accommodation relative to the size, financial resources; type, location, nature and structure of the employer's operations and the impact of the accommodation on the specific facility (29 CFR 1630.2 [p]).

The screening physician's role in determining an appropriate accommodation should be as part of a team that may identify procedures, devices, job aids, medicines, or work restrictions that would allow the individual to perform job functions without an undue risk. There are examples of possible accommodations described in the medical guidelines, including use of medications while on duty, use of corrective devices, use of sick leave, etc. Individual accommodation must be based on the functional abilities of the individual and be determined on a case-by-case basis.

As with all decision making under the ADA, it is the employer who has the ultimate responsibility for (1) determining what risk is acceptable; (2) determining what accommodation is reasonable; and (3) making the final hiring or rejection decision.

Presently, there are five basis reasons for an employer to refuse to hire a candidate for a particular job:

- The candidate has a medical condition that does not substantially limit a major life activity but creates a level risk of injury to him or herself or to others that is unacceptable to the employer.

- The individual is currently unable to perform the essential functions of the job with or without reasonable accommodation.

- The presently disabled individual with or without reasonable accommodation would not be able to perform the essential functions of the job for a reasonable period of time (2-3 years).

- By performing the essential functions of the job, it is likely that the disabled individual would significantly threaten his/her own health and safety and no reasonable accommodation exists that would eliminate or sufficiently reduce this risk.

- By performing the essential functions of the job, the presently disabled individual would significantly threaten the health and safety of others, and no reasonable accommodation exists that would eliminate or sufficiently reduce this risk.

5.0 JOB ANALYSIS INFORMATION

Two essential types of job information need to be considered in a medical pre-placement examination. First, the physical tasks and physical demands of the job should be specified. Any environmental hazards known to adversely impact health conditions should be described. The screening physician is then able to consider the physical and environmental conditions of the job in relation to the individual's clinical condition. For many diseases it is important to recognize that individual variability may exist among those with the same clinical condition. Therefore, when performing the pre-placement examination, consideration must be given to individual variability prior to making any final recommendations. Additional job information may be obtained directly from supervisory and management personnel and on-site inspections.

Job analysis provides the screening physician with accurate, objective and detailed descriptions of the actual tasks required for performance

of the job. Job analysis is also useful in that it:

- Provides a common set of tasks that may be used by the screening physician, private treating physicians and consulting specialists to consider when making their independent individual determinations regarding the direct threat posed by the individual with a disability.

- Helps to ensure that the hiring procedures do not discriminate against a qualified individual because of nonjob-related criteria or considerations.

- Provides a basis for evaluating whether reasonable accommodations can be made to enable an individual with a disability to perform safely and efficiently; conversely, it can provide documented evidence as to why particular accommodations cannot be made;

MED-TOX Health Services has performed a detailed analysis of the physical and sensory demands of several law enforcement officer classifications. In addition to the task analyses, the employer has the survey results from the working conditions analysis conducted as part of this project. The occupational medicine physician should obtain these documents from the department prior to conducting any medical examinations using these guidelines.

6.0 SUMMARY

The following general principles that have proven useful in facilitating medical screening decisions that are job-related and consistent with business necessity.

- Avoid slavish adherence to the guidelines and recommendations in this manual.

The examination and evaluation protocols in this manual are offered as guidelines. Although they provide concrete guidance pertaining to a wide range of conditions and circumstances, the medical protocols are intend to permit (in fact, to foster) the individualized assessment of each individual's medical status and history.

- Properly partition the roles of the screening physician and hiring authority.

A critical part of pre-placement medical screening is the need to partition the roles of the screening physician and the hiring authority. Although they work together, each must be aware of the extent and limits of their own responsibilities. As depicted in Table 1, the employer is initially responsible for providing the screening physician with a complete, accurate, and medically relevant description of the job demands and environmental hazards of the job. Physicians, in turn, are responsible for ensuring that their examinations and recommendations are based on full familiarity with these job demands and environmental hazards.

- Tailor the examination to the specific needs of each individual.

All individuals should receive the same basic medical examination. However, physicians should conduct more in-depth tests as necessary when an initial condition of concern is identified. It is imperative that a sufficient amount of information be accrued to warrant an ultimate hiring recommendation. A "good faith" belief alone that a individual cannot perform the job is not sufficient.

- Collect information from other parts of the screening process as necessary.

Depending upon their order of occurrence, information gleaned form other parts of the screening process, such as the background investigation or physical ability test, can provide the physician with valuable supplementary information regarding an individual's medical status and history. In addition, instances where an individual manifests certain physical limitations (e.g., missing finger), the screening physician may want to recommend a non-routine, task specific evaluation (e.g., firearms assessment). However, functional capacity assessments must be carefully constructed since these assessments can be considered employment tests may be subject to criticism if they are not appropriately validated.

- Consult with and/or gather information from other medical experts as necessary.

This may include consultation with specialists and the candidate's treating physician. Physicians submitting opinions regarding the functional capacity of persons with disabilities to perform the demands of a job should review and reference the job demands in submitted reports.

- Make sure that medical recommendations and decisions are consistent with legal standards.

Both physician and employer must be aware of the changing nature of the legal standards imposed on pre-placement medical screening and keep current with modifications as they occur.

All screening decisions (particularly those that have an adverse impact on the individuals with a disability) must be based on an explicit link between the individuals' condition(s) and his/her ability to perform specific job functions. A summary decision that does not provide this level of detail is not adequate. The screening physician should identify the specific job dut(ies) or working condition(s) that prohibit a disabled individual's ability to perform and/or create a risk of injury to the candidate or to others.

- Limit access to information regarding the individual's medical status.

Medical screening information is to be treated as confidential and maintained in records separate from the individual's personnel file. Although hiring authorities have an absolute right to these records with appropriate medical releases, it is advisable to limit the information conveyed from physician to the employer to restrictions and work limitations only which are necessary for making employment-related decisions. This may not always be possible since the ADA requires the employer have this information and that it be provided to first aid and supervisory personnel in some circumstances. In general, however, limiting information in this way can head off accusations of unfair treatment attributed to an individual's disability status.

- Ensure that the confidentiality of medical records.

While the Health Insurance Portability and Accountability Act of 1996 (HIPAA) does not apply to pre-placement medical examinations, employers and physicians must ensure that medical records are maintained in a fashion consistent with state law.

- If a medical screening decision results in a job denial or restriction, fully explain the reasons to the individual.

A rejection without a complete explanation can create a feeling of unfairness on the part of the candidate. In fact, one of the primary reasons behind the ADA's prohibition against pre-placement medical

inquires is the elimination of the common practice of presumptively disqualifying disabled job applicants without disclosing the basis for the rejection. It is, therefore, advisable to provide the individual with a full, task-specific explanation of the basis for any adverse decision, be it disqualification, work restriction, or deferral.

- Have an appeal process for candidates who disagree with the results of the medical evaluation.

The ADA requires that disabled applicants must be permitted to submit independent medical opinions for consideration before a final determination is made. This is best accomplished within the context of an in-house appeal process. Such a process could involve a review by a supervising physician, general manager, independent medical review panel, and/or a civil service commission. An appeal process serves two purposes. It provides the applicant with an expeditious alternative to filing a discrimination claim with the state or federal regulatory agency. Secondly, it reduces the risk of administrative or physician error, and helps prevent the unnecessary loss of an otherwise good candidate.

7.0 REFERENCES

ADA Amendments Act of 2008, Public Law 110-325 [s. 3406], Sept. 25, 2008

29 CFR 1630 *Equal Employment Opportunity for Individuals with Disabilities: Final Rule.*

45 CFR 160 *Standards for Privacy of Individually Identifiable Health Information:* Final Rule, August 14, 2002.

Americans with Disabilities Act of 1990 (ADA or Act), 104 Stat. 328, 42 U.S.C. § 12101.

Carelli, R. (January, 9, 1999). *Court to Clarify Disability Bias*, Washington, DC: Associated Press.

Chevron U.S.A v. Echazebal, (U.S. 00-1406, 2002).

Daley v. Koch, 882 F.2d 212, 215 (2nd Cir. 1989).

Equal Employment Opportunity Commission (May 19, 1994). *Enforcement Guidance: Pre-employment Disability-Related Inquires and Medical Examinations Under the Americans with Disabilities Act of 1990.* Number 915.002.

Equal Employment Opportunity Commission (January, 1992). *A Technical Assistance Manual on the Employment Provisions (Title I) of the Americans with Disabilities Act.* Washington, DC: EEOC.

Guidotti, T.L., Cowell, J.E., Jamieson, G.G. & Engelberg, A. (1989) *Occupational Health Services: A Practical Approach*. Chicago: American Medical Association.

Johns, R.E., Bloswick, D.S., Elegante, J.M., & Colledge, A.L. (1996). Chronic, recurrent low back pain: a methodology for analyzing fitness for duty and managing risk under the Americans with Disabilities Act. *JOM*, 36, 537-547.

Letz, G., Christian, J.H. & Tiermon, S. "Disability prevention & management", In: Ladou, J. (2007). *Current Occupational & Environmental Medicine, Fourth Edition*. New York: McGraw-Hill, 32.

Nylander S. & Carmean, G. (1987). *The Medical Standards Project Final Report: Volume I*. San Bernardino, California: San Bernardino County.

Rothstein, M. (1989). *Medical Screening and the Employee Health Cost Crisis*. Washington, DC: Bureau of National Affairs.

Sacks, D.L. (1991). Applying the rules of evidence to causation. In: *Clinical Epidemiology: A Basic Science for Clinical Medicine*. Boston: Little Brown, 294-297.

PREPLACEMENT EXAMINATION PROTOCOL

1.0 MEDICAL EXAMINATION PROTOCOL

1.1 Scope and Depth of the Examination

Preplacement examinations imply that a conditional job offer has been made, but the candidate will be medically examined before the candidate starts work. The scope and depth of the preplacement examination must be sufficient in order to gather enough medical information about an applicant so that a decision can be made about the applicant's fitness for the job that has been offered. The preplacement examination should be able to determine the applicant's baseline health status, including pre-existing medical conditions.In addition to assessing the applicant's health status, the physician must assess the degree of risk a medical condition that is discovered by a preplacement examination poses to the applicant were he or she to perform the tasks and duties of the job. The examiner needs to assess whether a medical condition may be made worse by the tasks and duties of the job, resulting in injury and/or disability for the worker and liability to the employer. The examiner must also determine whether a medical condition may cause an undue risk to the candidate's coworkers or to the public he or she will serve. If medical conditions are found which may place the applicant, coworkers or public at risk, the examiner may need to place preplacement restrictions or limitations on the worker. It will be up to the employer to decide if the restrictions can be reasonably accommodated.

1.2 Medical History Questionnaire

A medical history is as critical to the preplacement examination process as a physical examination and laboratory testing. Medical history questionnaires are typically poorly designed and inadequate. Because the preplacement medical examination is the only time during the employment process that an applicant's health status can be ascertained, it is particularly important that the examination be comprehensive. The medical history questionnaire should adequately cover several major areas, such as previous disease or injury, current acute and chronic medical conditions, prior injuries and disabilities (both work related and non-occupational), previous hospitalizations and surgeries, allergies, and current use of medications and drugs. The form should also include a family history, an occupational history, an

exposure history, current immunization status, and a social history. The social history should include questions on hobbies, sports, and habits such as smoking, alcohol use and illicit drug use.

The occupational history is an especially important component of the medical history questionnaire, since it provides the examining physician with a summary of the jobs held by the applicant in the past. This information is useful in determining whether the applicant has performed physically demanding work in the past and whether he or she experienced any difficulties with job performance. The occupational and exposure history can also provide key information about risk factors for future diseases. It is recommended that the MED-TOX *Medical History Questionnaire* or similar comprehensive form be used during the preplacement examination of all applicants. The *Medical History Questionnaire* is located in the Appendix. Additional copies can be obtained from MED-TOX.

1.3 Documentation of Applicant Interview and Questionnaire Review

Since questionnaires are typically deficient and inadequate, the examiner should properly document any history obtained upon interview of the patient and review of the questionnaire. Past and current medical conditions such as hypertension, diabetes, asthma, and migraine for example should be well documented as pre-existing medical conditions. Past surgeries including eye surgery such as LASIK, orthopedic repairs, and cosmetic surgery should be documented. Any other details from the review of the occupational, exposure, family or social histories should be included.

For any medical conditions or injuries found, the candidate should be questioned regarding how the condition impacts his capability to perform work, recreational or any tasks associated with daily living. Any functional limitations should be described along with requirements for treatment or management, if necessary. Medication use, with attention to dosage, frequency, and compliance should also be documented, as a consideration for the potential to physical or cognitive impairments, and can also provide insight on the severity of the condition.

For persons with previous injuries, the physician should ask the candidate several detailed follow up questions.Was the injury work related? Common non-work related injuries include sports injuries and motor vehicle accidents. What type of treatment was required for the injury? Severity of the injury can be gauged by the level of treatment

used. Were there limitations in basic activities such as sitting, standing, lifting, or walking? Was there any time off from work and how much? Were work restrictions necessary, what type of restrictions were used and for how long? Did the candidate return to the same work duties? Did the candidate work despite the presence of pain? Was the candidate awarded any temporary or permanent disability? What was the impact of the injury on the candidate's participation in sports or other activities of daily living? Are there any current symptoms or residual impairment of functional ability? Have there been any recurrences, exacerbations or other problems since the recovery period?

The examining physician should clearly document the basis or rationale for subsequent placement decisions.

1.4 Physical Examination

The examination should be focused at assessing whether the candidate has any medical condition(s) that could impair the candidate's ability to perform the job safely.

To assess these factors, the physician should select the appropriate tests that may be necessary due to the working conditions and physical demands of the job to fully assess the particular condition of the applicant for the job in question. The MED-TOX medical examination protocol stress that individuals be evaluated on a case-by-case basis. Consideration should be given to additional diagnostic information from additional tests for applicants with preexisting problems. Table 1 includes the recommended routine and additional tests recommended for screening law enforcement officers.

Table 1: Recommended Procedures and Tests for Law Enforcement Officers

Physical Examination Component	Notes
Review Medical History Questionnaire	A. Personal Health History B. Family Health History C. Health Habit History D. Job and Exposure History
Vital Signs	A. Height and Weight B. Blood Pressure C. Pulse D. Temperature E. Respiration F. Pain
Vision test (R & L)	A. Near - corrected (M- System or equivalent) B. Far - corrected (Bailey-Lovie or equivalent) C. Far - uncorrected (Bailey-Lovie or equivalent) D. Peripheral (Automated or confrontation) E. Color (Ishihara as an initial screen) F. Farnsworth D-15 (For those who fail Ishihara)
Audiogram	A. Audiogram using equipment and procedures established by CAOHC B. Hearing in Noise Test (HINT) C. If HINT is unavailable, utilize Pure Tone alternative.
Electrocardiogram	A. For those under 40 with no risk factors
Exercise Treadmill	A. Bruce Protocol (For those over age 40 or under age 40 with two or more risk factors)
Chest X-ray	A. If history warrants
CBC (Complete Blood Count)	A. With differential
Metabolic Panel	A. With renal and liver function tests
Urinalysis	A. For all candidates

Table 1: Recommended Procedures and Tests, Continued

Physical Examination Component	Notes
Mantoux skin test	A. 2-Step if history warrants
Pulmonary Function Test	A. Basic spirometry
Back X-ray	A. If history and symptoms warrant
Immunization Status	A. Check Medical History Questionnaire B. Titres or proof of immunity as recommended by policy C. In absence of policy see: CDC recommendations http://www.cdc.gov/mmwr/pdf/wk/mm5641-Immunization.pdf
Drug Screen	A. As mandated by policy

Individual medical guidelines include detailed evaluation guidelines and the relevant factors to consider in conducting the examination.

1.5 Documentation of Abnormal Physical Findings

Complete documentation of orthopedic and other physical examination findings is essential. Prior surgical and nonsurgical scars should be noted on skin examination. These findings could be significant in future workers' compensation and disability determination proceedings in evaluating whether any abnormal findings were related to a pre-existing condition.

The examining physician should clearly document the basis or rationale for subsequent placement decisions.

1.6 Integrating the Data to Reach a Decision

Information from the applicant's medical and occupational history, physical examination and ancillary test findings needs to be reviewed before a placement decision can be reached. If the individual has any significant symptoms or a detected medical condition, the impact on job performance needs to be closely assessed. In very complex cases, opinions of specialist physicians and the applicant's treating physicians may be necessary to fully evaluate the health status of the candidate.

The examining physician may also choose to review any past medical records of the applicant.

DERMATOLOGICAL SYSTEM

1.0 INTRODUCTION

The skin is the major organ that provides the interface between man and the outside environment. It has several functions including: protection, heat regulation, and sensation. It is exposed to a wide variety of climatic conditions and potentially noxious stimuli. The ability of the skin to tolerate or accommodate to many environmental conditions, such as temperature, humidity, and exposure to noxious stimuli can be impaired if the skin is affected by some preexisting disorder. Significant worsening of a preexisting skin condition may occur as a result of work place exposure to a wide variety of environmental conditions. Work performance can be impaired if an individual has a marked exacerbation of an underlying skin disorder. One of the goals of a preplacement medical examination program is to ensure that persons with preexisting skin disorders are not placed in positions that will significantly exacerbate their preexisting skin condition or where their disorder limits their ability to perform their job safely.

Occupational skin disease is the most frequently reported occupational disease in the United States today. In a sample of 20,000 persons from the general population, nearly one-third were found to have some skin pathology (Johnson, 1979). Skin disorders account for 40 percent of all reported occupational diseases in the nation and are a leading cause of lost time from work. Millions of dollars are spent annually for the treatment of occupational skin diseases. The estimates for annual lost days may be low and associated costs may be significantly higher because of the generally recognized under reporting of occupational skin disorders. Persons with preexisting skin disorders are often at increased risk of developing exacerbations of the disease as a result of exposure to work place conditions that do not affect the majority of other workers. Since preexisting skin disorders are prevalent in the work force, dermatologic screening is especially relevant.

2.0 OCCUPATIONAL FOCUS

The physician needs to assess both an applicant's overall physical condition and the underlying skin disorder. This is essential since other health conditions may indirectly affect the skin. Through a history and physical examination, the medical examiner should identify any skin disorders and factors that have been known to exacerbate the condition in the past.

It is important for the medical examiner to recognize that individual variability may exist among persons with the same apparent skin disease. The medical examiner needs to consider all factors, including individual variability prior to making any final recommendations regarding an individual's ability to perform a given job.

2.1 Factors Producing Occupational Skin Disease

The definition of occupational skin disease is any abnormality of the skin induced or aggravated by the work environment. Since the skin is the most prominent interface between the worker and his environment, it is not surprising that occupational skin disease accounts for approximately one-half of all occupational disease in the American worker.

Dermatitis is a term that refers to a skin disease that has an inflammatory component in its pathogenesis. Dermatosis describes a skin disease from any cause, including inflammatory and noninflammatory problems.

Factors producing occupational skin disease are thought to be related to the following four classes.

Chemical - Organic and inorganic chemicals can act as primary irritants or allergic skin sensitizers. The primary irritants are substances that, if permitted to contact the skin in sufficient concentration for a sufficient length of time, will produce adverse skin effects at the site of contact in anyone. They damage skin because of their inherent characteristics, and the effect is dependent upon the length of contact, strength of irritant, site of contact, and any unusual susceptibility of the individual.

A sensitizer does not produce effect after first contact, but take multiple contacts to produce an allergic sensitization in only a small percentage of persons exposed. The capacity to develop immunologic or sensitization reactions varies among individuals and is not necessarily related to the dose or extent of exposure. Allergic sensitization is not seen in persons after one exposure.

Physical Causes - Heat, cold, sunlight, ionizing radiation and ultraviolet light are capable of inducing injury directly.

Mechanical - Mechanical trauma, including friction or pressure, produces adverse effects, including calluses.

Biologic - Bacteria, viruses, fungi and parasites from occupational exposure can attack the skin and sometimes produce systemic infection.

2.0 OUTLINE OF HIGHLIGHTED CONDITIONS

Skin disease may be due to a primary disorder or be secondary to systemic diseases. For secondary disorders, evaluation of the underlying disease is required to ensure that it is not disqualifying in and of itself.

There are a variety of dermatological conditions that can have an impact on an individual's ability to perform law enforcement officer activities. Examples include:

- **Eczema** (for example, nummular eczema of the hand), which in its severe stages can restrict the ability to handle weapons, apply physical restraints, etc. Severe eczema can also put an individual at risk of harm from exposure to toxic substances or body fluids;

- **Psoriasis**, if accompanied by marked fissuring or hyperkeratosis of the palms or soles, can have a significant impact on the ability to grasp and fully use one's hands or to perform duties that require weight bearing;

- **Dermatitis** (atopic - e.g., wool, latex) can render an individual unable to wear rubber gloves or certain uniforms, or to handle various substances (e.g., fingerprint powder) common to law enforcement activities;

- **Other disorders** due to heat, cold, or vibration (sweat retention, Raynaud's disease, urticaria) and abnormal reactions to light (photodermatitis, polymorphic light reaction, solar urticaria) have obvious implications for a candidate's ability to work outdoors, or in other adverse environments;

- **Cosmetic disfigurements** (severe scarring, burns), depending upon their location on the body, can result in restricted functioning of the facial muscles, or upper and lower extremities, and interfere with an individual's flexibility, grip strength, ability to communicate orally, etc.

- **Systemic cutaneous lesions** may represent skin manifestations of secondary disorders of other conditions that require evaluation. Such disorders include (but are not limited to):

Cold urticaria and hereditary angioneurotic edema.
Untreated syphilis, chancroid, lymphogranuloma venereum, granuloma inguinale
Lupus erythematosus
Dermatomyositis
Scleroderma
Raynaud's disease
Sarcoidosis
Drug eruptions
Deep mycotic infections
Recurrent needle sticks (ie, intravenous drug use)
Acquired immunodeficiency syndrome

- **Chronic use of medications** that might interfere with patrol duties. Examples are antihistamines that might cause drowsiness, pharmacologic doses of systemic steroids, and systemic retinoids (Johnson, 1979).

3.0 IMPLICATIONS FOR JOB PERFORMANCE

While disorders of the skin severe enough to limit the ability to perform law enforcement job functions are quite rare, there are a number of job-related concerns that must be addressed when evaluating a candidate with skin abnormalities. These are addressed next:

3.1 Impact on Ability to Perform/Withstand Physical Job Demands

Both routine and vigorous physical activity may be hampered by severe skin conditions. Routine activities such as wearing full uniforms with bulletproof vests in warm weather could be sufficiently uncomfortable with certain skin conditions. Vigorous physical activity may be hampered by skin irritation or interference with treatment of the condition. Skin conditions might also result in restricted joint functioning in the hands or elsewhere. In addition, performance of job duties can be adversely affected by discomfort or itching associated with severe skin conditions.

3.2 Risk of Infection/Contagion

Candidates with open skin lesions or eczema can present a risk of body fluid exposure at accident and crime scenes.

3.3 Environmental Controls/Restrictions

Environmental conditions, such as high wind, dust, direct sunlight, snow and ice, and temperature extremes, present an extreme challenge to persons with certain cutaneous disorders. Other work requirements, such as the need to wear gloves when dealing with hazardous materials and to prevent exposure to body fluids, might interfere with the treatment of certain skin disorders or otherwise worsen skin problems.

3.4 Heightened Proneness to Infection

Certain skin conditions when coupled with the demands of law enforcement occupations, can result in a very high risk of repeated or prolonged infection, which may require excessive time off for treatment or recuperation.

3.5 Survival from dermatologic malignancies

The incidence of melanoma in the US ranks this condition seventh among all malignancies. The incidence increased an estimated 3.9% between 1973 and 1991. Surveillance, Epidemiology and End Results (SEER) data from those years show that in whites a tiny cumulative risk of developing malignant melanoma begins at age 30 (approximately 0.1%). By age 35, the age-specific incident rate for white males and females is approximately 13-14/100,000, and the mortality rate is 1-2/100,000. Survival depends upon the thickness of the lesion at diagnosis, and whether there are local lymph node or more distant metastases. Lesions $<.76$ mm thick afford a 5-10 year survival rate of 95%, dropping to 30% at >8 mm or with lymph node involvement, and to 5% with distant metastases (Liu & Seng-Jaw, S., 1996 and Moschella & Hurley, 1992, p. 1760).

4.0 MEDICAL EXAMINATION AND EVALUATION GUIDELINES

4.1 General Screening Recommendations

4.1.1 Medical History

The examining physician should follow up on any positive answer ("previously had but do not have now;" "now have" "don't know") on the Skin section of the Medical History Questionnaire, obtaining more detailed information about sensitivity to light, heat, cold, chemicals, vibration, personal protective equipment, and food. Any history of skin

conditions in the past should be reviewed, including the treatment required and the outcome of treatment. The examining physician may also consider obtaining more detailed information to positive answers on other sections of the Medical History form, such as "edema" (under Cardiovascular System), Endocrine/Metabolic, Allergies, Cancer, if there is any likelihood that there might be a dermatologic manifestation of an underlying medical condition.

4.1.2 Physical Examination

The physical examination should include inspection of skin of at least the head, upper and lower extremities, thorax, abdomen, back and visible mucous membranes. Skin examination of the pelvic region would be warranted only if the history suggests possible skin lesions in that region. Examination may reveal skin changes requiring additional history to clarify the significance of the condition. The skin should be examined for lesions to determine their morphology, distribution, shape, and arrangement.

4.1.3 Routine Testing

No routine testing is required.

5.0 EVALUATION OF COMMON CLINICAL SYNDROMES

5.1 Undiagnosed Skin Disorders

These disorders require evaluation if their is potential to impact on job duties. Treatment may be required prior to determination of fitness for duty. Chronic or recurrent skin conditions should be evaluated by a dermatologist.

5.2 Minor Skin Conditions

Minor skin conditions can usually be treated successfully such that performance job duties will not be adversely affected (Trottier & Brown, 1994, p. 108). Candidates with treated skin conditions that will not be worsened by the environmental conditions of the job or by performing essential job duties are medically qualified.

5.3 Treated Skin Conditions that Require Control of the Environment and/or Job Duties

If it is determined that the conditions and/or demands of the job will result in a relapse or worsening of the skin condition to a point where the candidate could not perform the essential functions of the job, or would pose a direct threat of harm to self or others, the individual is unsuitable for law enforcement work. However, this determination should not be made before considering possible accommodations through which the candidate could perform the job without a direct threat of harm.

5.4 Skin Conditions that Cannot be Effectively Treated to Maintain an Intact Barrier to Infection or Injury

Environmental conditions and exposures at emergency situations (e.g., administering first aid, subduing combative subjects) may present a direct threat of harm to the individual due to the risk of infection. Candidates with these types of skin conditions who are unable to work effectively and safely in emergency situations (even with reasonable accommodation) are unsuitable for law enforcement work.

6.0 REFERENCES

Adams, R. (1999). *Occupational Skin Disease, Third Edition*. Philadelphia: W.B. Sanders.

Chowdhury, M. & Maibah, H. Occupational Skin Disorders. In Ladou, J. (2007). *Occupational and Environmental Medicine*. New York: McGraw-Hill.

Johnson, M.L.T. (1979). *Skin conditions and related needs for medical care among persons 1-74 years. United States 1971-1974, Series II, No. 212.* (DHEW Publication No. PHS 79-1660). Washington, DC: U.S. Department of Health, Education and Welfare.

Liu T. & Seng-Jaw S. (1996). Epidemiology of malignant melanoma. *Surg Clin North Am*, 76, 1205-1222.

Moschella S.L. & Hurley J.H. (Eds) (1992). *Dermatology*, Philadelphia: W.B. Saunders.

Sauer G.C. & Hall J.C. (1996). *Manual of Skin Diseases*. Philadelphia: Lippencott Raven.

Trottier, A. & Brown, J. (1994). *Police Health: A Physician's Guide for the Assessment of Police Officers.* Ottawa: Canada Communications Group.

EARS, NOSE AND THROAT

1.0 INTRODUCTION

A careful examination of the ears, nose and throat is important since several conditions that could impact on the ability of the candidate to perform the job may be discovered.

2.0 OUTLINE OF HIGHLIGHTED CONDITIONS

- Anosmia
- Meniere's disease
- Dizziness and Vertigo
- Benign Paroxysmal Positional Vertigo (BPPV).
- Tinnitus
- Otitis externa
- Otitis media
- Perforated tympanic membrane
- Communicative disorders

3.0 IMPLICATIONS FOR JOB PERFORMANCE

Several ENT conditions can severely limit job performance on a variety of critical tasks. Anosmia, for example, precludes the ability to smell to detect unusual odors (i.e., the smell of alcohol on someone's breath, the smell of a dead body coming from an apartment, chemical smell indicating presence of drug lab, etc.) (Wrobel, et al., 2004)

Vertigo, when caused by Meniere's disease, benign positional vertigo or other conditions, can incapacitate a law enforcement officer precluding the performance of many critical physical (or cognitive) law enforcement officer tasks.

Vertigo can also affect a law enforcement officer's ability to safely work at heights, maintain stability on slippery surfaces, avoid injury from moving objects and safely drive, or operate machinery/weapons.

Tinnitus with and without hearing deficit can degrade performance of critical hearing tasks (See section on Hearing).

Communicate disorders will affect the ability of a law enforcement officer to alert others or the public of incipient danger.

4.0 EXAMINATION OF THE EARS, NOSE AND THROAT

The examination of the head, neck and ears should always start with visualization of the external features. Careful observation will allow visualization of congenital deformities such as microtia and an accessory tragus. This can be associated with middle and inner ear malformations. Preauricular pits may indicate sinus tracts. Normal or abnormal facial nerve function may also indicate otologic disease. Chronic mouth breathing may indicate intra nasal pathology.

After careful visual inspection, the examination starts out with the auricle and external ear canal. Abnormal appearance of the auricle is grounds for further investigation of the middle ear. The external canal should be carefully inspected fot signs of debris or infection. An ear canal occluded by wax may have a conductive hearing loss or hide an occult infection. The examination should then progress medially to the tympanic membrane. The normal tympanic membrane is translucent and grey. A dull, retracted, amber drum is seen in serous otitis. Bubbles may be a sign of resolving otitis media. Pathology affecting the middle ear may cause a conductive hearing loss in that ear. Examination of the tympanic membrane will reveal if it is intact or if a perforation is present. A perforation may have healed with a very thin monomeric membrane that can only be seen under pneumatic otoscopy with a microscope. Pneumatic otoscopy refers to examining the tympanic membrane via an airtight speculum and observing movements with the gentle insufflation of air. Mobility may be limited by scarring, middle ear effusion, or perforation. Perforations rarely cause hearing loss but if placed near important inner ear structures or involving the whole membrane may cause significant hearing loss. Even a small perforation precludes the officer from active duty involving possible water exposure to the ear. Infection or vertigo may result. If a perforation is present, then the middle ear mucosa may be viewed directly.

Eustachian tube function may be assessed by watching the ear drum as the candidate swallows with the nose pinched off (Toynbee maneuver)

and then swallows with the nose unobstructed.

A complete assessment of hearing requires audiometry. It is an integral part of the evaluation of any candidate with hearing or ear complaints such as hearing loss, tinnitus, vertigo, etc. Unilateral hearing loss due to serous otitis may be the presenting symptom of cancer of the nasopharynx, due to occlusion of the eustachian tube. All candidates with serous otitis media should have a thorough nasopharyngeal exam to look for a lesion. Careful palpation of the neck to detect possible metastasis and lymphadenopathy from an occult tumor is also required.

Tuning forks can be used to grossly assess hearing, but more importantly, to differentiate between conductive and sensorineural hearing loss. With a conductive hearing loss, the sound will appear to be on the side of the bad ear. If there is a sensorineural loss, the sound will be perceived in the better ear. The Rinne test compares air conduction hearing (a tuning fork generates sounds in the air just outside external auditory canal) to bone conduction hearing (base of tuning fork is placed over the mastoid process). In conductive hearing loss, bone conduction is more sensitive than air conduction. Using a combination of these tests will allow the examiner to determine if a hearing loss is conductive or sensorineural and which ear is involved.

Complete evaluation of the ear includes assessment of the facial nerve and vestibular function. The facial nerve travels in a bony canal through the middle ear and may be involved by disease in the mastoid, such as cholesteatoma. Weakness of the facial nerve is uncommon; however, the most common cause is Bell's Palsy. Local diseases must be ruled out. The external ear is examined to look for vesicular lesions and the middle ear for infectious or destructive lesions. The neck is palpated for parotid neoplasms. Weakness of the facial nerve may leave the officer with the inability to protect the cornea of the eye. Conjunctivitis and increased sensitivity to wind, etc may be present.

Vertigo is the sensation of spinning of self or surroundings. It is most commonly due to processes involving the inner ear. It may be constant or positional. When present it is very debilitating as the officer will be unable to stand and the associated nausea can be crippling. Positional vertigo can be detected by a Dix-Hallpike maneuver. When present it may last for seconds but put the individual at risk should they be in a tense situation or in a precarious position.

The nose should be examined. Anterior rhinoscopy with a bivalve speculum may be performed to examine the anterior ends of the inferior turbinates and the septum. Topical vasoconstriction may permit a more thorough examination. Nasal patency may be compromised by swollen

turbinates, septal deviation, or intranasal masses, such as tumors, or nasal polyps. A perforation of the nasal septum can cause symptoms such as a whistling noise during breathing, epistaxis, and excessive crusting of the nose. A correlation between visualized obstruction and difficulty breathing may be present. Obstructed nasal passages may also predispose the individual to sleep apnea. Inability to get air to the superior part of the nose secondary to obstruction may cause anosmia.

Adequate light and a tongue blade are necessary for examining the mouth. The blade should be used to systematically expose all teeth and mucosal surfaces, including those recesses inferior and posterior to the tongue, and the gingivobuccal sulci. The parotid duct orifice can be seen on the buccal mucosa opposite the upper second molar, and massage of the gland should express clear fluid. The submandibular and sublingual glands empty into the floor of the mouth. Complete examination of the mouth includes bimanual palpation of the tongue and the floor of the mouth to detect possible tumors or salivary stones.

The posterior wall of the oropharynx can be visualized easily via the mouth, by depressing the tongue with the tongue blade. Inspection of the hypopharynx, larynx, and nasopharynx requires use of specialized equipment such as a fiberoptic nasopharyngoscope and is generally performed by an otolaryngologist (ENT specialist). Use of this instrument allows evaluation of the vocal cords and their movement. Hoarseness or voice problems can be assessed with a proper referral.

Since direct visualization of the sinuses is difficult, one must rely on indirect physical assessment and radiology. Purulent drainage from the sinuses may be noted in the nose. Tenderness may be elicited by tapping over the frontal or maxillary sinuses or applying pressure under the supraorbital rim or near the medial canthi. Fiberoptic examination of the nasal cavity is now standard in otolaryngologic assessment performed by an ENT specialist. It allows evaluation of the drainage areas of the paranasal sinuses. Infection or obstructive disease may be seen. Chronic headache and sinus congestion can be diagnosed and treated. Should these methods not yield a diagnosis, CAT scanning has become the next most common investigation. Specialized protocols are available.

The normal neck is supple, with the hyoid, larynx and trachea easily palpable in the midline. A complete examination should include external observation for symmetry and possible masses by thorough palpation of all tissue and auscultation. The exact position and size of any mass should be carefully noted, along with any relationship to the thyroid, carotid, or airway. A neck mass may be an inflammatory lymph node, an aneurysm, a thyroid mass, a dermoid cyst, or a thyroglossal duct

cyst. It may also be a metastasis from cancer in the head, neck or lung. With the exception of the supraclavicular lymph nodes, the neck is an uncommon site of metastasis from below the diaphragm.

Decisions regarding work limitations or placement should be based on sound clinical judgment, recognizing that individuals vary in response to several environmental factors, even though they may have the same diagnosis.

5.0 EVALUATION OF COMMON CLINICAL SYNDROMES

5.1 Anosmia

Anosmia is the inability to perceive smells. It can be congenital or acquired and has been reported to affect 1 to 2% of the population (Schiffman, 1997). Upper respiratory infections, injury to the head, industrial chemical exposure and mechanical obstruction are associated with smell or taste problems (Corwin, et al., 1995). Smell plays an integral part in the sensation of taste for some substances. So while the taste buds and neural pathways may be intact, the ability to taste may be adversely affected. For instance people with normal "taste" but anosmia will not "taste" coffee, since much of it's neuronal appreciation comes from the smell. Anosmia can also result from polyps in the nasal or sinus cavities, hormonal disturbances, dental problems or, in rare circumstances, brain tumors. It can also be caused by prolonged exposure to certain chemicals such as tobacco smoke, insecticides and by radiation therapy for cancers of the head and neck.

The Alcohol Sniff Test (AST) provides a quick method to assess anosmia (Davidson & Murphy, 1997). The University of Pennsylvania Scratch and Sniff Test (UPSIT) is also available to evaluate the degree of anosmia (Doty, Gregor, & Monroe, 1986).

The AST can be performed in a clinic office with the use of a 70% isopropyl alcohol pad. Tear the top of the disposable container away from the pad so that 1/2 - 1/3 of the pad is exposed. Ask the candidate to take a sniff so that he or she can identify and recognize the alcohol odor. Pull the pad away from the candidate, ask him to close his eyes. Place the pad directly under the nose at approximately mid chest. Ask the candidate to breathe normally. If they breathe deeply or if they sniff, the test is not valid. When the candidate is breathing normally, move the pad toward their nose 1cm with every exhalation. Ask the candiate to indicate when they first smell or detect the alcohol odor. Measure the distance from the bottom of the nose to where the candidate first detects the alcohol. Normals should detect the alcohol odor at 20cm.

Those with a diminished sense of smell, called hyposmia, will detect it between 2cm and 20cm. Those who are truly anosmic will not smell the odor. They may sense or feel the alcohol when it is very close to their nose. Some will confuse this with smell, some will say, "I can feel it, but not smell it" (Davidson, 2009).

Quantitative smell tests are also commercially available such as the University of Pennsylvania Scratch and Sniff Test (UPSIT) which can be used to evaluate the degree of anosmia (Doty, Gregor, & Monroe, 1986). However, quantitative smell tests are generally performed in specialists' offices and research studies. Candidates with impaired sense of smell should be referred to a specialist for a comprehensive evaluation and work up.

Treatment of mechanical, structural or infectious causes of anosmia can be very successful in returning the sense of smell. Unfortunately if no cause is apparent or the anosmia was a result of trauma, this sense may not be recoverable.

Candidates with anosmia are deprived of an early warning system capable of alerting the officer to smoke from fires, poisonous fumes and leaking gas. Performance may be impaired in being unable to smell alcohol on the breath of a motorist or detect the fumes of marijuana in a vehicle. Law enforcement officers are frequently separated from their partners and must perform critical tasks alone. The failure of a law enforcement officer to detect leaking gas, smoke, and other chemicals could result in a serious injury to the officer or member of the public. Severe anosmia should be considered disqualifying for these reasons.

5.2 Meniere's Disease

Meniere's disease is a chronic condition characterized by acute episodes of vertigo, hearing loss and tinnitus. Approximately 50% of all Meniere's cases are of unknown origin. Meniere's disease has been associated with allergy; congenital or acquired syphilis; deficient activity of the adrenal gland; narrowing of the inner ear canal; physical trauma, for example, fracture of the temporal bone or concussion of the balance organ; acoustic trauma, for example, due to exposure to loud noise; vascular diseases including congestive heart failure, hypertension, diabetes, and elevated blood fat; low levels of estrogen; and viral infections.

Episodes of Meniere's disease usually occur suddenly and are often preceded by the following symptoms occurring in one ear: a decrease in hearing, an increased feeling of fullness or tinnitus in the affected ear. The most disabling symptom will be vertigo originating in the

symptomatic ear. The vertigo is associated with nausea and vomiting and often renders the candidate bed ridden. The attack may go away within an hour or may continue for hours or days. Many persons avoid a variety of everyday activities due to the unsettling effects of the disease and to avoid triggers (Hagnebo, Melin, Larsen, Lindberg, Lyttkens & Scott, 1997). Some candidates have long periods between episodes whereas others experience attacks more frequently (Tokumasu, et al., 1996).

In Meniere's disease, the tinnitus is often described as an ocean roar or a hollow seashell sound that is so persistent that patients report they would prefer complete deafness to their symptoms (Sataloff & Sataloff, 1993, p. 446.).

Diagnosis of Meniere's disease is generally made on the basis of four symptoms (hearing loss, tinnitus, vertigo, fullness) being present. Diagnosis of Meniere's disease must be made by a qualified specialist. Referral for additional testing may be made as well as for a neurological examination, audiometry, laboratory tests and X-rays.

An audiologist consultation is usually necessary to complete a hearing loss workup. The hearing loss associated with acute attacks usually resolves in a few days to weeks. Unfortunately, the hearing almost never returns to the previous level. Each successive attack will leave the individual with slightly worse hearing. Meniere's disease is usually unilateral but may affect both ears.(Tokumasu, et al, 1996). As well as being harder to hear, sounds may appear "tinny" or distorted. Loud sounds may be particularly disturbing. Hearing loss can fluctuate over time. The degree of hearing loss may get progressively worse with time, eventually affecting all frequencies until hearing is completely lost in the affected ear.

Meniere's disease requires evaluation as per tinnitus, vertigo, and hearing deficit (See Section on Hearing), including evaluation of frequency of attacks, duration of attacks, precipitating factors and the side-effects of any medications.

5.3 Dizziness and Vertigo

Dizziness can be described as an impairment in spatial orientation. Spatial orientation, "the ability to know one's location in relation to the environment one is in or to know where an object is in relation to oneself" (Fleishman & Reilly, 1992, p. 31) can be compromised when the central nervous system receives conflicting messages from the vestibular labyrinth, eyes, skin, proprioceptive nerve endings, and neck

muscles about one's position in space. Conflicting messages, arising in the inner ear, result in the sensation of spinning of self and surroundings. This spinning sensation is called vertigo. It needs to be distinguished from other reported complaints such as light headedness, foggy feelings, and etc. Most vertigo is in fact not real vertigo but a light headed feeling that does not originate from the inner ear.

Disorders of blood circulation are among the most common causes of dizziness. This could be caused by arteriosclerosis or hardening of the arteries, and it is commonly seen in persons who have high blood pressure, inadequate cardiac function, neuroma, diabetes, or high levels of cholesterol. Certain drugs can decrease the blood flow of the brain, especially stimulants such as nicotine and caffeine. Head injuries are an important contributor to dizziness.

A survey of British subjects (n = 16,964) indicated that the prevalence of dizziness for 17-40 year olds was 34% for males and 47% for females. Of those who experienced episodes of dizziness, 13% indicated it had affected their work in some way. Respondents were asked about episodes of dizziness and its association with other events. These included events such as transport, 10%; faints or near-faints, 23%; physical strain, 32%;, working at heights, 29%; mental stain, 30%; strong emotion, 21%; and during periods of elevated anxiety, 37%. Episodes were brought on by various activities, such as straightening up after bending down, 62%; looking down or bending down, 41%; and making a sudden turn, 51% (Edwards & McCallum, 1988).

Candidates with a history of dizziness require a thorough examination. Sataloff and Sataloff (1999) suggest all of the questions listed under vertigo (next section) be asked. It is especially important to separate peripheral causes (which are often treatable) from central causes that may have a poor prognosis.

Candidates with acute disorienting episodes that occur without warning may be a potential danger to themselves or others. Persons who have attacks without warning should not be permitted to drive unless they have demonstrated stability and control of the condition under appropriate medical management. In general, candidates should be symptom free for at least one year.

For those who do have warnings, individual determination must be made with regard to precipitating factors, the level of disorientation during an attack, the frequency and duration of the attack, and the amount of lost time from work on account of dizziness.

As previously mentioned, vertigo is to be distinguished from dizziness. Vertigo is the sensation of spinning of self or surroundings. It often originates in the inner ear. Rarely it can be due to central causes. The sensation is very disorientating. The sudden confusion in brain signaling is often associated with disabling nausea and vomiting. Persons with vertigo will seek to limit any head motion so as to decrease their symptoms. The sensation is similar to that of alcohol intoxication or after spinning on an amusement ride. Vertigo can be constant or induced by head motion. When constant, it is due to an imbalance or irritation of the inner ear. As the condition resolves or the brain adapts, the feeling will decrease. Positional vertigo is due to motion in one of the axis of the semicircular canals that causes a mismatch in signals from the inner ears to the brain. The resulting confusion is perceived as vertigo.

When it occurs, vertigo can be very debilitating. Constant vertigo will gradually resolve over time. Depending on the etiology, it may take days to weeks. Complete resolution of symptoms can be expected in most people. Positional vertigo will induce vertigo whenever a particular head motion is performed. Resolution can be accomplished with certain maneuvers.

Sataloff and Sataloff (1993) suggest the following questions for the documentation and evaluation of vertigo (p. 454-455):

1. When did you first develop dizziness?
2. What is like when you have symptoms (nausea, vomiting, blacking-out, etc.)?
3. Do you or your environment spin? Is it spinning in the direction of motion to the right or left?
4. Is your dizziness constant or episodic?
5. If episodic, how long do the attacks last?
6. How often do you have attacks?
7. Have they been more or less frequent recently?
8. Have they been more or less severe recently?
9. Under which circumstances did your dizziness first occur?
10. Have you had any head injuries?

11. If you first noted dizziness after your head injury, how many hours, days or weeks elapsed between the injury and your fist imbalance symptoms?

12. Did you have any other symptoms at the same time, such as neck pain, shoulder pain, jaw pain, ear fullness, hearing loss, or ear noises?

13. Did you have a cold, the flue, or "cold sores" within the month or two prior to the onset of your dizziness?

14. Are you completely free of dizziness between attacks?

15. Do you get dizzying rolling over in bed?

16. Is it to the right, to the left, or both?

17. Do you get dizzy with position change?

18. Does your dizziness occur only in certain positions?

19. Do you get dizzy from bending, lifting, straining, or forceful nose blowing?

20. Do you have trouble walking in the dark?

21. Do you know of a cause for your dizziness?

22. Is there anything that will stop the dizziness or make it better?

23. Is there anything that will bring on an attack, or make your dizziness worse (fatigue, exertion, hunger, certain foods, menstruation, etc.)?

24. Do you have warnings the attacks are about to start?

25. Once an attack has begun, does head movement make it worse?

26. Do you have significant problems with motion sickness?

27. Do you get headaches in relation to attacks of dizziness?

28. Do you get migraine headaches?

29. Are there other members of your family with migraine headaches?

30. Does your hearing change when you are dizzy?

31. Do you have fullness or stuffiness in your ears?

32. If yes, does it change when you have an attack of dizziness?

33. Have you ever injured your neck?

34. Do you have any spine disease like arthritis (especially in the neck)?

35. Have you had any injuries to either ear?

36. Have you ever had surgery on either ear?

37. What drugs have you used to treat your dizziness?

38. Have the drugs helped?

39. Do you have hearing loss or tinnitus?

40. Do you have any other medical problems (diabetes, high or low blood pressure, history of syphilis, other?

Evaluation of vertigo should involve consideration of hyporeflexia or hyperreflexia, signs of Parkinson's disease, and positive a Romberg test (A pass requires the ability to maintain balance while standing with shoes off, feet together side by side, eyes closed and arms by sides, for thirty seconds). A specialist may be required to do further evaluation and studies on the candidate. Imaging studies and Electronystagmography (ENG) should be used to rule out cerebellopontine angle tumors. Dynamic posturography tests, such as the Equitest, have shown value in assessing balancing strategies and responses (Nashner, 1971). If the candidate is under medication to control dizziness, an assessment of drug side-effects, such as blurred vision is necessary. Neurologic and audiologic consultation is typically required.

5.4 Benign Paroxysmal Positional Vertigo (BPPV).

BPPV is a disease where vertigo is experienced by a change in head position. BPPV is not associated with tinnitus. Symptoms are often reproducible with Dix-Hallpike or Barany maneuver (rapidly laying candidate down with hyperextension of the neck over the edge of the bed). BPPV is generally idiopathic but may develop after head trauma or viral illness. Typically it will wax and wane over months to years, but

most cases resolve with time. All candidates with BPPV should be evaluated by a qualified specialist. Testing may include an audiogram and brainstem auditory evoked responses (BAERs) to screen for tumors. If positive BAER, then MRI or CT should be done; however, if negative, then no further workup needed. The Epley maneuver will cure the majority of candidates although it may need to be repeated.

5.5 Tinnitus

Tinnitus is the perception of ringing, buzzing, or humming sounds in the ear in the absence of these sounds. Symptoms of tinnitus are common in people with otologic problems and can occur in persons with normal audiograms (Sataloff, Sataloff & Lueneburg, 1987). Epidemiological data demonstrates that 90% of persons with hearing loss experience some tinnitus (Parnes, 1997). Tinnitus can have a major debilitating impact on activities of daily life and can interfere with sleep (National Institutes of Health, 1990). It can be stressful and invokes anxiety and depression (Halford & Anderson, 1991 and van Dijk, Souman, & de Vries, 1987). Tyler and Baker (1983) surveyed 72 tinnitus sufferers and found that understanding speech, depression, going to sleep, irritability and inability to relax were the most commonly cited difficulties associated with tinnitus. Exposure to noise can make tinnitus worse. Sataloff and Sataloff (1993, pp. 444-445), suggest the following questions for the evaluation of those with a positive history of tinnitus:

1. Are the noises localized?
2. If so, are they in your right ear, left ear, both ears or head?
3. How long have you heard noises in your head?
4. Was there a particular incident (cold, explosion, head injury) that seems to have started your tinnitus?
5. What was the time relationship between the incident and the onset of your tinnitus?
6. Has your tinnitus changed since it first appeared?
7. Is it constantly present?
8. Is it episodic?
9. If it is episodic, are you completely free of tinnitus between attacks?

10. Recently, have attacks occurred more frequently, less frequently, or without change

11. How frequently do you experience attacks?

12. Are your noises more apt to occur at a particular time of day or night?

13. Is there any activity that brings on the noises or makes them worse?

14. Are the noises worse when you are under stress?

15. Are there any foods or substances to which you are exposed that aggravate the noise (alcohol, cigarettes, coffee,, chocolate, salt, etc.)?

16. Are the noises worse during any one season?

17. Is there anything you can do to decrease the noises or make them go away?

18. Are there any activities or sounds that make the tinnitus less disturbing?

19. Can you characterize the noise (ringing, whistling, buzzing, seashell, heartbeat, hissing, bells, voices)?

20. To which would you compare the loudness of your noises?

    a. soft whisper?
    b. electric fan?
    c. diesel truck engine?
    d. a jet taking off?

21. Is the loudness fairly constant?

22. If it varies, does it vary slightly or widely?

23. Does the noise sound the same in both ears?

24. What medications or treatments have you tried?

25. How would you rate the severity of your tinnitus:

    a. mild (aware of it when you think about it)

b. moderate (aware of it frequently, but able to ignore most of the time; occasional interferes with falling asleep)
c. severe (aware of it all the time, very disturbing)
d. very severe (aware of it all of the time, interferes with daily activities, communication, and sleep)

26. Do you think other people should be able to hear the noises?

27. Do the noises sound as if they are coming from inside or outside your head?

28. Are your head noises ever voices?

29. Do you have a feeling of fullness in your ears?

30. If so, does it fluctuate with the tinnitus?

31. Has anyone else in your family had tinnitus?

32. Do you have hearing loss or dizziness?

33. Do you have any other medical problem (diabetes, high or low blood pressure, history of syphilis, other)?

There is large individual variability in the degree of functional impairment associated with tinnitus. The above listed questions provide an indication of the functional impact of the tinnitus on the individual. An individualized assessment of the candidate must be made by a qualified audiologist and/or ENT specialist.

The final determination should be based on objective tests including the Hearing in Noise Test (HINT) or equivalent. Tinnitus can be caused by middle ear or cochlear problems which can produce problems with maintaining equilibrium. The candidate's ability to maintain balance should be closely assessed. Diagnostic tests performed by the ENT/audiologist to determine the cause of tinnitus such as ENG may indicate a cochlear problem that is likely to be associated with balance difficulties. Hearing loss is often associated with tinnitus. The correlation between the degree of hearing loss and the perceived level of the tinnitus is not well defined. The degree to which the tinnitus interferes with the ability to function can best be determined by the question set above. Candidates must meet the hearing requirements specified in the section on Hearing.

5.6 Otitis externa

Otitis externa is characterized by inflammation of the external ear canal. Symptoms typically include pruritus and otalgia. There may be varying degrees of a sense of fullness to throbbing pain and hearing loss. Purulence may be present. Most persons will notice a collection of material on the pillow in the morning. An odor is usually associated with the discharge. The etiology commonly involves trauma. Som individuals may have chronic inflammation of the external ear canal for several reasons including the overuse of Q-tips.

Otitis externa requires treatment and generally does not preclude employment as resolution of the process is possible. An audiogram should be performed after the infection has resolved to obtain a valid test of hearing. Placement should be carefully evaluated in persons with chronic otitis externa if the position requires the use of equipment which contacts the ear canal (e.g., earphones or ear plugs). Drainage may be a presenting sign of a tympanic membrane perforation. Careful examination of the external canal and the middle ear should be performed after the infection has resolved.

5.7 Otitis media

Acute middle ear infections usually present with pain and a conductive hearing loss. In general, they resolve quickly after appropriate treatment. Acute infections in adults are uncommon and if there are multiple episodes the nasopharynx should be examined. Chronic untreated ear or recurrent infections can cause scarring and destruction of the middle ear ossicles and the tympanic membrane that may impair conductive hearing. Treatment is required to avoid permanent hearing loss. Serious infectious complications can include acute and chronic mastoiditis, meningitis, brain abscess, labyrinthitis, sigmoid sinus thrombosis, facial paralysis and other serious illnesses.

Otitis media, bilateral or unilateral requires treatment prior to placement. Untreated otitis media can cause difficulty in balance and fluctuating hearing acuity especially in speech frequencies. The ears should be evaluated for both hearing deficit and tinnitus to ensure adequate hearing capability in light of the critical tasks. The candidate should be under the care of a physician who has expertise in diagnosing and treating such conditions. After the resolution of the underlying disease the hearing should be checked to ascertain that there has been no damage to the middle ear structures.

5.8 Perforated Tympanic Membrane

Rupture can be caused if the ear is struck, after a sudden explosion, or by objects (such as a bobby pin, Q-tip, or stick) pushed into the ear canal. The degree of hearing loss is dependent on the size and location of the perforation. If the perforated eardrum is due to a sudden traumatic or explosive event, the loss of hearing can be great and ringing in the ear (tinnitus) may be severe. The inciting event may also have caused an ossicular disruption which will result in a severe conductive loss. Hearing loss that is due to the perforated tympanic membrane usually returns with the resolution of the perforation. The conductive loss secondary to the ossicular disruption requires amplification or surgical correction. The ringing diminishes in a few days. Chronic infection, as a result of the perforation, can cause major hearing loss.

Candidates should be assessed for hearing ability. Individuals may have problems with certain specialized assignments if they involve wearing a respirator in hazardous environments or underwater diving. If use of SCUBA or other underwater activities are undertaken, special medical standards for diving should be used by the examining occupational medicine physician.

5.9 Communicative Disorders

Communicative disorders include conditions that impair ability to speak clearly and could be expected to interfere with proper field communications while performing critical law enforcement tasks such as verbal communication with other officers, dispatchers, superiors, over vehicle and portable radios.

The magnitude of the impairment of communication disorders can be variable and requires an individualized assessment. The determination of what level of speech ability is considered sufficient to perform the duties of a law enforcement should involve a team that includes the physician examiner, human resource personnel and department management who can provide additional information about the position in which the candidate will be placed.

The ability of specialists who can assess speech intelligibility are available in most cities. Most speech problems can be determined and treated by a qualified otolaryngologist/ENT specialist. Some problems may require referral to a specialized center that has a dedicated laryngologist. Most academic medical centers have one on staff. These subspecialists are able to more fully assess speech and communicative

disorders. Experts at these centers typically include a team of speech pathologists and otolaryngologists who have specialized diagnostic tests to determine the underlying cause of the communicative disorder and develop treatment and rehabilitation plans for individuals. Formal testing typically requires audibility, intelligibility, and functional efficiency of speech. Audibility permits one to be heard over background noise, intelligibility is the ability to link recognizable phonetic units of speech in a manner that can be understood. Functional efficiency is the ability to sustain voice and speech for a period sufficient to permit useful communication.

All candidates with speech complaints require evaluation of the laryngeal structures to determine the etiology of the speech disorder. Hoarseness is the most common affliction affecting the individual. It usually involves an inflammatory process of the vocal cords. It is easily diagnosed by looking at the vocal cords. Visualization of the vocal cords may be performed by a qualified specialist and can be done either with a mirror or a flexible fiberoptic nasopharyngoscope. Once the etiology of the hoarseness has been determined it can be treated. Most hoarseness is easily treated and resolves quickly with no long term sequelae. Hoarseness lasting longer than two weeks requires visualization of the vocal cords to rule out cancer.

Other causes of hoarseness include pathologic lesions of the vocal cords. These may range from polyps to nodules. Most are caused by trauma to the vocal cords or abuse of the vocal system. The majority can be treated with medical therapy but occasionally surgery may be needed. Taking the officer out of the environment that promotes poor vocal habits may be required.

Hoarseness may be associated with chronic cough secondary to gastroesophageal reflux. This process allows acids from the stomach to irritate the vocal cords. It is also a treatable condition with little sequelae.

Severe communicative disorders can be disqualifying since the failure to communicate in the field could pose a direct threat to the health and safety of other officers and greatly impair effective radio and other forms of speech communication.

6.0 REFERENCES

Cantor, R.M. (1995). Otitis externa and otitis media: a new look at old problems, *Emerg Med Clin North Am*, 13, 122-136.

Corwin, J., Loury, M. & Gilbert, A.N., (1995). Workplace, age, and sex as mediators of olfactory function: data from the National Geographic Smell Survey. *J Gerontol B Psychol Sci Soc Sci*, 50, 179-86.

Davidson, T.M. & Murphy, C. (1997). Rapid clinical evaluation of anosmia: The Alcohol Sniff Test. *Arch Otolaryngol Head Neck Surg*, 123, 591-94.

Davidson, T.M. 2009). *The Alcohol Sniff Test*. http://drdavidson.ucsd.edu/TheAlcoholSniffTestAST/tabid/144/Default.aspx.

Doty, R.L., Gregor, T., & Monroe, C. (1986). Quantitative assessment of olfactory function in an industrial setting. *JOM*, 28, 457-60.

Edwards, F.C. & McCallum, R.I. (1988). *Fitness for Work: The Medical Aspects*. Oxford:Oxford Medical Publications.

Fleishman, E.F. & Reilly, M.E. (1992). *The Handbook of Human Abilities.* Palo Alto:Consulting Psychologist Press.

Hagnebo, C., Melin, L., Larsen, H.C., Lindberg, P., Lyttkens, L. & Scott, B. (1997). The influence of vertigo, hearing impairment and tinnitus on the daily life of Meniere patients. *Scand Audiol*, 26, 69-76.

Halford, J.B. & Anderson S.D. (1991). Anxiety and depression in tinnitus sufferers. *J Psychosom Res*, 35, 383-90.

Jackman, A.H. & Doty, R.L. (2007). Utility of a three-item smell identification test in detecting olfactory dysfunction. *Am J Rhinol*. 21, 460-73.

Nashner, L.N. (1971). A model describing vestibular detection of body sway motion. *Acta Otolaryngil Scand*, 72, 429-36.

National Institutes of Health, (1990). *Noise and Hearing Loss. NIH Consensus Statement* [www.nih.gov]. 8, 1-24.

Parnes, S.M. (1997). Current concepts in the clinical management of patients with tinnitus. *Eur Arch Otorhinolaryngol*, 254, 406-9.

Sataloff, T.S. & Sataloff, J.S. (1993). *Occupational Hearing Loss: Second Edition.* New York:Marcel Dekker, Inc.

Sataloff, T.S., Sataloff, J.S. & Lueneburg,W. (1987). Tinnitus and vertigo in healthy senior citizens with a history of noise exposure. *Amer J Otol,* 8, 87-89.

Schiffman, S.S. (1997). Taste and smell losses in normal aging and disease. *JAMA*, 278, 1357-62.

Seward, J.D. (1997). Neuropsychological evaluation. *Occupational Medicine: State of the Art Reviews,* 12, 413-32.

Tokumasu, K., Fujino, A., Naganuma, H., Hoshino, I. & Arai M. (1996). Initial symptoms and retrospective evaluation of prognosis in Meniere's disease. *Acta Otolaryngol Suppl*, 524, 43-9.

Tyler, R.S. & Baker, L.J. (1983). Difficulties experienced by tinnitus sufferers. *J Speech and Learning Disorders*, 48, 150-54.

van Dijk, F.J. Souman, A.M., & de Vries, F.F. (1987). Non-auditory effects of noise in industry. VI. A final field study in industry. *Int Arch Occup Environ Health*, 59, 133-45.

Wrobell, B.B. & Leopold, D.A. (2004). Smell and taste disorders. *Facial Plast Surg Clin North Am*, 12, 4, 459-68.

EYES AND VISION

1.0 INTRODUCTION

Job analysis and discussions with law enforcement officers indicate that adequate vision is ranked as one of the most important abilities that officers must possess. The high importance assigned to visual capabilities is not surprising given that law enforcement officers must make decisions with life or death consequences and much of the information used to make these decisions is dependent upon good far, color, and peripheral vision.

This chapter describes the tools and information necessary to evaluate candidates for occupations in law enforcement. All of the tests described herein may be obtained from http://spectacle.berkeley.edu/alumni/alumni_materials.html.

2.0 OUTLINE OF HIGHLIGHTED CONDITIONS

- Far Visual Acuity Deficiency
- Visual Field Deficiency
- Color Vision Deficiency
- Binocular Deficiency
- Refractive Surgery
- Miscellaneous Conditions

3.0 IMPLICATIONS FOR JOB PERFORMANCE

The job analysis report describes the critical visual tasks required the job for the study classifications. These task statements should be carefully reviewed by the examining physician.

4.0 EVALUATION GUIDELINES FOR ACUITY

4.1 Medical History

The medical history questionnaire should be used. The questionnaire includes questions regarding previous ocular surgery, glaucoma, temporary or permanent loss of vision, use of corrective lenses, double vision and previous injuries to the eye and head.

4.2 Assessment for Corrective Lenses

Contact lens wearers should provide records from their optometrist or ophthalmologist documenting the length of time they have worn contact lenses and the following:

1. Length of time the candidate has worn soft contact lenses.
2. Date the last pair of lenses were dispensed.
3. Condition of the current lenses.
4. History of difficulty with lens wear.
5. Current uncorrected far visual acuity.
6. Current far visual acuity with contact lenses.
7. The refractive power of the contact lenses in dioptres.
8. Does the candidate have any of the following conditions:

Dry eyes	Rosacea
Scleroderma	Lupus
Epilepsy	Rheumatoid Arthritis
Diabetes	Sjorgren's Syndrome
Allergic conjunctivitis	

9. Eye doctor's evaluation of whether the candidate is a successful contact lens wearer and a listing of any potential contraindications for contact lens wear in the future.

There are several absolute and relative contraindications to the use of contact lenses. Diabetes can result in loss of corneal sensation which can decrease an individual's awareness of epithelial damage from the lens. Increased glucose concentrations in the tear fluid also serve to

encourage infections. Other absolute contraindications include autoimmune disorders, which are commonly complicated by the sicca syndrome (dry eyes and mouth). These would include scleroderma, Sjogren's syndrome, rosacea, rheumatoid arthritis, and lupus.

Relative contraindications to soft contact lens (SCL) use include a history of dry eyes, use of antihistamines (which decrease tear flow), or a history of medical complications from contact lens use. These include corneal abrasion, corneal infection, neovascularization of the cornea (often seen in post-radial keratotomy patients who wear contacts), and contact allergic conjunctivitis (which is conjunctival irritation from the tear film proteins or the contact lens itself). A severe form of allergic conjunctivitis is giant papillary conjunctivitis (GPC). GPC is a sterile inflammatory reaction of the upper eye lid caused by friction and irritation from repetitive blinking over the upper portion of the contact lens. This condition occurs more commonly with extended wear lenses. It is treated with steroids and discontinuation of contact lens use for a period of time.

Candidates who currently wear hard or rigid gas permeable lenses (RGP) should be encouraged to be refitted with soft lenses since these lenses are not recommended for high physical activities. Hard contact lenses may still be indicated for those with irregular astigmatism, such as keratoconus. Those candidates with astigmatism changing to soft contact lenses may have to purchase toric lenses at an increased cost. Complications such as neovascularization, superior limbic keratoconjunctivitis, GPC, corneal ulcers, and infections are more common with soft lenses. For this reason, requiring some minimal period of use of SCLs, such as six months, would not be unreasonable for candidates who have an established history of success with hard or gas permeable lenses and no prior negative experience with SCLs.

During the examination of the cornea, special attention should be given to detecting radial keratotomy incisions. In most cases, incisions can be readily detected using the +20 lens of the ophthalmoscope (black numbers) to focus on the cornea.

4.3 Minimum Requirements - Corrected Visual Acuity

4.3.1 Near Corrected Acuity

A minimum requirement of 20/20 on a reduced Snellen chart (.40 M in the M notation) with both eyes open is recommended. This requirement may be met with or without correction (spectacles or contact lenses). Failure to meet this standard is due to inadequate prescription for

reading in almost all cases.

4.3.2 **Far Corrected Acuity**

A minimum requirement of 20/20 with both eyes open is recommended. This requirement may be met with or without correction (spectacles or contact lenses), however, see uncorrected acuity.

4.4 **Minimum Requirements - Uncorrected Visual Acuity**

4.4.1 **Near Uncorrected Acuity**

No uncorrected near visual acuity requirement is recommended. Near vision tasks are not typically performed in an uncorrected state.

4.4.2 **Far Uncorrected Acuity**

A minimum requirement of 20/40 with both eyes open is recommended for law enforcement officers who carry guns (Deputy Sheriff and Police Officer). For those who do not carry guns (Corrections Officers) no uncorrected standard is recommended. For evaluation purposes, candidates may be placed in the following groups:

GROUP I: CANDIDATE WEARS NO CORRECTIVE DEVICE

These candidates meet the 20/20 requirement already without correction.

GROUP II: CANDIDATE WEARS SPECTACLES OR HARD OR RIGID GAS PERMEABLE CONTACT LENSES

A minimum requirement of 20/40 uncorrected acuity is recommended. Due to the likelihood of loss, dislodgement, or removal of corrective eye wear, these candidates must meet the uncorrected minimum requirement. Candidates with visual acuity worse than 20/40 cannot perform the essential functions of the job without corrective devices.

If spectacles are worn they should consist of polycarbonate lenses and frames that meet ANSI Z87.1 specifications. Candidates should be required to have a spare pair of spectacles at all times while on duty.

Sport-type spectacles with straps to lessen the risk of dislodgement are not allowed as device to circumvent the uncorrected visual acuity requirement. The likelihood that the spectacles would have to be removed due to environmental factors such as rain, snow or fog on the

lenses is actually higher than the likelihood that the spectacles would be dislodged (Hovis, et al., 1998).

GROUP III: CANDIDATE WEARS DISPOSABLE OR SOFT CONTACT LENSES:

Candidates in this group are subject to no uncorrected requirement, provided they meet the following qualifications:

1. Candidate documents (See 4.2) that he or she is a "successful" long-term wearer and has worn contact lenses for the preceding six months without complications.

2. Candidate agrees to replace the lenses every six months to one year or more frequently if the lens becomes uncomfortable or difficult to wear.

3. Candidate agrees to clean the lenses on a regular basis as recommended by the manufacturer.

4. Candidate agrees to maintain contact lens wear and to sign the Agreement in the Addendum (Section 10.0) as a condition of employment.

5. As part of this agreement, the officer would take a sick day (or at least be assigned to non-patrolling duties) should temporary complications develop such as infection or irritation, and they cannot wear their lenses. Approximately 25% to 35% of officers who wear contact lenses (both SCL and RGP) reported that there was at least one day per year that they could not wear their lenses. It is estimated that this would result in 0.11 additional sick days per person year for contact lens wearers (Hovis, et al., 1998).

4.5 Recommended Tests for Acuity

The recommended charts:

1. Bailey-Lovie Visual Acuity Chart

2. A near vision card (reduced Snellen) for near visual acuity assessment.

ANSI Z80.21 specifies design principles for far visual acuity testing. The Bailey-Lovie chart is one of only two commercial wall charts

meeting these specifications (NAS-NRC, 1980). It is important to use standardized charts since using non-standardized charts leads to erroneous measurement and unreliable results. The luminance (brightness) of the chart should be even at 160 cd/m^2 (candelas per meter squared). An acceptable range is between 80 and 320 cd/m^2. This level of luminance is achieved by placing a 100 watt light bulb 2.5 feet from the chart in an otherwise dark room. Most florescent lit rooms, unless they are highly lit, will require some auxiliary lighting to accomplish 160 cd/m^2. Luminance can be measured with a photographic light meter or luminance meter. If a luminance meter is unavailable then the amount of light falling on the chart should be 545 lux (54.4 foot candles) with an acceptable range from 275 lux to 1000 lux.

Wall charts are also recommended due to the lack of validity and reliably evidence for automated vision devices. Further, even if the tests were reliable and valid, there is a tendency for the candidate to squint undetected by the examiner.

4.6 Measurement of Far Visual Acuity

4.6.1 Administration - Bailey-Lovie Chart

Uncorrected testing should occur first to establish a baseline. The candidate should remove the glasses or contact lenses, including cosmetic lenses, for uncorrected testing. Although the standard is specified for both eyes viewing together, corrected testing should be tested first starting with the right eye for medico-legal purposes. The left eye should be covered with a suitable occluder. It may be convenient to let the candidate hold the occluder. Assist the candidate in positioning the occluder and establishing the proper head position. The candidate should be told to keep both eyes open and to not squint. The examiner should ask if the candidate can read the top line of the chart. If the candidate responds affirmatively, ask the candidate to read from left to right the lowest line of letters that can be read without straining. If the candidate reads the letters correctly ask him or her to read the letters on the next line down. Continue in this manner until a point is reached at which the candidate can no longer read the letters correctly, or has read the bottom line. Success is defined as being able to read 75% or more of the letters on the line. Be sure to watch the candidate's eyes so as not to allow squinting, peeking, turning of the head, closing of the occluded eye, or pressure on the eye from the occluder.

It is important for the examiner to be familiar with the letters and

organization of letter sizes on the Bailey-Lovie chart. The candidate should not be hurried during the testing. The examiner should direct the candidate's attention to the line to be read. If a high uncorrected refractive error is suspected, start with larger letters. If it is suspected that the candidate has memorized the letters on a particular line, instruct him of her to read the letters from right to left or move the candidate closer to the chart to a specified distance in order to read a different line. The candidate should be encouraged to guess as the visual threshold is approached.

If the candidate is unable to read the top line, the candidate should walk toward the chart to a marked distance in either feet or meters. By decreasing the test distance from 6 m to 4.8 m (16 feet) this causes a *one row shift* in the size of the letters in a given line to a larger angular size. For example, if the candidate reads the line marked 12 (40) on the left size of the chart using a 16 foot test distance, then the candidate has an acuity of 6/15 (20/50). Table 1 provides the conversions.

Table 1: Bailey-Lovie Conversion Chart

Letter Size Designation Listed on the Left Side of the Chart	Snellen Acuity at 6m (20 ft.) Test Distance	Equivalent Snellen Acuity at 4.8m (16 ft.)	Equivalent Snellen Acuity at 3.8m (12.5 ft.)
60 (200)	6/60 20/200	6/75.5 20/250	6/95 20/317
48 (160)	6/48 20/160	6/60 20/200	6/75.7 20/250
38 (125)	6/38 20/125	6/48 20/160	6/60 20/200
30 (100)	6/30 20/100	6/38 20/125	6/48 20/160
24 (80)	6/24 20/80	6/30 20/100	6/38 20/100
19 (63)	6/19 20/63	6/24 20/80	6/24 20/80
15 (50)	6/15 20/50	6/19 20/63	6/24 20/63
12 (40)	6/12 20/40	6/15 20/50	6/19 20/63
9.5 (32)	6/9.5 20/32	6/12 20/40	6/15 20/50
7.5 (25)	6/7.5 20/25	6/9.5 20/32	6/12 20/40
6 (20)	6/6 20/20	6/7.5 20/25	6/9.5 20/32
4.8 (16)	6/4.8 20/16	6/6 20/20	6/7.5 20/25
3/8 (12.5)	6/3.8 20/12.5	6/4.8 20/16	6/6 20/20
3 (10)	6/3 20/10	6/3.8 20/12.5	6/4.8 20/16

Following the establishment of the uncorrected acuity in the right eye, repeat the instructions for the candidate's left eye and then both eyes together. The candidate should be asked to read the letters from right to left for the last test in order to minimize the effects of memorization. Following uncorrected testing, the candidate should replace his or her

contact lenses or glasses. The procedure above is then repeated for corrected acuity for monocular and binocular acuities. Results are recorded.

4.6.2 Maintenance

The test surface should be kept clean and free of dust.

4.6.3 Reliability

Reliability for this test has been established (Bailey & Lovie, 1976).

4.7 Measurement of Near Visual Acuity

4.7.1 Administration - Reduced Snellen Card.

Near vision testing should be performed in a corrected state using the American Optical Near Point Card (available at http://www.bernell.com/product/698/13) or a comparable reading card such as the Bailey-Lovie Near card. If the candidate wears bifocals, the examiner should ensure that the candidate is viewing the reading card through the correct lenses. Near vision should be recorded using the M-System notation or the equivalent Snellen fraction for near vision (Reduced Snellen). The M-System is recommended since scores based on other scoring systems may be unique to the properties of the individual chart. The M-System is compatible with the standard 20/20 measures used for measuring Snellen acuity.

Table 2: **Conversion of M-Notation to an Equivalent Snellen Acuity for Near Vision for a 16 in (40cm) test distance**

M-Notation Acuity	Reduced Snellen Acuity
4.0 M	20/200
3.2 M	20/160
2.5 M	20/125
2.0 M	20/100
1.6 M	20/80
1.25 M	20/63
1.0 M	20/50
0.8 M	20/40
0.63 M	20/32
0.5 M	20/25
0.4 M	20/20

5.0 EVALUATION GUIDELINES FOR COLOR VISION

While the law enforcement officer job does not require superior color aptitude or even normal color vision, it does require adequate color vision to perform the essential functions of the job.

5.1 Medical History

The medical history questionnaire should be used. The questionnaire includes an item for color vision deficiency (CVD). Candidates should be questioned if they are wearing colored contact lenses purported to aid in color discrimination or correct color vision defects. These lenses permit persons to pass color vision tests but do not improve actual color vision performance (Matsumoto, et al., 1983; Hartenbaum, et al., 1997; North, 1993). These lenses include the X-Chrom Contact Lens or Chromagen Color Deficiency lenses.

5.2 Minimum Requirement - Color Vision

Significant loss of color vision (a score of two or more crossings on the Farnsworth Munsell D-15) panel test is unacceptable for a law enforcement officer. A crossing is defined as a difference between adjacent caps that is four (4) or greater.

Any colored lens that is purported to improve or correct color vision deficiencies are unacceptable for law enforcement tasks requiring adequate color vision.

5.3 Recommended Tests for Color Vision

Two specific tests are recommended:

1. Ishihara pseudoisochromatic plate test (38 plate edition)

2. Farnsworth Munsell Dichotomous Test for Color Blindness (Panel D-15)

5.3.1 Pseudoisochromatic Plate Tests

There are many types of pseudoisochromatic plate tests (e.g., American Optical Hardy-Rand-Rittler, Ishihara, Dvorine, Tokyo Medical College). All provide efficient screening (90 to 95%) of congenital red-green defects. Basically these tests consist of a series of cards on which colored dots or discs of various sizes are printed to form a multicolored figure against a multicolored background. The figure is an easily identifiable letter, Arabic numeral, or geometric configuration (e.g., a circle, triangle, or cross). The only systematic difference between the figure and background dots is in color: the figure is composed of dots of one or more colors, and the background is composed of dots of different color or colors. Variations in the size, lightness, and saturation of the dots may be employed so that identification of the intended figure by cues other than hue is less likely. Observers with normal color vision can detect the hue difference between figure and background and consequently can easily read the figures, but observers with defective color vision may fail to distinguish between figure and background colors and hence fail to read the figures. In this sense the colors of the plates appear isochromatic only to the defective observer.

The Ishihara test for color blindness is designed to screen red-green and green-red color defects. An instruction manual is provided, but no sample scoring sheet accompanies the plates. There have been numerous editions, and there are slight variations in the color printing.

In all editions, Plate 1 is a demonstration plate: a double-digit numeral formed by small colored circles appears on a background of different-colored circles. Colors are chosen so that all observers with acuity better than 20/200 can read the demonstration plate. If an observer misses the demonstration plate, the test should be discontinued.

5.3.2 Plate Test Administration

The candidate is instructed to read the numerals within three seconds. The plates are held at a distance of 50-75 cm perpendicular to the line of sight under daylight illumination. The pages are well designed for easy turning. The plates are numbered and the sequence can be changed.

The Verilux True Color fluorescent tube (F15T8VLK) provides inexpensive and appropriate illumination for the Ishihara (Milburn & Mertens, 1993). However, any fluorescent lights with a specified Correlated Color Temperature (CCT) ranging from 5000 °K to 7500 °K and a General Color Rendering Index greater than 90 (Hovis & Neumann, 1995; Dain, 1998). The GE Chroma 75 40 watt fluorescent lamp or the Duro-Test color classer 75 40 watt fluorescent lights are commercially available and meet this criterion.

5.3.3 Plate Test Scoring

Persons who score with more than three errors on the 38-plate edition, more than two errors on the 24-plate edition, and more than two errors on the 16-plate edition should be administered the Farnsworth D-15.

5.3.4 Plate Test Maintenance

The manual indicates that "exposure to sunlight causes fading of the color of the plates." If the set of plates is kept closed when not in use, and if the plates are not touched with the fingers, they will be valid indefinitely.

5.3.5 Plate Test Reliability

Test-retest reliability studies indicate high levels of reliability for the 24 and 38 plate editions of the Ishihara Test (CIE, 2001). The reliability and validity of the other editions has not been established.

5.3.6 Plate Test Validity

Test validity coefficients for individual plates have been reported between 0.61 to 1.00. Because of this variability in validity, all plates should be administered.

5.4 Farnsworth Munsell D-15 Panel

Adequate color vision should be assessed by performance of the Farnsworth Munsell Dichotomous Test for Color Blindness (Panel D-15). This test is designed to select those candidates with severe color discrimination loss. The test is designed to give the test taker the opportunity to confuse very different colors from opposite sides of the color circle [e.g. green and purple] (Adams & Haegerstrom-Portnoy, 1987, p. 700.). The test differs from the Farnsworth-Munsell 100 test in that the FM-100 asks the test taker to distinguish among hues that are very similar to each other. The D-15 asks the candidate to discriminate hues that have easily noticeable differences in color. Individuals who cannot pass the D-15 are considered to have a defect severe enough to interfere with color judgments that are encountered in everyday life. In addition to determining whether an individual has a red-green deficiency, the test indicates whether the candidate has a severe tritanope (blue-yellow) deficiency.

The test consists of 15 removable colored caps placed in a box with one fixed reference cap. The color samples are chosen to represent approximately equal hue steps in the natural color circle and are similar in chroma to those of the Farnsworth-Munsell 100 test. An instruction manual and scoring sheets are provided with the test.

5.4.1 Farnsworth D-15 Administration

The examiner prearranges the caps in random order on the upper lid of the open box. The subject is instructed to "arrange the caps in order according to color;" in the lower tray, starting with the cap closest in color to the fixed reference cap. The box is presented at a comfortable distance under daylight illumination of at least 270 lux. The same day light source used for the Ishihara test can be used for the D-15 test. The majority of individuals with normal color vision can complete the test within one minute. There is no time limit established for the test; however, individuals should be prompted to finish the test with one to two minutes after five minutes.

It is recommended that the test be repeated up to three times and the candidate must pass on two of three tries in order to qualify for law

enforcement duties (See section 5.4.4).

5.4.2 Farnsworth D-15 Scoring

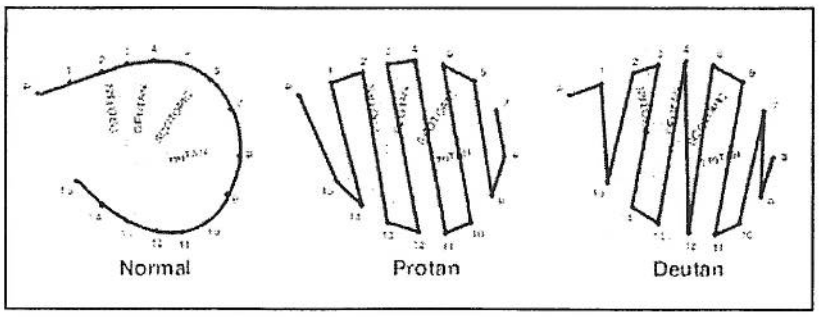
The order of the caps is plotted directly on the score sheet on a diagram that shows correct cap positions extending in a circle from the reference cap. Errors occur when caps are misplaced from the correct order. The scorer draws lines connecting the caps in their actual order. In correct order, the lines retrace the hue circle. An example of a minor error might be reversing the order of caps 5 and 6. This error leads to a reversal in the plot at caps 6 and 7 since cap 4 is connected to cap 6, cap 6 is connected to cap 5, and cap 7 is connected to cap 5. Major errors are defined as the connection of two caps that differ by at least four (15 & 1). In errors that differ by four or more the line connecting the caps crosses the hue circle. Subjects with normal color vision will make at most only one or two minor errors. Occasionally a single line crossing the circle may occur when the observer reverses part of the series. Dichromats, and extreme anomalous trichromats, make multiple (6 to 12) crossovers, forming a nearly parallel series of lines.

Typical arrangement patterns are shown in Table 3.

Table 3: Typical Arrangement Patterns for the Farnsworth D-15 and CVD Classification

Severe Tritanopes	R, 1, 2, 5, 3, 4, 6, 7, 15, 14, 8, 9, 13, 12, 11, 10
Severe Protanopes	R, 15, 1, 14, 2, 13, 3, 12, 4, 11, 5, 10, 6, 9, 7, 8
Severe Deuteranopes	R, 1, 15, 2, 14, 3, 12, 4, 5, 13, 11, 6, 10, 7, 9, 8

Figure 1: Scoring the Farnsworth Munsell D-15 and CVD Classification



The multiple crossings drawn on the score sheet will usually take on a pattern that is characteristic of a severe red-green color vision defect (either protan or deutan) or a severe tritan color vision defect (blue-yellow). The axis of the crossover lines is characteristic of the type of defect. According to the original design, the test is failed if an observer makes two or more major crossovers.

Deception on the test is rare, but has occurred in law enforcement screening. Examiners should carefully observe candidates to ensure they do not systematically "rearrange" the caps after initially matching them up.

5.4.3 Farnsworth D-15 Maintenance

The colors must be protected from dust, fingertips, and light. Candidates and examiners must handle the caps by their plastic rims or wear gloves. Candidates must not touch the pigments. The caps should be replaced in the box in a mixed order, and the box should be kept closed.

5.4.4 Farnsworth D-15 Reliability

The test and retest data given in the test manual show a coefficient of agreement .96. Higgins and Knoblauch (1977) obtained perfect reliability (R = 1.0) in their evaluation of screening with the Farnsworth D-15. However, these values are subject sample that has either a large number of color-normals or individuals with a more severe defect (Hovis, et al., 2004). For this reason, it is recommended that the test be repeated up to three times and the candidate must pass on two of three tries in order to qualify for law enforcement duties.

5.4.5 Farnsworth D-15 Validity

Cole and Orenstein (2003) assessed the ability of the Farnsworth D-15 to predict the ability of color-normals and CVD individuals to name surface colors. They found that deutera-normals who pass the D-15 have an average error rate of 1.9% compared with and error rate of 0.9% for color-normals. Confusing blue and purple were the most frequent errors and more errors occurred when the color patch being used during the test was small. They found the D-15 to be an imperfect predictor for the ability to name surface colors because 20% of those CVD individuals who passed the D-15 made some color naming errors. Cole recommended that all persons with CVD should be excluded from any job in which safety is dependent on color coding (p. 228).

Although Cole and Orenstein demonstrate that the D-15 is not perfect with regard to sensitivity and specificity, a review of a number of studies demonstrates the D-15 has a sensitivity and specificity between 0.75 and 0.80 for identifying colors of objects that are larger than 30 min arc (one half degree). This means that the D-15 will be incorrect only 20% to 25% of the time in determining who would pass or fail a given practical task. Most other clinical tests are either not as good as, or no better than, the D-15 in predicting performance of color-defective individuals. Until a better test is available for color vision screening, the Farnsworth D-15 should be used.

5.5 Color Vision Assessment

The Ishihara plate tests have been recommended as useful screening tests because they can be completed quickly. However, such tests are not sensitive to blue-yellow defects (tritan defects) which may affect only one eye individually and be an early sign of glaucoma, diabetes and other diseases. If there is a concern of detecting acquired color vision deficiencies, then the Hard, Rand, Rittler (HHR) 4th edition or the Standard Pseudoisochromatic Plates Part 2 should be added to the assessment. Both of these tests screen for blue-yellow defects and are more sensitive than the D-15.

Consideration should be given to testing candidates who wear soft contact lenses and have very poor uncorrected visual acuity. Testing should be performed in each eye separately with the Farnsworth D-15 to determine if the candidate has any early signs of glaucoma or other disease as indicated by tritanopia in one eye.

Using just the Ishihara plate tests as an initial screening device will permit blue-yellow defectives to pass the color vision screening unnoticed. This condition is very rare in the young adult population, however. Candidates assessed may be placed into one of the following groups.

GROUP I: CANDIDATES WHO PASS THE ISHIHARA

These candidates pass the screening test and, therefore, have normal color vision.

GROUP II: CANDIDATES WHO FAIL THE ISHIHARA AND PASS THE FARNSWORTH D-15

These candidates pass the screening test and, therefore, have adequate color vision to perform color-dependent law enforcement tasks.

GROUP III: CANDIDATES WHO FAIL BOTH THE ISHIHARA AND THE FARNSWORTH D-15

These candidates have a color vision deficiency that is severe. As a result, they cannot accurately recognize and name colors in various lighting conditions in a reliable manner. These candidates are unacceptable for law enforcement jobs requiring adequate color vision discrimination under an array of lighting conditions.

6.0 EVALUATION GUIDELINES FOR VISUAL FIELD DEFICIENCY

6.1 Medical History

The medical history questionnaire should be used. The questionnaire includes questions regarding previous surgery, glaucoma, use of corrective lenses, unexplained chronic headaches, stroke, loss of vision, and previous injuries to the eye.

6.2 Minimum Requirements - Visual Fields

The presence of either monocularity or significant bilateral field defects in candidates is unacceptable for law enforcement officer visual field tasks. Candidates with a total horizontal binocular field is of < 120 degrees are unacceptable. Candidates with a total vertical field of < 100 degrees, or with large scotomas, are unacceptable.

6.3 Measuring Visual Fields

Only about two percent of the general population will have a visual field loss. This means that 98% of all visual field tests will produce results within normal limits. Automated perimetry is best to detect visual field defects. Unfortunately, the equipment is expensive and usually unavailable in clinics where medical screening is performed.

Confrontation field testing requires only a test target usually held in the examiner's hand. The candidate and the examiner face each other and close opposite eyes. They should be 60 cm apart. Fixation is established by having the candidate look steadily at the examiner's open eye. The test target (a white dot fastened to black wire) is moved laterally and vertically equidistant in the space between the candidate and the examiner. The candidate is to report when the test target disappears. The examiner is to compare the performance of the applicant with his own performance to estimate the horizontal angle of

the visual fields.

Confrontation field testing can only detect significant quadrantanopsias and hemianopsias and as a result has poor sensitivity. One approach that has been recommended is to refer candidates for automated perimetry when there is a high risk for visual field defects. Candidates at high risk include those with a personal or family history of glaucoma, any eye problem other than refractive errors, history of retinal detachment or stroke, decreased visual acuity (worse than 20/40) in either eye that cannot be corrected with spectacles or contact lens, unexplained chronic headaches, and detection of a blue-yellow color defect (tritanopia) on the Farnsworth D-15.

7.0 BINOCULAR DEFICIENCIES

Binocular vision (viewing with two eyes) provides a superior ability to perform several functions (Blake & Fox, 1973). In a study of binocular vision (Jones & Lee, 1981) found subjects with binocular vision performed much better on a series of detection tasks under both dim and bright light conditions than were performed in a monocular condition. Groome and Johnson (1993) found that individuals could detect an approaching pedestrian in simulated fog 12% more quickly with both eyes open than viewing with one eye. Rubin (1995) states that binocular summation provides an increase in contrast sensitivity of approximately 50%.

Normal binocular vision is required for both depth perception by means of stereopsis, and requires that both eyes be focused and fused on the same point in space. A strabismus is said to exist when the eyes are directed at different points. The resulting double vision (diplopia) and visual confusion become the stimuli for suppression of the deviated eye, and, if not treated at a young age, can result in a permanent loss of vision in the deviated eye (amblyopia). The eye may be intermittently or constantly turned inward (esotropia), outward (exotropia), or vertically deviated (hypertropia). This condition can markedly interfere with peripheral vision task performance and would rarely be acceptable for a law enforcement officer position.

Depth perception can be affected by binocular fusion deficiency; however, many of the cues used in depth perception are not dependent on two eyes to the extent that the cues are visible. These cues include motion parallax (nearer objects move more than farther objects with head or eye motion), the overlay of contours, the distribution of highlights and shadows, aerial perspective (atmospheric effects such as fog where objects appear farther than they are, and the farther an object

is the cooler or bluer it appears), relative height (farther objects are nearer the horizon), blurring of retinal images (closer objects are more distinct), the size of known objects (bigger means closer), and proprioception (visual acts of focusing and fusion may provide depth clues. What is not known, however, is the effectiveness of these cues in stressful situations. However, some performance differences are emerging. Bauer, et al., (2001) have found that strabismic drivers performed significantly worse in driving through a slalom course at moderate speed.

Using monocular cues involves judgment based on experience, and the cues must be present in abundance. The presence of cues in critical situations cannot be guaranteed for any law enforcement officers since they may have to perform critical vision tasks under a wide variety of conditions including degraded lighting.

7.1 Assessment

Normal stereo acuity is considered 40 seconds of arc or better, which corresponds to achieving correct responses on all 9 Titmus Stereo Test targets. However, given the uncertainty regarding compensatory mechanisms in individuals with binocular fusion deficiencies, the recommended criterion for passing is 80 seconds of arc, or dot #6.

Candidates who initially test worse than 80 seconds of arc should be evaluated by a vision specialist to establish the reason for the deficit if it is not readily apparent. In some cases, correction of near vision may enable the candidate to pass the Titmus test. However, it is not uncommon for some candidates to test poorly for no apparent reason (i.e., no amblyopia, strabismus, or phoria). In these cases, it is recommended that judgment be used in the interpretation of Titmus test results.

If stereopsis is not assessed, then individuals with a difference of at least 2 lines in their corrected monocular acuities or a history of strabismus themselves or in the family should be referred for further assessment to determine whether they stereopsis is adequate and double vision is unlikely.

8.0 EVALUATION GUIDELINES FOR REFRACTIVE SURGERY

8.1 General Guidelines for Evaluating Refractive Surgery

All candidates who have had corneal refractive surgery (RK, PRK,

LASIK, LASEK) should be deferred using the following guidelines to ensure vision has stabilized.

8.2 Medical History

Previous eye surgery is listed on the medical history questionnaire. Candidates should be questioned about whether they have difficulties with rings or halos around lights, glare, seeing objects in dim light, night time driving, or fluctuating visual acuity from morning to evening. Candidates should be questioned as to whether they have experienced haze or double vision.

8.3 Medical Records

A medical records review is necessary and complaints of side-effects are red flags. All post-op records must be reviewed including subsequent "touch up" surgeries. The make and model of the laser used should be obtained to ensure that only an FDA-approved device was used for refractive eye surgery. A current listing of FDA-approved devices can be found at http://www.fda.gov/cdrh/lasik/lasers.htm.

8.4 Specialist Examination

Due to the need for specialized testing, referral out for these candidates is necessary. The specialist examination should include present corrected and uncorrected acuity (preferably with both a high contrast and low contrast Bailey-Lovie chart) as well as contrast sensitivity and glare disability measures. Candidates should be tested for hyperopia.

Candidates should be tested with the Bailey-Lovie high and low contrast charts three times (early morning, afternoon, and evening) on three occasions at least ten days apart (Gauthier, et al., 1998). Acuity measurements for each test and test time need to be recorded.

8.5 Assessment

As with all candidates who have had refractive surgery, all currently employed officers need to be able to meet the recommended far visual acuity requirements at all times. There should be no significant problems with fluctuating acuity, glare, haze, and difficulty in seeing in dim lights. All law enforcement officers who have had refractive

surgery should be periodically re-evaluated for progressive hyperopia, night vision, and problems with glare.

Candidates who have undergone refractive surgery and do not meet the uncorrected visual acuity requirement and who wish to meet the acuity requirements with soft contact lenses should be evaluated using the minimum requirements for both RK and SCL use. Specific examination for neovascularization of the incisional scars should also be conducted. Vascularization of one or more scars for at least 25% of its length is considered significant, and probably a contraindication to continued SCL use. Progressive hyperopia should also be considered a contraindication to SCL use, since this condition may be exacerbated by SCLs.

Safety glasses should be considered for candidates with RK and AC-PIOLs (Anterior Chamber Phakic Intra Ocular Lenses) as a means of protecting the eyes from blunt trauma (Groves, 1996).

Radial Keratotomy (RK)

Radial keratotomy, has fallen out of favor as a surgical technique to correct refractive errors. The reasons for its decline are the relatively high number of complications and diurnal fluctuation in vision. Nevertheless it is still performed in some cities on individuals with small refractive errors so a candidate may be encountered who has had the procedure done. If a candidate is contemplating RK surgery, then he/she should be strongly encouraged to investigate newer laser refractive surgery techniques.

The major concerns for RK from an occupational health perspective are the instability of final refractive status and weakened resistance of the cornea to subsequent trauma. Rupture of the globe has occurred during assaults, sports participation, and vehicle accidents. In a study of 28 of these injuries, two patients died, six eyes were blinded, six were legally blinded, six recovered acuity between 20/40 and 20/100, and eight recovered acuity better than 20/40 (Vinger, et al., 1996).

Fluctuating acuity between morning and afternoon has been demonstrated in several studies (Schanzlin, et al., 1986; Santos, et al., 1989; McDonnell, et al., 1989; MacRae, et al., 1989; Kwitko, et al., 1992). Bullimore, et al., (1994) studied the surgical results of firefighter job candidates who elected surgery as a means of gaining entry into a fire department and found a significant shift in acuity between morning and afternoon tests for their sample. McDonnell, et al., (1996) found morning to evening changes in acuity to persist for as long as 11 years after surgery.

Laser Refractive Surgery

In this procedure, an excimer laser is used to sculpt an area 5 to 9 millimeters in diameter on the surface of the eye. A benefit of this procedure is that the integrity and strength of the corneal dome is retained since the process causes less trauma to the eye.

There are three different types of laser refractive surgery. The one that is most common is laser assisted in situ keratomileusis (LASIK). LASIK involves the cutting of a flap of corneal tissue, lasing targeted cells beneath it, and then replacing the flap. The second most popular procedure is photorefractive keratectomy (PRK). This procedure modifies the shape of the cornea without prior removal of the epithelium or cutting the cornea. The third technique which is gaining popularity is laser assisted subepithelial keratomileusis (LASEK). LASEK involves loosening the superficial layers of the cornea with alcohol and then peeling this layer back before applying the laser. The healing time and postoperative management is similar to PRK and so PRK and LASEK are considered similar procedures as far as law enforcement duties are concerned.

Follow-up studies of laser refractive surgery techniques have shown fewer serious complications than with RK especially in young patients with preoperative refractive error of less than six dioptres (Seiler, 1995). However, problems with nighttime vision, halo and glare are reported for some patients (Shimizu, et al., 1994; Schallhorn, et al., 1996; Seiler, 1995; Bodanowitz, et al., 1995; Verdon, et al., 1996; Niesen, et al., 1996). Hamberg-Nystrom, et al., (1995) found halo problems were experienced "always" by 34% of their patients and "sometimes," by 26%. Permanent night vision problems were experienced by 40% of the sample. Niesen, et al., (1997) found disability glare and a reduction in contrast sensitivity in most patients (46 eyes) one year after surgery.

Disability glare is frequently associated with temporary blindness caused by night road lighting and glare from oncoming headlights while driving at night (Megaw, 1992). Increased sensitivity to glare was found to be significantly more prevalent in a group of 754 persons who had experienced nighttime traffic accidents than a large group of controls (Lachenmayr, et al., 1998).

Garty (1993) found a correlation between the magnitude of the halo effect and the amount of induced refractive change. At one year, 10% of his patients declined to have the other eye treated because the halo effect was severe enough to interfere with night driving.

As with RK, overcorrection can be a progressive problem with some

PRK patients. Schallhorn, et al., (1996) found nearly half (47%) of a young healthy sample of U.S. military personnel to exhibit hyperopia one year following surgery.

Best corrected acuity typically worsens with PRK as with RK (Schallhorn, et al., 1996), and stability in acuity may not be reached for as long as 18 to 24 months (Epstein, et al., 1994).

Although the earlier literature indicates that there is some concern about low contrast and low light level visual function in law enforcement recruits who have undergone refractive surgery, the percentage of these individuals who have compromised vision (beyond the nonrefractive 3rd standard deviation) under these viewing conditions is near 15% (Hovis & Ramaswamy, 2006).

Intrastromal Corneal Rings (ICR)

In 1999 the Food and Drug Administration approved intrastromal corneal rings (ICR) for persons with mild myopia, however, the procedure is increasingly rare. The procedure had the benefit of being reversible if serious side effects occur. Early results have showed that, over time, persons treated with ICRs tended to achieve better uncorrected visual acuity that those corrected with LASIK (Suiter, et al., 2000).

Corneal rings require evaluation as per the general guidelines for evaluating refractive surgery because some patients experience problems with fluctuating acuity, glare, and double images especially at night (Schanzlin, 1999). Because ICRs are removable (removal rate during the first year is 11%) and there is insufficient data to determine the long term effectiveness of the device.

Phakic Intraocular Lenses (PIOL)

Phakic Intraocular Lens Implants (PIOL) are a recently approved device to correct refractive errors of the eye which are either too large (usually for refractive errors greater than -5.00 D) to be corrected by Laser Refractive Surgery or when Laser Refractive Surgery is contraindicated. The PIOLs can be implanted in the anterior chamber (AC-PIOL) of the eye or the posterior chamber (PC-PIOL). The surgery to implant the devices is invasive and similar to cataract surgery. Three different devices have been approved by the FDA. These are the Artisan intraocular lens (Ophtec USA, Boca Raton, FL), the Verisyse (Advance Medical Optics, Santa Ana, CA) and Visian ICL (also know as the Implantable Collamer Lens) (STAAR Surgical, Monrovia, CA). The Artisan and Verisyse are actually the same AC-IOL, but are distributed by two different companies. The Artisan and Verisyse are AC-PIOL and

the Visian ICL is a PC-PIOL. A list of FDA approved PIOL is available at the FDA website. http://www.fda.gov/cdrh/phakic/approvedlenses.html

The early concerns with PIOLs were the potential for corneal decompensation, cataracts and glaucoma. Most of these concerns have been addressed with the newer designs and materials. However, cataract formation remains an issue along with potential night vision (glare, halo) problems. Cataracts can be caused by surgical trauma, disruption of the aqueous flow that brings nutrients to the crystalline lens, or the crystalline lens touching the implant. Surgically-induced cataracts occur within the first year postoperative and tend to remain stable while the other cataracts tend to occur later and are progressive. Night vision problems arise from a number of factors; however, the primary cause appears to be a small optical zone in the PIOL relative to the pupil size (Anre, 2000). For law enforcement, there are two additional issues. One issue is how well the PIOL will stand up to trauma to the head and eyes. The other is that the PIOL are nonpermanent and can be surgically removed at a later date.

The incidence of surgically-induced cataracts for the Visian ICL ranges from 2.5% to 33% depending on the definition of cataract and the skill of the surgeon (Lackner, et al., 2003, 2004; Sanders, et al., 2002, 2003, 2004). For a skilled surgeon, the value is probably close to 2.5%. Most of these cataracts are defined as trace or mild with about half of these individuals having symptoms. The majority (70% of these cases) of these cataract cases occur within 90 days, but it could take up to two years for them to develop. In PIOL studies, clinically significant cataracts usually means that there has been an appreciable decrease in visual acuity (ranging from 2 to 4 lines on the visual acuity chart). This relatively coarse definition of vision loss makes it difficult to determine whether the more subtle cataracts/opacities would cause vision losses that could be detrimental for policing duties. Although the studies report that the individuals with the trace focal cataracts tend to be asymptomatic, individuals with more dense cataracts do report problems with glare, halos, and night vision problems. The cataracts in a significant proportion of these patients will progress to the point that surgery is required in order to restore vision. Approximately half the individuals with cataracts after the PC-PIOL implantation will require cataract surgery within two to three years. Cataract progression is more likely for older patients (>40 yrs), females and patients implanted with earlier PC-PIOL models. The incidence of cataract formation after one year for the Visian model is less than 1% (Sanders, et al., 2002).

The incidence of night vision problems, including glare, halos and night driving difficulties, also varies across studies with 7% to 54.3% of the PC-PIOL patients reporting at least one of these problems (Arne, et al.,

2000; Sanders, et al., 2003, 2004). However, the incidence of night vision problems in large scale studies is between 7% to 12%. This incidence is about the same as reported for refractive surgery patients.

There are no known reports of dislocation/dislodgement of the STAAR Visian lens due to trauma. Removal of this PIOL is usually related to cataract formation, wrong size, or wrong power. In the case of cataract surgery, the PIOL and crystalline were replaced by a single implant and the results of the surgery were reported to be successful.

The incidence of surgically-induced cataracts with the AC-PIOL ranges from 2% to 3% (Menezo, et al., 2004; Alio, et al., 2002; Maloney, et al., 2002). The cataracts usually appear during the first two months and remain stable. The incidence of progressive cataracts is low (<1%), and these appeared between 3 yrs and 10 yrs after surgery in older patients. This suggests that the cataracts may have been due to normal aging processes (Menezo, et al, 2004). Although the manufacturer claims that the refractive error is stable on day 1 post-op, there does appear to be a slight shift back towards myopia during the first 6 months (Maloney, et al, 2002). The incidence of glare and halo problems ranges 5% to 18%.

One case of cataract formation and four cases of AC-PIOL dislodgements due to trauma have been reported to date (Yoon, et al., 2002; Munzo, et al., 2003; Moshirfar, et al., 2007). The trauma in all cases was moderate and confined to one eye such that it would be unlikely to incapacitate an officer with damage to other ocular structures or other eye. The AC-PIOL dislodgements occurred immediately while the cataract developed over a two week period. Overall, the incidence of Artisan dislodgements is low, near 0.1% of the patients implanted with the lens. However, it is important to remember that the level of trauma was not severe and the trauma appeared to be similar to the level required to displace spectacles without severely damaging an eye. In addition, these patients were from the general population where the risk of ocular trauma was probably extremely low. This suggests that it would be prudent for the officer with the Artisan PIOL to wear protective eyewear. Nevertheless it is worth noting that of the 8 patients who experienced non-penetrating blunt trauma to the eye, only two had the AC-PIOL actually dislodge (Moshirfar, et al., 2007).

Although the PIOLs can be removed at anytime, there does not appear to be any reports of voluntary explantation without some precipitating complication. This finding is not surprising given that there is little reason to remove a refractive device from the eye that provides clear vision without the need of high prescription spectacles or contact lenses. This is also the reason why patients rarely request to have their

intraocular lens implant removed after cataract surgery.

The FDA approved PIOLs are acceptable corrective devices that would allow candidates to meet the visual acuity requirements. Nevertheless, there should be a waiting period to ensure that 1) the incisions have healed, 2) the refractive error is stable, and 3) cataracts are unlikely over a 12-month period.

GROUP I: ***CANDIDATES WITH PRE-OP REFRACTIVE ERRORS UP TO 6.00 D SPHERICAL EQUIVALENT:***

ICR - deferred three months
RK - deferred three months
PRK & LASEK - deferred three months
LASIK - deferred three months

GROUP II: ***CANDIDATES WITH PRE-OP REFRACTIVE ERRORS FROM GREATER THAN 6.00 D SPHERICAL EQUIVALENT:***

ICR - deferred six months
RK - deferred six months
PRK & LASEK - deferred six months
LASIK - deferred six months

For the AC-PIOL, the waiting period should be a minimum of six months, provided that the candidate can document that the refractive error and visual acuity have been stable between three and six months postoperatively and there are no lens opacities, lens vacuoles, or cataracts present in either eye. If any lens opacities/vacuoles/cataracts have developed, then the minimum waiting period would be extended to be no sooner than six months after the first appearance of the opacities/vacuoles/cataracts. This would ensure that these conditions are non-progressive and do not impact vision.

The minimum waiting period for the PC-PIOL should be a minimum of 12 months and there are no lens opacities/vacuoles/cataracts present. If lens opacities/vacuoles/cataracts have developed with the first 12 months postoperatively, then the waiting period should be extended to a minimum of 12 months after the first appearance of the opacities. This would ensure that these conditions do not progress and do not impact vision.

Night Vision Assessment

Prior to recent years, night vision assessments for law enforcement candidates have been difficult because the tests were not available. As a result, a number of agencies have developed their own protocol for candidates that have had refractive surgery. Although there are differences between the protocols, the commonalities are measuring high and low contrast acuity in room illumination and in dim illumination. The differences include whether or not contrast sensitivity is also measured and the transmission of the filter worn to lower the illumination.

It is recommended that a minimum test battery of measuring visual acuity under standard lighting using both the high and low contrast Bailey-Lovie charts and re-measuring with the candidates viewing through a filter that transmits between 0.5% to 1.5% of the incident light assuming a chart luminance of 160 cd/m2. This would be equivalent to a Shade 6 welding filter. Obviously a high contrast normal clinical illumination corrected acuity worse than 20/20 would disqualify the candidate. Other cut-off scores that could be used are based on the third standard deviation of nonrefractive surgery recruits are low contrast normal illumination acuity worse than 20/30, dim high contrast worse than 20/40 and dim low contrast acuity worse than 20/80 (Hovis & Ramaswamy, 2006).

9.0 MISCELLANEOUS CONDITIONS

9.1 General Guidelines for Evaluating Miscellaneous Conditions

These conditions would be very rare in the candidate population since they are more often found in older adults. There are a wide range of visual impairments due to these conditions. All candidates with these conditions should be referred for a complete ophthalmological examination. Present function must be considered in relation to the known physical and sensory demands of the job and the wide variety of working conditions under which task performance is required. Individual evaluation is necessary.

Orthokeratology

Orthokeratology is a technique of temporarily changing the power of the cornea with the use of special contact lens fitting techniques. The primary issue with this procedure is that the resulting changes in the refractive power of the eye are only temporary. Contact lenses must be worn periodically (every 3 to 5 days) to maintain the altered corneal

power. Unless the department is willing to periodically monitor uncorrected and corrected acuity to ensure that the acuity remains within the standard and they are willing to accommodate the officer should they elect or be required to stop the procedure, orthokeratology must be disallowed.

Cataracts

Cataracts are an opacification of the lens which develops through the alteration of the lens proteins. It may occur with aging, ultraviolet radiation, metabolic disorders such as diabetes, medications (including long term corticosteroid therapy), or ocular trauma. Surgical intervention is usually successful, especially with the implantation of an intraocular lens (IOL) that leaves the eye in a state of pseudophakia. Pseudophakia can be allowed provided the candidate meets all other vision requirements and in the opinion of the surgeon, the candidate is able to carry out the sensory and physical demands of a law enforcement officer.

However, some patients who cannot receive an IOL are functionally without a focusing lens: this state is called aphakia. Such patients may thus need to wear contact lens or thick spectacle lenses (Jaffe, et al., 1990). Fortunately, aphakic individuals are very rare in the applicant pool and they are unlikely to meet the other vision requirements.

Glaucoma

Glaucoma is a disease of the eye characterized by an increase in intraocular pressure. This may lead to damage to the retinal nerve fiber layer, which can lead to atrophy of the optic nerve and subsequent losses in the visual field. The most common, primary glaucoma has no known etiology; less common, secondary glaucoma is caused by anatomic abnormalities, trauma, or ocular disorders such as uveitis. A variety of medical and surgical treatments are available. Periodic intraocular pressure checks and ophthalmologic evaluation of the optic nerve and visual field are important because untreated glaucoma can lead to progressive loss of vision in the absence of symptoms. Risk factors include elevated intraocular pressure, race, age, and family history. It recommended that candidates who are over 40 years old and have a family history of glaucoma be referred for further assessment including formal visual field testing.

Diabetic retinopathy

Diabetic retinopathy is a major cause of blindness for persons of middle age. The pathological changes involve hemorrhages and vascular and

fibrous proliferation. The frequency of retinopathy increases with the duration of the diabetes. Diabetic retinopathy may be especially severe in individuals with juvenile-onset diabetes. Frequent periodic monitoring by a vision specialist is critical in preventing needless loss of vision in patients with diabetes (See: Endocrine System).

10.0 ADDENDUM

DRAFT NOTICE OF CONDITIONAL EMPLOYMENT

FOR REVIEW BY EMPLOYER'S LEGAL COUNSEL

(Do not place in employee's personnel file)

Medical Condition: Poor uncorrected far visual acuity - myopia correctable with soft contact lenses.

I, _____, acknowledge that the medical condition listed above was present at the time I was offered employment by_____. I affirm that I am currently, and have been for the past ____ months prior to employment, a bona fide successful soft contact lens wearer. I also understand that my use of soft contact lenses is permitted as a reasonable accommodation for my refractive error.

I understand that my ability to perform the duties assigned to me as a law enforcement officer are contingent upon my ability to successfully wear soft contact lenses on while on duty, and I shall wear such lenses whenever I am on duty except when authorized by my supervisor. I also understand that it is my responsibility to notify my supervisor should I become unable to wear soft contact lenses while on duty or should I take any other medical action which would otherwise affect my vision or my ability to wear soft contact lenses. I am aware that if I become unable to wear soft contact lenses while on duty, I may be assigned to restricted duty assignments or take a sick leave until I can safely wear my contact lenses on duty.

I have been informed that, as part of the reasonable accommodation to the medical condition noted above, that my use of soft contact lenses may be subject to verification by my employer and to such medical eye examination as necessary in the judgment of the employer's occupational medical advisor.

By my signature below, I acknowledge and agree to the conditions of employment described above.

_____ _____

Employee Date

In my opinion the foregoing medical restrictions and conditions of employment are necessary for the safe performance of the essential functions of the job.

_____ _____

Occupational Medicine Physician Date

_____ _____

Designated Appointing Authority (employer) Date

11.0 REFERENCES

Adams, A.J. & Haegerstrom-Portnoy, G. (1987). Color Deficiency. In: Amos, J.F. (Ed.) *Diagnosis and Management in Vision Care.* Boston: Butterworth.

Atkin, A., Asbell, P., & Justin, N. (1986). Radial keratotomy and glare effects on contrast sensitivity. *Doc Opthalmol*, 62, 129-148.

Alio, J.L., Mulet, M.E., Shalaby, A.M. (2002). Artisan phakic iris claw intraocular lens for high primary and secondary hyperopia. *J Refract Surg*, 18, 697-707.

Arne, J.L., Lesueur, L.C. (2000), Phakic posterior chamber lenses for high myopia: functional and anatomical outcomes. *J Cataract Refract Surg*, 26, 369-374.

Arrowsmith, P.N. & Marks, R.G. (1989). Visual, refractive, and keratometric results of radial keratotomy. *Arch Ophthal*, 107, 506-11.

Atkin, A., Asbell, P., & Justin, N. (1986). Radial keratotomy and glare effects on contrast sensitivity. *Doc Opthalmol*, 62, 129-148.

Bailey, I.L. & Lovie, J.E. (1976). New design principles for visual acuity letter charts. *Am J Optom and Physiol Optics*, 53, 740-745.

Barr, J.T. (1997). Vision standards and contact lenses. *Contact Lens Spectrum,* March.

Bauer A., Dietz, K., Kolling, G., Hart, W., & Schiefer, U. (2001). The relevance of stereopsis for motorists: a pilot study. *Graefes Arch Clin Exp Ophthalmol,* 239, 400-6.

Binder, P.S. (1986). Optical problems following refractive surgery. *Ophthalmology*, 93, 739-45.

Blake, R. & Fox, R. (1973). The psychophysical inquiry into binocular summation. *Percept Psychophys,* 14, 161-85.

Bodanowitz, S, Heinz, P., & Kroll, P. (1995). The assessment of visual function after photorefractive keratectomy with a view to legal requirements for the German police service. *Klin Monatsbl Augenheilkd*, 207, 203-05.

Bullimore, M.A., Sheedy, J.E., & Owen, D. (1994). Diurnal visual changes in radial keratotomy: Implications for visual standards. *Optometry & Vision Science*, 71, 516-21.

CIE. (2001). International recommendations for colour vision requirements for transport. CIE/NRC (Vienna, Austria: Commission Internatioinale de l'Eclairage.

Coles, B.L. & Orenstein, J.M. (2003). Does the Farnsworth D-15 test predict the ability to name colours? *Clin Exp Optom*, 4, 221-229.

Dain, S.J. (1998). Daylight simulators and colour vision tests. *Ophthalmic Physiol Opt,* 18, 540-4.

Deitz, M.R., Sanders, D.R., & Marks, R.G. (1984). Radial keratotomy: An overview of the Kansas City study. *Ophthalmology*, 91, 467-78.

Deitz, M.R., Sanders, D.R., & Raanan, M. (1987). A consecutive series (1982-1985) of radial keratotomies performed with the diamond blade. *Am J Ophthal*, 103, 417-22.

Edwards, G.A. & Schaefer, K.M. (1987). Corneal flattening associated with daily wear soft contact lenses following radial keratotomy. *J Refract Surg*, 3, 54-58.

Ellingsen, K.L., Nizam, A., Ellingsen, B.A., & Lynn, M.J. (1997). Age-related refractive shifts in simple myopia. *J Refract Surg*, 13, 223-8.

Epstein, D., Fagerholm, P., Hamber-Nystrom, H., & Tengroth, B. (1994). Twenty-four month follow-up of excimer laser photorefractive keratectomy for myopia: Refractive and visual acuity results. *Ophthalmology*, 101, 1558-64.

Garbus, J.J. (1989). Corneal topography and fluctuating visual acuity after radial keratotomy. *Ophthalmology*, 96, 665-70.

Garty, D.S., Kerr Muir, M.G., & Marshall, J. (1993). Excimer laser photorefractive keratectomy: 18 month follow-up. *Ophthalmology*, 100, 873-82.

Groome, W. & Johnson, C. (1993). *Final report on entry-level draw-bridge operator vision standards for the California Department of Transportation*. Sacramento: California State Personnel Board.

Groves, D. (1996). Refractive surgery: Defining rupture risks. *Phys Sports Med*, 24, 39-40.

Gauthier C.A., Holden, B.A., Epstein, D., Tengroth, B., Fagerholm, P., & Hamberg-Nystrom, H. (1998). Assessment of high and low contrast visual acuity after photorefractive keratectomy for myopia. *Optom Vis Sci*, 75, 585-90.

Hamberg-Nystrom, H., Tengroth, B., Fagerholm, P., Epstein, D., & van der Kwast, E.M. (1995). Patient satisfaction following photorefractive keratectomy for myopia. *J Refract Surg*, 11(3 Suppl), S335-6.

Hartenbaum, N.P. & Stack, C.M. (1997). Color vision deficiency and the X-chrom lens. *Occupational Health and Safety*, September, 36-38.

Higgins K.E., & Knoblauch, K. (1977). Validity of Pinckers' 100-hue version of the Panel D-15. *Am J Optom and Physiol Optics*, 54, 165-170.

Hovis, J.K. & Neumann, P. (1995). Colorimetric analyses of various light sources for the D-15 color vision test. *Optom Vis Sci,* 72, 667-78.

Hovis, J.K., Ramaswamy, S., & Anderson, M. (2004). Repeatability indices for the Farnsworth D-15 test. *Vis Neurosci*, 21, 449-53.

Hovis, J.K. & Ramaswamy S. (2006). Visual function of police officers who have undergone refractive surgery. *Am J Ind Med*, 49, 885-94.

Jaffe, N.S., Jaffe, M.S., & Jaffe, G.F. (Eds.) (1990). *Cataract Surgery and its Complications*. St. Louis, MO: Mosby Fifth Ed.

Jones, K.R. & Lee, D.N. (1981). Why two eyes are better than one: the two views of binocular vision. *Journal of Experimental Psychology*, 7, 30-40.

Kwitko, S. Gritz, D.C., Garbus, J., Guaderman, W.J., & McDonnel, P.J. (1992). Diurnal variation of corneal topography after radial keratotomy. *Arch Opthalmol*, 110, 351-6.

Lachenmayr B, Berger, J., Buser, A., & Keller, O. (1998). Reduced visual capacity increases the risk of accidents in street traffic. *Ophthalmologe*, 95, 44-50.

Lackner, B., Pieh, S., Schmidinger, G., Hanselmayer, G., Dejaco-Ruhswurm, I., Funovics, M.A., & Skorpik, C. (2003). Outcome after treatment of ametropia with implantable contact lenses. *Ophthalmology*, 110, 2153-2161.

Lackner, B., Pieh, S., Schmidinger, G., Simader, C., Franz, C., Dejaco-Ruhswurm, I., & Skorpik, C. (2004). Long-term results of implantation of phakic posterior chamber intraocular lenses. *J Cataract Refract Surg*, 30, 2269-2276.

MacRae, S. Rich, L., Phillips, D., & Bedrossian, R. (1989). Diurnal variation in vision after radial keratotomy. *Am J Ophthalmology*, 107, 262-7.

Maloney, R.K,, Nguyen, L.H., & John, M.E., (2002). Artisan phakic intraocular lens for myopia: short-term results of a prospective, multicenter study. *Ophthalmology*, 109, 1631-1641.

Marmer, R. (1987). Radial keratomy complications. *Ann Opthalmol*, 19, 409-11.

Megaw, E. The visual environment In. Jones, D.M. & Smith, A.P. (Eds). (1992). *The Handbook of Human Performance: Volume I.* New York: Academic Press. p. 280.

Matsumoto, E.R., Johnson, C.A., & Post, R.B. (1983). Effect of X-Chrom lens wear on chromatic discrimination and stereopsis in color deficient observers. *Am J of Optom and Physiol Optics*, 60, 297-02.

McDonnell, P.J., Nizam, A., Lynn, M.J., & Waring, G.O. (1996). Morning-to evening changes in refraction, corneal curvature, and visual acuity 11 years after radial keratotomy in the Prospective Evaluation of Radial Keratotomy (PERK) Study. *Ophthalmology*, 103, 233-39.

Menezo, J.L., Peris-Martinez, C., Cisneros-Lanuza, A.L., & Martinez-Costa, R. (2004). Rate of cataract formation in 343 highly myopic eyes after implantation of three types of phakic intraocular lenses. *J Refract Surg*, 20, 317-324.

Milburn, H.J. & Mertens, H.W. (1993). Validation of an inexpensive test illuminant for aeromedical color vision screening. DOT/FAA/AM-93-16. Oklahoma City: FAA Civil Aeromedical Inst. NTIS.

Moshirfar, M., Dodd, J.G., Muir, G.J,, & Gagnon, M.R. (2007). Occurrence and prognosis of non-penetrating injuries in eyes with Verisyse iris-supported phakic intraocular lens. *J Cataract Refract Surg*, 33, 166-9.

Munoz, G., Montes-Mico, R., Belda, J,I,, & Alio, J.L. (2003). Cataract after minor trauma in a young patient with an iris-fixated intraocular lens for high myopia. *Am J Ophthalmol*, 135, 890-891.

NAS-NRC (Report of Working Group 39). (1980). Recommended standard procedures for the clinical measurement and specification of visual acuity. *Advances in Ophthalmology*, 41, 103-148.

Niesen, U., Businger, U., Hartmann, P., Senn, P., & Schipper, I. (1997). glare sensitivity and visual acuity after excimer laser photorefractive keratectomy for myopia. *Br J Ophthalmol*, 81, 136-40.

Niesen, U., Businger, U., & Schipper, I. (1996). Disability glare after excimer laser photorefractive keratectomy for myopia. *J Refract Surg*, 12, S267-8.

North, R. (1993). *Work and the Eye.* London: Oxford University Press.

Rashid, E.R. & Waring, G.O. (1989). Complications of radial and transverse keratotomy. *Survey of Ophthalmology*, 34, 73-106.

Rubin, G.S., Munoz, B., Fried, L.D., & West, S.K. (1995). Monocular vs. binocular visual acuity as measures of vision impairment. *Vision Science and its Applications: Technical Digest Series Volume I.* Washington: Optical Society of America, pp. 328-31.

Santos, V.R., Waring, G.O., Schanzlin, D.J., Cantillo, N., Espinal, M.E., Garbus, J., Justin, N., & Roszka-Duggan, V. (1989). Morning-to-evening changes in refraction, corneal curvature, and visual acuity 2 to 4 years after radial keratotomy in the PERK Study. *Ophthalmology*, 95, 1487-93.

Schanzlin, D.J. (1999). Studies of intrastromal corneal ring segments for the correction of low to moderate myopic refractive errors *Trans Am Ophthal Soc*, 97, 815-90.

Schanzlin, D.J., Santos, V.R. Waring, G.O., Lynne, M., Boourque, L., Cantillo, N. Edwards, M.A., Justin, N. Reingig, J., & Roszka-Duggan, V. (1986). Diurnal change in refraction, corneal curvature, visual acuity, and intra ocular pressure after radial keratotomy in the PERK study. *Ophthalmology*, 93, 167-75.

Sanders, D.R. & Vukich, J.A., (2002). Incidence of lens opacities and clinically significant cataracts with the implantable contact lens: comparison of two lens designs. *J Refract Surg*, 18, 673-682.

Sanders, D.R., Vukich, J.A,, Doney, K., & Gaston, M. (2003). U.S. Food and Drug Administration clinical trial of the Implantable Contact Lens for moderate to high myopia. *Ophthalmology*, 110, 255-266.

Sanders, D.R., Doney, K., & Poco, M. (2004). United States Food and Drug Administration clinical trial of the Implantable Collamer Lens (ICL) for moderate to high myopia: three-year follow-up. *Ophthalmology*, 111, 1683-1692.

Schallhorn, S.C., Blanton, C.L., Kaupp, S.E., Sutphin, J., Gordon, M., Goforth, H., & Butler, F.K. (1996). Preliminary results of photorefractive keratectomy in active-duty United States navy personnel. *Ophthalmology*, 101, 5-21.

Seiler, T. (1995). Current evaluation of myopia correction with the excimer laser. *Ophthalmologe*, 92, 379-84.

Shimizu, K., Shiro, A., & Shunichi, T. (1994). Photorefractive keratectomy for myopia: One year follow-up in 97 eyes. *Supplement to Journal of Refractive & Corneal Surgery*, 10, S178-87.

Suiter, B.G., Twa, M.D., Ruckhofer, J., & Schanzlin, D.J. (2000). A comparison of visual acuity, predictability, and visual function outcomes after intracorneal ring segments and laser in situ keratomileusis. *Trans Am Ophthalmol Soc*, 98:51-5

Verdon, W., Bullimore, M., & Maloney, R.K. (1996). Visual performance after photorefractive keratectomy. A prospective study. *Arch Opthalmol*. 114, 1465-72.

Vinger, P.F., Mieler, W.F., Oestreicher, J.H., & Easterbrook, M. (1996). Ruptured globes following radial and hexagonal keratotomy surgery. *Arch Opthalmol*, 114, 129-34.

Waring, G.O. Lynn, M. J., & McDonnell, P.J. (1994). Results of the prospective evaluation of radial keratotomy (PERK) study 10 years after surgery. *Arch of Ophthalmol*, 112, 1298-308.

Yoon, H., Macaluso, D.C., Moshirfar, M., & Lundergan, M. (2002). Traumatic dislocation of an Ophtec Artisan phakic intraocular lens. *J Refract Surg*, 18, 481-483.

EARS AND HEARING

1.0 INTRODUCTION

The evaluation of a candidate's hearing is a relatively simple matter that involves an audiometric evaluation. The subsequent recommendations that result from these evaluations, however, may become very complicated and will occasionally require consultation by specialists trained in these areas. Any preplacement medical program should include provisions for consultation and referral services provided by an otorhinolaryngologist who is a specialist in medical problems of the ears, nose, and throat, in combination with the services of an audiologist who is specialist in communication disorders relating to hearing loss.

Hearing ability and work performance has been of interest to medical researchers because of the high number of work place accidents that are associated with hearing loss. Moll, van Charante, and Mulder (1990), for example, found noise and hearing loss to be associated with 43 percent of all injuries for shipyard workers. In a national study of occupational injuries between 1985 and 1994, Zwerling, Whitten, Davis, and Sprince (1997) found that hearing impairment was strongly associated with work place accidents at a rate that is approximately 50% greater than for persons without hearing loss (p. 1). In fact, these researchers found that only blindness and deafness constitute greater risk factors for occupational injury than partial hearing impairment.

2.0 THE PHYSIOLOGY OF HEARING

Sound is generated by vibrating objects that result in changes in air pressure. These sound pressure changes in the air pass through the external ear canal and impinge on the eardrum, causing it to vibrate. The vibrations of the eardrum are transmitted to the fluids of the inner ear by the three bones of the middle ear. The vibrations of the fluids in the inner ear cause movement of the Organ of Corti that produces a bending of the hairlike projections from the sensory cells. This bending of the hairlike projections results in the initiation of electrochemical nerve impulses that travel up the auditory nerve to the brain where sounds are interpreted into what we know as hearing.

In general, the young adult human ear can hear frequencies (pitch) ranging from about 20 to about 20,000 cycles per second (cps - now called Hertz, abbreviated Hz). Perhaps the most important frequencies are those that have to do with understanding speech, located approximately between 250Hz and 6000Hz. Although vowel sounds

contain some energy at frequencies lower than 250Hz and some consonant sounds contain some energy at frequencies higher than 6000Hz, most speech communication can effectively be understood in quiet listening environments if only energy between 500Hz and 3000Hz is present. In noisy listening environments, however, effective speech communication requires energy at frequencies up to 6000Hz. As far as sensitivity is concerned, the normal ear is able to detect sounds between 1000Hz and 4000Hz at lower levels than is the case for sounds at frequencies below 1000Hz or for sounds at frequencies above 4000Hz. An auditory threshold is the intensity (measured in decibels - dB) of a sound that can just barely be detected by a person. The auditory threshold will be different for various sounds depending on their complexity and frequency range because of the differential sensitivity of the ear to various frequencies.

3.0 OUTLINE OF HIGHLIGHTED CONDITIONS

For purposes of otologic and audiologic diagnosis, the auditory system is divided into the conductive system and the sensorineural system. The conductive system consists of the ear canal, the eardrum, the middle ear and the ossicles (bones) in the middle ear. The purpose of the conductive system is to change sound into mechanical energy and to conduct or transmit this mechanical energy to the fluid-filled inner ear. The sensorineural system consists of the inner ear (cochlea), the eighth cranial nerve and the neural pathways in the central nervous system that relate to hearing. The purpose of the sensorineural system is to change the sound-caused fluid motion in the cochlea to nerve impulses that are then transmitted to the brain for processing.

Hearing may be tested by two different methods, called air-conduction and bone-conduction. A hearing test that is administered using earphones is called an air-conduction hearing test because the sound travels from the earphone, through air in the ear canal, to the eardrum. Therefore, the air-conduction signal must travel through both the conductive and the sensorineural auditory systems before it is heard by the person being tested. If an air-conduction sound must be made louder than normal for a person to hear it, then a hearing loss exists and may be the result of some abnormality of the conductive auditory system, the sensorineural auditory system, or both. The site of the abnormality (i.e., conductive hearing loss or sensorineural hearing loss) cannot be diagnosed by administering an air-conduction hearing test only. A hearing test that is administered using a plastic vibrator that is placed on the mastoid process behind the ear is called a bone-conduction hearing test. The bone conduction vibrator causes the entire skull to vibrate and results in direct stimulation of the fluids in the inner

ear and subsequent initiation of the electrochemical neural impulses to the brain. Therefore, the bone-conducted sounds travel through the sensorineural system only and do not depend on transmission of the conductive auditory system to reach the inner ear. It is important to note, however, that some abnormalities of the conductive auditory system can cause a reduction of sensitivity to bone-conducted sounds.

The diagnosis is related to whether a person's hearing is normal or if a hearing loss exists. If a hearing loss does exist, then it must be determined whether the medical abnormality is located in the conductive auditory system, the sensorineural auditory system or both systems. This diagnosis is performed by comparing the person's ability to hear pure-tone signals for both air-conduction and bone-conduction methods of presentation. Three diagnostic possibilities exist:

Conductive Hearing Loss - meaning that the abnormality is located in the conductive auditory system. Examples of a conductive hearing loss would be a person who has impacted ear wax in the external canal or an ear infection with fluid present in the middle ear space. A conductive abnormality will result in a hearing loss for air-conduction signals, indicating that the problem is in either the conductive or sensorineural systems or both. Normal hearing will be found for bone-conduction signals since the sensitivity of the sensorineural system is not materially affected by conductive abnormalities.

Sensorineural Hearing Loss - meaning that the abnormality is located in the sensorineural auditory system. Examples of a sensorineural hearing loss would be a person who has been exposed to intense noise levels for a long period of time without the use of ear protection or a person with an acoustic tumor affecting the eighth cranial nerve. A sensorineural abnormality will result in a hearing loss for air-conduction signals, indicating that the problem is in either the conductive or sensorineural systems or both. A hearing loss for bone-conduction signals that is equal to the hearing loss for air-conduction signals will also exist since the problem is located entirely in the sensorineural system. The presence of a hearing loss for bone-conduction signals that is equal to the hearing loss for air-conduction signals indicates that the conductive auditory system is functioning normally. This does not necessarily mean that some conductive medical pathology does not exist because some medical abnormalities will not result in a measurable hearing loss.

Mixed Hearing Loss - meaning that the abnormalities exist in both the conductive and the sensorineural auditory systems. An example of a mixed hearing loss would be a person who has a noise-induced sensorineural hearing loss and impacted ear wax in the external canal.

A hearing loss for air-conduction signals will exist, indicating that the problem is in either the conductive or sensorineural systems or both. A hearing loss for bone-conduction signals will also exist but will not be as great as the loss for air-conduction signals since the problem exists in both the conductive and the sensorineural auditory systems.

Retrocochlear Conditions - Understanding speech is not just an auditory process, but also involves cerebral processing of the signals from the ear. Therefore, for a variety of reasons, functional impairment may occur when the audiogram is normal. Known as obscure auditory dysfunction or discriminatory hearing loss, this condition may represent up to 10% of the patients that visit hearing specialists. Known causes include cortical damage due to stroke or head trauma and attention deficit disorder (Cook, et. al., 1993). While not pathological, learning English as a second language also affects the ability to understand English in noise. This is especially true when English is learned after the age of 14 (Mayo, et. al., 1997).

4.0 IMPLICATIONS FOR JOB PERFORMANCE

4.1 Critical and Essential Tasks

The job analysis study that accompanies this report shows critical hearing tasks for each of four functional hearing abilities as identified by the public safety study classifications. These tasks should be carefully reviewed as part of the evaluation of hearing.

4.2 Implications for Law Enforcement Officer Job Performance

Hearing impairment can have serious consequences for persons in public safety occupations. For example, verbal communication in traffic noise is a frequent activity for law enforcement officers. Asahina (1993) simulated the ability of persons with high frequency hearing loss to understand speech in traffic noise. Asahina (1993) demonstrated that traffic noises, measured in the mid-high frequencies of 1000 Hz or more, disrupt the ability of persons with high frequency hearing loss to understand speech under these conditions. Communication is particularly poor for persons with hearing impairment when the competing noise consists of speech as would be typical in a jail environment or a crowd scene.

Sound localization is an important ability needed by law enforcement officers. In a study using 87 bilaterally hearing-impaired listeners, Noble, Byrne and Lepage (1994) demonstrated that persons with high

frequency sensorineural hearing loss performed poorly on controlled tests of sound localization as compared to persons with normal hearing. Persons with hearing loss in the 4000 kHz to 6000 kHz performed very poorly in discriminating front from rear sounds during the test (p. 1004). At present, there is no specific standardized test for sound localization.

5.0 GENERAL SCREENING RECOMMENDATIONS

The otologic and the audiometric preplacement evaluations are necessary to determine factors that may interfere with a candidate's ability to perform the job, to identify pathologies that may be further aggravated by exposure to the environment inherent in certain positions, to identify abnormalities that may pose safety hazards in certain jobs, and to establish a medicolegal baseline from which to measure further damage or deterioration of the ears or hearing. It is necessary to perform both an otologic inspection of the ear as well as a formal test of hearing during the preplacement examination since most abnormalities of the ears or hearing mechanism are not obvious to the personnel interviewer or identified during a cursory physical examination. For example, it is common that persons with a mild or partial hearing loss, or with a significant loss of hearing in one ear only, will be able to communicate very effectively during the physician's examination since the communication is usually on a one-to-one basis in a small room that does not contain high background noise levels. Such hearing loss may pose a significant handicap in positions that require a high degree of communicative efficiency. Conversely, some prospective employees may appear to have a hearing loss during the physical examination but the loss may not actually affect his or her job performance in any significant way.

Examination - In order to properly view the eardrum, the physician will have to remove any ear wax (cerumen) that may be occluding the ear canal. This should also be a routine procedure to make sure that the hearing test is not affected by some simple blockage of the external canals. The physician will note the condition of both the external ear canal and the eardrum.

Interpretation of the Examination - In general, the results of a normal otologic examination reflect the absence of malformations, swelling, infection, or redness of the external canal in combination with the absence of redness, bulging, retraction or perforations of the eardrum.

Referral Criteria - Any medical abnormality that is noted should be explained to the prospective employee and be referred to the candidate's own physician for examination and further referral if

warranted.

5.1 Otologic Examination

The otologic examination may be performed by any physician during the initial stages but should only be performed by an otolaryngologist for diagnostic and therapeutic purposes. Examination of the ear canal and the eardrum will be performed with an otoscope, often equipped with an air bulb to determine the mobility of the drumhead. Examination of the status of the middle ear and the sensorineural auditory systems requires the otolaryngologist and the audiologist to use additional diagnostic techniques such as the acoustic impedance bridge, advanced audiologic tests, x-ray studies, electronystagmography, etc. (See Section on Ears, Nose, and Throat).

5.2 Medical History

The otologic history should include careful questioning about the presence of ear pain, drainage from the ears, and any feeling of fullness or discomfort of the ears related to previous problems. These items may indicate the presence of some problem of the conductive auditory system that requires further examination or treatment. In addition, the presence of ringing or buzzing in the ears (tinnitus), of vertigo or imbalance problems, or of a sudden or fluctuating hearing loss may indicate the presence of some problem of the sensorineural auditory system that requires further examination or treatment. In addition to questions about hearing difficulties, the MED-TOX Medical History Questionnaire has questions relating to firearm noise exposure, excessive noise, and exposure to loud tools and machinery. These areas should be reviewed. It is important to document the use of ear protection, if any.

5.3 The Audiometric Evaluation

The audiometric evaluation (hearing test) should only be performed after the otologic evaluation so that any occluding objects such as ear wax would have been removed. If this is not practical, the person who is testing the hearing must inspect the ear canal with an otoscope to make sure that occlusion of the ear canal is not present.

Personnel - While there are a number of persons who may actually perform the preplacement hearing test, the entire program should be directed and supervised by a state-licensed audiologist who holds, at a

minimum, a master's degree and is uniquely trained to coordinate the hearing conservation and preplacement testing programs with the medical department, the human resources department and the safety department. Although the primary thrust of this publication is in relation to the assessment for work, a secondary aspect of the preplacement hearing test concerns the post-employment aspect of hearing conservation in the presence of potentially hazardous occupational noise levels. It is important, therefore, to establish and document a baseline audiogram for all candidates.

If it is not practical for the audiologist to actually perform the preplacement hearing test, the function may be delegated to a technician. There are a number of ways by which a technician may be trained to be a valuable assistant in the hearing testing program. Some audiologists prefer to train the technician to perform hearing tests without the benefit of formal course work. This usually involves training the technician to take the person's history and to perform the hearing testing that is necessary to obtain a valid audiogram. If the audiologist trains an assistant, that assistant must be registered with the state under the audiologist's name.

Technicians may also be trained in audiometry by enrolling in university audiology classes. This training usually takes considerable time and results in a level of academic knowledge that is greatly in excess of that required to obtain an accurate history and valid hearing test. Prospective technicians may also take a short course in audiometry that is offered in various areas under the sponsorship of the Council for Accreditation in Occupational Hearing Conservation. This course involves a minimum of 20 hours of study including practice in performing hearing tests. Technicians who take this short course are repeatedly cautioned that the course of study is designed to qualify them to perform hearing tests only under the direction of an audiologist or physician.

History - The history taken during the audiometric evaluation is closely related to that obtained during the otologic examination. The history should include the length of time since most recent exposure to intense noise. This is important because recent exposure to intense noise may cause a temporary decrease in hearing that would make the candidate's hearing appear worse than it actually is. Therefore, a hearing test should not be performed unless the candidate has been free of exposure to intense noise for at least 14 hours.

The history must also document any exposure to non-occupational hazardous noise levels such as those resulting from firearm use, loud music, use of power tools such as chain saws or metal working

equipment, or exposure to loud vehicles such as motorcycles or racing cars.

5.4 Pure Tone Audiometry

Audiometry is the use of techniques and procedures for determining a person's ability to hear, compared to standard levels that are known as being normal. While diagnostic audiometry used by audiologists and otolaryngologists requires both pure-tone and speech signals, air-conduction and bone-conduction methods of presentation, and requires complex and expensive testing equipment, determining a candidate's ability to hear pure-tone-air-conduction signals is a relatively inexpensive and uncomplicated procedure.

A pure-tone audiometer is used to generate and control the frequency and intensity of signals used to test a candidate's hearing. Since the primary purpose of the preplacement hearing test is to determine the extent and pattern of a person's hearing loss, if any, and not to diagnose the type of hearing loss that exists, preplacement audiometry is usually restricted to pure-tone-air-conduction testing only. The pure-tone audiometer allows the tester to select the test frequency (pitch), to turn the tones on and off as desired, and to regulate the intensity (loudness) of the tones used for testing. It is suggested that the frequencies 250 Hz, 500Hz, 1000Hz, 2000Hz, 3000Hz, 4000Hz, 6000Hz and 8000Hz be tested since these frequencies cover the important frequencies required for adequate understanding of speech communication. The examiner will use the audiometer to determine the lowest intensity of each tone in each ear that is barely audible to the candidate. These levels are recorded in units called decibels (dB) and are recorded as individual threshold levels for each frequency in both ears on a form called an audiogram.

Smoorenburg (1992) demonstrated the ability of pure tone audiograms to predict the ability to hear speech in quiet and noisy environments. Using 200 subjects (400 ears) Smoorenburg measured the ability of normals and hearing impaired listeners to hear and understand speech under conditions of silence and noise. Smoorenburg found that the ability to hear and understand speech in noise was negatively correlated with hearing loss at frequencies above 1000 Hz and hearing loss at and below 1000 Hz was inversely related to the ability to perceive speech in a quiet environment. In other words, the greater the loss at the 2000, 4000, and 6000 Hz frequencies as demonstrated on the audiogram, the poorer ones ability to hear and understand speech in noisy environments. And the poorer one scores on the audiogram at 1000 Hz and below, the poorer one's ability to hear and understand simple speech in a quiet environment. Using multiple regression

analysis, Smoorenburg demonstrated that the speech reception threshold in noise could be predicted (**R** = .72) using the measures at the 2000 Hz and 4000 Hz from the pure tone audiogram (p. 321). He also demonstrated that hearing loss even at 10 to 15 dB has some effect on the ability to understand speech in noise and that at 30 dB, the impairment is noticeable (p. 421).

Background Noise Levels - In order to obtain a valid hearing test, the candidate must be tested in an ANSI-approved sound booth.

Testing Equipment - There are two basic types of pure-tone audiometers. A manual audiometer is designed so that the tester maintains complete control over the intensity, frequency and duration of the test sounds during testing. The second type is the patient-controlled computerized audiometer designed to automatically increase or decrease the intensity of the test tones and automatically change the test frequency after a specified period of time. In this test the patient presses a button every time he hears a signal and the computer presents new test signal. This procedure results in a digital printout about the person's threshold that is recorded on a test form.

The use of a manual audiometer requires that the tester actually vary the intensity of the different tones until a decibel level required to achieve the person's threshold is obtained. A hearing test obtained using a manual audiometer takes approximately five minutes and a hearing test obtained using a self-recording audiometer takes approximately fifteen minutes.

The primary advantage of the manual audiometer is that it is considerably less expensive than is a computerized audiometer and that the tester is in complete control of the test signals at all times. The primary advantage of the computerized audiometer is that several of the units can be in operation at the same time and can be monitored by one person. The selection of an audiometer should be made in consultation with an audiologist.

Interpretation of Results - Results of the hearing test will indicate whether the candidate has normal hearing or will yield some basic information that an existing hearing loss will result in an impairment that is severe enough to interfere with adequate job performance.

From an audiologic and medical point of view, any candidate who has hearing threshold levels that do not exceed 25 dB at any frequency in either ear must be considered as having normal hearing. This person will not be expected to have any significant communication difficulties related to abnormalities of the auditory system.

Conversely, a candidate who has hearing threshold levels that exceed 25 dB in either or both ears must be classified as having a hearing loss that reflects some abnormality of the auditory system, even if only to a minor degree. Whether or not a person's hearing loss will result in a significant impairment of their ability to communicate on the job depends on a number of criteria in addition to the extent and pattern of the hearing loss. That is, communication depends on the adequateness of the person who is talking, the intensity of background noise that is present and may interfere with the speech signal, the attentiveness of the listener, as well as the predictability of the message that will be communicated. Communication may be very difficult even for a person with entirely normal hearing if the speaker talks softly and is a "mumbler," if the communication is being conducted in the presence of high noise levels such as would be present in a machine shop, if the speaker has not obtained the listener's attention prior to talking or if the speaker is using technical jargon that is not familiar to the listener.

On the other hand, a person who has a mild or moderate hearing loss may communicate very well in the absence of interfering noise when the speaker calls him by name to obtain their attention prior to communicating and if the communication does not contain a great number of unfamiliar or unpredictable words or phrases. Furthermore, communication also depends on the general awareness level and interest of the persons concerned. By this, we mean that some hearing impaired persons communicate more effectively than some normal hearing persons just because they are alert, motivated and very interested in maintaining successful communication. Obviously, this is not easily measured. This is especially true of those hearing losses that are mild in degree or limited to only a portion of the frequency range that was tested.

Referral Criteria - Referral may be necessary to determine the extent and type of hearing loss and to obtain a medical diagnosis of the abnormality. Most people with a minor medical abnormality or a minor hearing loss will not be aware of these problems and will question the utility of an otologic or audiologic referral. Referral should occur when there is indication of a moderate to serious problem of the auditory system.

Recommendations - Audiological recommendations are generally related to hearing conservation. These recommendations should be explained to the candidate only by the physician or audiologist and should not be part of the technician's responsibility if a technician is used for hearing testing. Furthermore, a written list of the recommendations should be given to the candidate and a copy of these recommendations should be placed in the medical file.

Audiologic recommendations are not usually necessary for candidates who have normal hearing and will not be working in high noise areas. Audiologic recommendations are always necessary for candidates who will be exposed to high noise levels on the job, regardless of whether they have normal hearing or have a preexisting hearing loss. These recommendations are based partly on the person's audiologic history, as well as being related to requirements of the job. Any candidate who will be working in high noise areas must be informed that exposure to high noise levels without the use of ear protection may be permanently damaging their hearing. Candidates must also be informed that use of ear protection in certain areas is mandatory and that failure to follow these rules can be cause for dismissal. Candidates must be informed that (if such is the case) they are also possibly damaging their hearing by non-occupational noise sources, as given on the history. Of particular importance here is the use of firearms or loud power tools such as chain saws without ear protection. All candidates should be encouraged to use ear protection (preferably earmuffs) when firing handguns or rifles.

5.5 Description of the Functional Test System

The HINT for Windows consists of a switching box and software that runs on a PC-based Windows system. This software and test box can direct appropriate signals to either standard headphones, insert earphones, of sound-field speakers. The various testing protocols are run through the software and the resulting data is securely stored and protected against manipulation or change. Audiologists seeking a local distributor and training can be located by calling Biologic Systems Corporation at (800) 272 8075.

5.6 Level of Training Required for Functional Testing

The functional screening may be performed by the same persons who perform the audiometric evaluation/screening. The screening program, however, should be under the supervision and direction of a licensed audiologist (See 5.3). The audiologist or a trained technician may perform the functional screening tests. The audiologist will be trained by representatives from the company that provides the test system. The audiologist will in turn train the technicians. Training will consist of instructions for running the software for the test system, for administering the functional tests, for maintaining and accessing the database in the test system, and for scoring and interpreting the test results.

6.0 RECOMMENDATIONS FOR HEARING STANDARDS

6.1 Two-Stage Screening Procedure

A two-stage screening procedure is recommended. The first stage is to consist of pure-tone audiometric thresholds measured for the left and right ears separately. If both ears meet the screening criteria, no further screening is required. If either ear fails the screening criteria at any of the test frequencies, the second stage of screening is required. The second stage screening is comprised of a functional hearing ability test that assesses speech intelligibility in quiet and in noise.

Candidates who meet any of the following criteria should receive the HINT test, even if their audiogram is normal.

1. History of moderate-to-severe head trauma.
2. History of stroke.
3. History of attention deficit disorder.
4. Learned English after age 13.

Hearing aids or other assistive listening devices are not to be used during either first stage or second stage screening. Hearing aids also are not to be used while on duty.

The following are the possible outcomes of the two-stage screening procedure:

GROUP I: CANDIDATES WHO ACHIEVE NORMAL RESULTS ON AUDIOMETRY.

These candidates pass the first stage audiometric screening. Unless the candidate meets any one of the four criteria above, the candidate meets the hearing requirement and no further testing is necessary.

GROUP II: CANDIDATES WHO FAIL THE FIRST STAGE AND PASS THE HINT TEST.

These candidates fail the first stage audiometric screening but achieve a passing score the HINT. These candidates meet the hearing standard and no further testing is necessary.

GROUP III: CANDIDATES WHO FAIL THE FIRST STAGE AND FAIL THE HINT.

These candidates should not be placed into law enforcement positions where hearing speech in noise is a critical tasks.

6.2 Criteria for First Stage Audiometric Screening

Pure-tone thresholds of audibility shall not exceed 25 dB HL in either the left or right ears at the following audiometric frequencies: 250 Hz, 500 Hz, 1000, Hz, 2000 Hz, 3000Hz, 4000 Hz, 6000 Hz. Thresholds shall be measured adaptively under headphones using standard audiometric procedures.

6.3 Criteria for Second Stage Functional Hearing Screening: Speech Intelligibility in Quiet and Noise.

Speech intelligibility in quiet and in noise shall be measured binaurally under headphones with the Hearing In Noise Test (HINT) using the HINT computerized test system (Nilsson, Soli, & Sullivan, 1994). The HINT can be administered via headphones using virtual audio sound processing that simulates the various conditions of noise front, noise right and noise left. It can also be administered through the sound field by using sound field speakers.

Adaptive test procedures shall be used to measure the threshold of intelligibility in quiet and in stationary noise presented at 65 dB(A). The spectrally matched HINT noise provided in the computerized test system shall be used to measure thresholds of intelligibility in noise.

Intelligibility in quiet shall be measured with the simulated location of the speech source in front of the subject at 0° azimuth. Intelligibility in noise shall be measured in three test conditions, as defined by the simulated location of the speech and noise sources in relation to the subject: speech and noise from 0° azimuth (Noise Front), speech at 0° azimuth and noise at 90° azimuth to the right of the subject (Noise Right), and speech at 0° azimuth and noise at 90° azimuth to the left of the subject (Noise Left). These three test conditions span the range of listening conditions in which binaural hearing can affect speech intelligibility in noise. Different sentence lists shall be used for each of the HINT tests in quiet and in noise.

Candidates who perform more poorly than the 5th percentile of the normal hearing control group under any of the three background noise

conditions (noise in front, right or left) should be restricted from safety-sensitive tasks which require accurate and rapid understanding of speech in noise. Candidates with quiet thresholds greater than 28 dB(A) on the HINT should be restricted from safety sensitive tasks, which require accurate and rapid understanding of whispered speech and speech heard through doors and windows. A quiet threshold on the HINT of 28 dB(A) corresponds to an intelligibility of approximately 90% at the job-critical level for soft or whispered speech of 30 dB(A).

The HINT threshold of intelligibility in the Noise Front condition shall not exceed 0 dN S/N ratio. Neither the HINT threshold of intelligibility in the Noise Front condition or in the Noise Left condition exceed -10 dB S/N ratio.

6.4 Alternative Law enforcement Officer Hearing Requirement Recommendation for those without access to Functional Hearing Testing Equipment

In the event that the equipment and trained personnel are not available for the HINT described above, the following pure tone requirement may be applied for law enforcement officer candidates.

Pure tone thresholds in the unaided worst ear not worse than 25 dB loss in three of the four frequencies (500Hz, 1000Hz, 2000Hz, and 3000Hz) or no greater than 30 dB at any one of the first three frequencies with an average loss of less than 30 dB for all four frequencies is acceptable. Testing with a hearing aid is not permitted.

6.5 Consideration of Prior Law Enforcement Experience

It could be argued that prior law enforcement officer experience may mitigate some of the impact of functional impairment on a candidate's job performance. For example, familiarity with typical police communications may reduce the criticality of understanding every word of communication. The judgment gained from prior experience may somewhat compensate for the loss of speech information in a given situation. However, great caution must be exercised when considering prior experience. The degree and nature of prior law enforcement experience can differ considerably from candidate to candidate. For example, a candidate from another state with another penal code might need to *unlearn* some of the agency-specific jargon of the previous employer. For these reasons, it is recommended that prior experience only be considered borderline cases.

7.0 REFERENCES

Asahina, N. (1993). A study on speech intelligibility in traffic noise. *Nippon Jibiinkoka Gakkai Kaiho*, 3, 401-13.

Cook, J.R., et al. (1993). A preliminary study of the relationship between central auditory processing disorder and attention deficit disorder. *J Psychiatry Neurosci,* 18, 3, 130-137.

Laroche, C., Soli, S., Giguere, J., Lagace, V., Vaillancourt & Fortin, M. (2003). An approach to the development of hearing standards for hearing-critical jobs. *Noise & Health*, 6, 21, 17-37.

Mayo, L.H., Florentine, M. & Buus. S. (1997). Age of second-language acquisition and perception of speech in noise. *J Lang Hear Res,* 40, 686-693.

Moll, A.W., van Charante, C., & Mulder, P.G. (1990). Perceptual acuity and the risk of industrial accidents. *Am J Epidem,* 131, 652-662.

Nilsson, M.J, Soli, S.D., & Sullivan, J. (1994). Development of a hearing in noise test for the measurement of speech reception threshold. *J Acoust Soc Am*, 95, 1085-1099.

Noble, W., Byrne, D., & Lepage, B. (1994). Effects on sound localization of configuration and type of hearing impairment. *J Acoust Soc Am*, 95, 992-1005.

Smoorenburg, G.F. (1992). Speech reception in quiet and noisy conditions by individuals with noise-induced hearing loss in relation to their tone audiogram. *J Acoust Soc Am*, 91, 421-427.

Zwerling, C., Whitten, P.S., Davis, C.S., & Sprince, N.L. (1997). Occupational injuries among workers with disabilities: The National Health Interview Survey 1985 -1994. *JAMA*, 278, 2163-2166.

PULMONARY SYSTEM

1.0 INTRODUCTION

The basic function of the respiratory system can be defined as those processes involved with gas exchange between and individual and the environment including:

1. Ventilation, which is the movement of air between the environment and the respiratory system;

2. Diffusion, which involves the movement of carbon dioxide and oxygen in opposite directions across the alveolar-capillary membrane;

3. Perfusion, which is the flow of blood through the pulmonary arteries, capillaries and veins matched to ventilation in local areas of the lung, and;

4. Control of ventilation, which is the central nervous system's reaction to cope with changing metabolic demands.

5. Metabolic balance, since normal "blowing off" carbon dioxide reduces acidity in the bloodstream;

6. Hormonal balance, as the lung metabolizes certain enzymes including one important in hypertension;

7. Defense against microbial infection and damage, as the lung has numerous specialized functions to prevent inhaled bacteria and viruses from infecting the rest of the body and comparable means of preventing inhaled particles and gases from damaging the body.

8. Waste removal, as the lung is able to eliminate volatile compounds into the air such as benzene.

Since the chest-wall, upper respiratory tract and cardiovascular system are also integrally involved in the respiratory process, they frequently become targets of pulmonary hazards as well. In order to meet the metabolic needs of the average worker, approximately 15 kg of air are inhaled daily. Thus, with the exception of the skin, the respiratory system has the greatest contact with the surrounding environment.

Respiratory symptoms apart from basic gas exchange may interfere with the ability of a law enforcement officer to function. For example, a severe cough may incapacitate an officer in a critical situation. Respiratory symptoms may also play a role in cardiac disease and the two systems, respiratory and circulatory, are very much interdependent.

Upper airway (nose, mouth, sinuses, and trachea) disorders are usually less severe than lung disorders. However, in some circumstances they may degrade the capacity of a law enforcement officer to perform. Severe allergies and especially sinusitis (which may be accompanied by severe headaches) may result in deterioration of cognitive function because of distraction, inflammation, medication side effects, and interference with sleep.

2.0 OUTLINE OF HIGHLIGHTED CONDITIONS

- Obstructive Disease
- Restrictive Disease
- Mixed Obstructive and Restrictive Disease
- Miscellaneous Conditions

3.0 IMPLICATIONS FOR JOB PERFORMANCE

A pulmonary limitation to exercise may cause serious injury to both the officer and the public. Law enforcement officers engage in vigorous activities requiring above-average degrees of fitness. Oxygen consumption at a level of at least 35 ml O2/kg/min is necessary to perform activities such as competitive soccer, rugby or karate; running at six miles-per-hour, and carrying heavy loads at a level of moderate-to-heavy intensity (Ainsworth, et. al., 2000). Since oxygen consumption in a life-or-death struggle certainly could be much greater than 35 ml O2/kg/min, this value represents a minimal level of fitness.

Depending on the work location, the physician also must consider that the above situations may occur during adverse environmental conditions such as:

High levels of dust, pollutants;

Exposure to allergens in a law enforcement officer who is sensitized to them;

Cold air;

Exposure to toxic substances, which may occur when officers become first responders at toxic spills or fires.

In addition, respiratory symptoms are a major cause of sleep disturbance and sleep apnea is a common secondary problem in lung disease, severe allergies, and sinusitis. Sleep disturbances can significantly degrade a law enforcement officer's cognitive function, showing up as lapses in judgment, short-term memory loss, inability to concentrate, and irritability. Medications used to control respiratory symptoms may help but may also contribute to sleep disturbance.

4.0 MEDICAL EXAMINATION AND EVALUATION GUIDELINES

4.1 History

Use the Medical History Questionnaire. Special attention should be paid to those candidates who have symptoms of pulmonary disease (dyspnea, wheezing, significant cough and/or phlegm production); signs of pulmonary disease (diminished breath sounds, unexplained crackles, chest deformity); history of exposure to toxic materials that may cause chronic respiratory disease (asbestos, diisocyanates, acute and significant exposure to respiratory irritants [as might occur in the military]). Attention should also be paid to candidates with a smoking history. Fifteen percent of cigarette smokers have an accelerated decline in the maximal volume of air exhaled in the first second (FEV_1). Smokers tend to lose 20 to 30 ml of FEV_1 per year, and "sensitive" smokes lose twice that much.

4.2 Physical Examination

General inspection of the candidate should reveal no labored breathing, cyanosis or use of accessory muscles of respiration. These are signs of impaired pulmonary status. The candidate should be able to speak in full sentences without being short of breath. Inspection of the chest and spine should be done to check for any abnormalities such as kyphosis, scoliosis, barrel chest or pectus excavatum. Chest wall excursion should be equal. A standard auscultation exam of the chest should be performed on all candidates.

4.3 Spirometry

Spirometry should be conducted on all candidates. The American Thoracic Society states that spirometry should be performed to assess

health status before beginning strenuous physical activity programs. (ATS, 2005). Candidates with normal spirometry will have FEV_1, FVC and FEV_1/FVC ratio all above the lower limit of normal (LLN). The American Thoracic Society (2005) recommends the use of the LLN instead of the 80% predicted.

See the Addendum for technical issues pertaining to spirometry.

4.4 Chest Radiography

Chest radiographs may have some benefit in routine screening of older candidates who have a history of smoking or exposure to asbestos. However, few candidates are hired who are older than 35 years of age. Therefore, the use of a chest x-ray as a routine screening tool in healthy adults has an extremely low yield, and therefore is not recommended. However, the chest radiograph may provide important information in candidates who have chronic pulmonary symptoms without a specific diagnosis or those with restrictive patterns on a spirometry.

4.5 Exercise Testing (ET)

Routine ETs to assess a potential pulmonary limitation to exercise are not necessary in candidates with no history of pulmonary disease or abnormal spirometry. However, when a pulmonary limitation to exercise is suspected, an ET is an important ancillary tool to help the physician assess the candidate's maximal aerobic capacity. Lack of pulmonary limitations does not obviate the need for exercise testing due to cardiac reasons or for assessment of VO_2 max. All candidates over the age of 40 or those under the age of 40 with two risk factors for heart disease such as smoking, diabetes, hypertension, male gender, high cholesterol, and a family history of heart disease before age 55 should be given an exercise treadmill. See Cardiology chapter for more details.

5.0 EVALUATION OF COMMON CLINICAL SYNDROMES

5.1 Obstructive Disease

Law enforcement candidates with a history of asthma, wheezing in the absence of a respiratory tract infection, or exercise-induced asthma (EIA) require special consideration. Candidates who have a family history of early emphysema and/or liver disease (in the absence of alcohol abuse) may be at risk for a hereditable condition known as alpha-1-antitrypsin deficiency; genetic screening is not advised but persons with such a history should have spirometry performed because they are at increased risk of obstructive pulmonary disease at a young

age.

Similarly, the physician should consider evaluating those who give a history of significant exposure to substances known to cause pulmonary impairment, or a history of symptoms compatible with pulmonary disease.

The key indicator for evaluating obstructive lung disease is the measurement of airflow. On spirometry, this takes the form of the FEV1 (relative to predicted) and the FEV1/FVC percent (relative to the individual's own vital capacity). Because other lung disease can reduce the FVC (restrictive disease) and a reduced lung capacity leads to a reduced FEV1 due to inadequate capacity, the FEV1/FVC ratio is the preferred measure for evaluating airflow if the spirometry is abnormal in any respect.

As previously stated, those individuals with FEV_1, FVC and FEV_1/FVC ratio all above the LLN are considered to have normal spirometry. Individuals with an FEV_1/FVC ratio below the LLN are diagnosed with an obstructive disease. The severity of the obstructive disease can be assessed by the percent predicted FEV_1.

Table 1: Severity of Obstructive Abnormality in Individuals with FEV_1/FVC < LLN

Degree of Severity	FEV_1 percent predicted
Mild	>70
Moderate	60-69
Moderately Severe	50-59
Severe	35-49
Very Severe	<35

Respiratory symptoms that accompany obstructive lung disease may limit capacity. Cough, particularly if it triggers coughing spells, and/or shortness of breath can severely limit the ability of a law enforcement officer to respond or to exert maximal effort in a critical situation.

5.1.1 General Considerations

Obstructive disease can be categorized into two general classes:

Fixed air flow obstruction: Conditions such as emphysema and other forms of chronic obstruction pulmonary disease (COPD) are

characterized by a fixed and relatively non-variable degree of air-flow obstruction. Chronic bronchitis (usually defined as cough and phlegm production for three consecutive months for at least two years) may also be accompanied by COPD. Unless there is a concurrent infection, measurements of lung volumes on a given day are a reliable predictor of volumes on random days.

The major consideration in these candidates is their exercise capacity. Individuals with normal spirometry or mild obstruction (FEV_1 > 70% of predicted) generally would not be expected to have a reduction in exercise capacity. Individuals with moderate obstruction (FEV_1 between 50% and 69% of predicted (as defined by ATS, 2005) should be given a pulmonary exercise stress test, testing for oxygen desaturation, and with pretest and posttest spirometry. Individuals with severe obstruction would not be expected to be able to perform the exercise-critical duties required of a law enforcement officer.

Variable air flow obstruction: Asthma is characterized by large variability in lung volumes and clinical symptoms. It is identified by inconsistency in airflow measured at different times but with consistency on the day of the measurement. On any given day, flow rates and volumes reflect combined influences of a multitude of factors such as compliance with medications, atmospheric conditions, exposure to allergens, air pollutant concentrations, and a recent history of aerobic exercise. Thus, an in-depth individualized assessment, that includes testing on multiple days and record review, is essential before these candidates be allowed to perform patrol officer duties without restriction. Evaluation of these candidates is further complicated by consideration of EIA and medication use.

Exercise-induced asthma (EIA) commonly occurs in individuals with a known history of asthma and in others who may deny asthma, but who have a history of allergies, such as hay fever. EIA can develop in individuals with no other predilection for asthma.

EIA's etiology is not clear; however, a trigger of EIA is thought to be an increase in ventilation of cool and dry air, which occurs in strenuous exercise with mouth breathing. Symptoms of EIA can occur either during or immediately after a period of aerobic exertion of 3-8 minutes (Tan, 1998), and last for at least five minutes to as much as 30 minutes (McFadden, 1995). Symptoms usually subside on their own after exercise.

EIA usually occurs in the same individual as "cold-induced asthma," in which the same symptoms occur at rest or only moderate activity breathing cold air. Severe cold-induced asthma may be a limiting factor

in cold climates but ordinarily the major limitation is reduced exercise capacity, as in EIA.

Depending on its severity, EIA may limit exercise capacity, thus posing a direct threat to the officer and the public. Although it is unusual for very strenuous exercise to last greater than three minutes in any given situation, it is quite possible that such strenuous activity may occur. Furthermore, a law enforcement officer cannot predict when a new situation that might require strenuous exercise might occur.

The clinical significance of EIA can be assessed by history and/or an ET with pre- and post-spirogrametry. Postexercise spirograms should be conducted at 5, 10 and 20 minute intervals. A decrease in FEV1 of more than 10% compared to the baseline is abnormal. However, clinical significance also depends on the absolute value of the FEV1, auscultatory findings, and symptoms. The primary concern is whether the candidate could re-initiate and sustain an exercise level requiring 35 ml O2/kg/min at the time of peak bronchoconstriction and symptoms (ATS, 1999).

Use of medication: Individuals with asthma who use medication can be separated into two broad categories:

1. Those who require pre-exercise medication to prevent EIA. Law enforcement officer candidates must be capable of maximal exertion without warning. Consequently, the use of pre-exercise medication cannot be accommodated.

2. Those who use only regularly scheduled medication (such as salmeterol, which has sustained activity for up to 12 hours) with no as-needed use before or after exercise: In this case, the candidate's past compliance with the prescribed medical regimen and the effectiveness of this regimen are the major determinants of fitness for duty.

5.1.2 Recommended Evaluation Protocol

Individuals with a positive history of obstructive disease, asthma (including EIA), or abnormal spirometry should be carefully interviewed. Specific inquiries should include:

1. Has there been any interference with routine exercise/activities in the last two years due to this condition?

2. Has the individual had to obtain unscheduled medical evaluations in the past two years? Has the individual had to visit an emergency room or be hospitalized for asthma in the past two years? Has the individual required intubation or mechanical ventilation in the past?

3. What are the current medications used, and has the candidate's condition required an increase in the dosage or number of medications in the past two years?

4. Is there use of non-inhaled steroids? (The use of inhaled steroids does not carry the same implications .)

5. What type, intensity, and duration of exercise causes EIA? Is any medication used either before or after exercise? (If an individual denies use of medication, be sure to ask about over-the-counter medications or use of a "friend's inhaler.")

6. Do symptoms only occur with concurrent infections? If so, what is the frequency and duration of these infections?

Positive answers to these questions would indicate considerable variability in the presentation of EIA.

Review of relevant medical and pharmacy records for the past two years is highly recommended.

5.1.3 Disposition

GROUP I: ***OBSTRUCTIVE PATTERN ON SPIROMETRY BUT NEGATIVE HISTORY OF OBSTRUCTIVE DISEASE, EIA, OR MEDICATION USE IN THE LAST 10 YEARS***

Level 1: **Moderate Obstructive Impairment**

A recommendation for unrestricted duty should be based on a reliable history and the ability to complete an acceptable level of exercise without clinically significant EIA. Restrict from these types of job duties if the individual cannot sustain normal job-related activity following vigorous exercise, for example because of excessive and/or distracting panting and/or coughing.

Level 2: **Severe Obstructive Impairment**

Severe respiratory impairment can interfere with performance through inadequate oxygen delivery to tissues, particularly muscles used in exertion, and ultimately to the brain and heart, leading to poor judgment, agitation, drowsiness, reduced concentration, weakness, and an increased demand on the heart which may lead to cardiac effects. It is highly probable that obstruction of this degree will prevent sustained pursuits or survival in a subsequent combative altercation. Therefore, restrict from these types of job duties.

GROUP II: ***ADMITS TO A POSITIVE HISTORY OF OBSTRUCTIVE DISEASE, EIA, OR MEDICATION USE IN LAST 10 YEARS***

The physician should carefully assess the variability of the candidate's disease. In addition to positive answers to the questions above on asthma (including EIA), reduction in FEV_1 of $>10\%$ between the pre- and post- exercise spirometry, when the pre-exercise FEV_1 is itself below 70% of predicted, might also be indicative of variability.

Level 1: Stable disease with no use of pre/postexercise medication during the past two years

Obtain an ET with pre/post spirometry. In general, no restrictions are necessary if the candidate is able to complete an acceptable level of exercise without clinically significant EIA, without use of as-needed bronchodilator medication and the physician believes that an acceptable level of functioning can be maintained during the vast majority of workdays within the next 2-3 years. (The physician has to consider whether the candidate will be able to maintain adequate functioning when exposed to severe environmental/toxic conditions.)

Level 2: Variable disease or need for pre- or post-exercise medication during past two years

In general, ET testing is unreliable in these candidates. Clinically significant variability makes functional assessment on any given day unrepresentative. Similarly, due to the difficulty in detecting whether a candidate has surreptitiously used an inhaler before a

scheduled ET, it is often not possible to reliably predict the severity of Exercise Induced Bronchospasm (EIB) in situations where intense and sustained exercise is required without warning. Given these limitations, the physician will have difficulty certifying that the candidate could sustain a pursuit or survive a subsequent combative altercation.

Restrict from these types of job duties if the individual cannot sustain normal job-related activity following vigorous exercise, for example because of excessive and/or distracting panting and/or coughing.

5.2 Restrictive Disease

5.2.1 General Considerations

Physicians should give special consideration to candidates with a history of a connective tissue disease, interstitial lung disease (including pneumoconiosis and sarcoidosis), scoliosis, or chest wall abnormality capable of causing a restrictive pulmonary defect. Given the relative youth of the most law enforcement candidates, musculoskeletal deformities would be the predominant reason for a reduction in lung capacity. Rarely, interstitial lung diseases affect younger individuals but are not symptomatic (including pneumoconioses and sarcoidosis). The prevalence of restrictive disease is low.

The American Thoracic Society defines restrictive ventilatory defect as having a Total Lung Capacity (TLC) below the lower limit of normal (LLN) and a normal FEV_1/FVC ratio. In the absence of TLC, a restrictive lung defect may be suspected with a decreased FVC, increased FEV_1/FVC ratio above 85%, and a convex pattern on the flow volume curve (ATS, 2005). A decreased FVC does not prove that there is a restrictive defect. If there is no obvious chest or spine deformity, and the FVC is below the LLN, then the physician first must make sure that the spirometry was performed correctly:

1. Are the tracings acceptable and reproducible? See the Addendum for technical issues pertaining to spirometry.

2. Do volume-time curves plateau (show no change) for at least one second at the end of the effort (ATS, 2005)?

3. Are the predicted volumes based on the correct age, height, and ethnicity data?

The physician should be aware that failure to produce three replicate smooth curves on spirometry does not necessarily mean lack of cooperation. This pattern has been associated with a high risk for lung disease and impairment even if the mean pulmonary function is at or near normal.

5.2.2 Recommended Evaluation Protocol

GROUP I: FVC < LLN DUE TO OBVIOUS CHEST WALL ABNORMALITY

Obtain an ET to assess exercise capacity.

GROUP II: FVC < LLN, POSITIVE HISTORY, OR POSITIVE PHYSICAL EXAM THAT IS NOT DUE TO OBVIOUS CHEST WALL ABNORMALITY

Request an evaluation by a pulmonologist that includes a chest radiograph and complete pulmonary function testing to measure total lung capacity (TLC) and diffusion capacity.

Level 1: Normal vital capacity, diffusing capacity, and chest radiograph. Capable of full duty, no work restrictions necessary.

Level 2: No evidence of interstitial disease since diffusing capacity and chest radiograph are normal, but restrictive pattern confirmed by low TLC (ATS, 2005).

Request an ET that includes expired gas analysis and oximetry. A full duty recommendation should be based on the attainment of an oxygen consumption level of at least 35 ml O2/kg/min without oxygen saturation falling below 90%. The latter would indicate inadequate oxygenation of the tissues which would impair sustained effort.

Level 3: **Specific disease diagnosed.**

Base final recommendation on an assessment of current functional ability (see ***Level 2***) consideration of the 2-3 year prognosis for significant progression, and the clinical significance of non-pulmonary manifestations.

5.3 Mixed Obstructive and Restrictive Disease

A mixed ventilatory defect is characterized by the coexistence of obstruction and restriction, and is defined physiologically when both FEV1/VC and TLC are below the 5th percentiles of their relevant predicted values (ATS, 2005).

Individuals may have a combination of an obstructive and restrictive lung defect. These individuals are diagnosed by having both the FEV_1/FVC ratio and TLC below the LLN. In the absence of TLC, FVC below the LLN is suggestive of restrictive lung disease but should be confirmed with complete pulmonary function testing. The recommended evaluation protocol for these individuals should match those previously outlined separately for obstructive and restrictive disease.

5.4 Miscellaneous Conditions

There are many other less common respiratory conditions that require special evaluation. These conditions require careful consideration of the nature, severity, duration, and likelihood of impairment associated with the condition and the demands and conditions of the job.

One of these conditions is the presence of a nodule or "spot" on the lung. Although the principal concern in such cases is whether the nodule represents cancer, non-malignant (non-cancerous) nodules are common and often represent the healed result of old lung disease. They are more common in the mid-west United States and California because of the frequency of benign fungal diseases among residents. Most nodules have no implications for exercise capacity or overall work capacity and risk to others. The exception is nodules that suggest a possible diagnosis of tuberculosis. Such cases require evaluation by tuberculin or other standard TB test to rule out TB as a personal health risk and to ensure the safety of others.

Upper airway (nose, mouth, sinuses, and trachea) disorders are usually less severe than lung disorders and are usually of shorter duration. When severe or when they lead to complications or medication side effects, however, they may degrade the capacity of a law enforcement officer to perform. Severe allergies and especially sinusitis (which may be accompanied by severe headaches) may result in deterioration of cognitive function because of distraction, inflammation, medication side effects, and interference with sleep.

Table 2: Miscellaneous Conditions

Condition	Consider for Disqualification	Consider for Deferral until Condition is more fully Documented
Pneumonia or other infection	1. Acute or active pleuropulmonary infection. 2. Persistent symptoms of a prior pneumonia, despite apparent resolution of the pneumonia on physical examination or chest radiograph.	1. A history of recent resolved pneumonia, occurring less than one month prior to the examination. 2. Active or chronic (defined as longer than one month) antimicrobial therapy for a pneumonia. 3. Residual complications from a recent or old pleuropulmonary infection, such as empyema, abscess, lobar atelectasis, lung cavity, bulla or bleb.
Tuberculosis	1. Active tuberculosis not under therapy, or active tuberculosis under therapy but deemed infectious by a pulmonary specialist. 2. Positive skin test with no known history of exposure or BCG, until a complete work up is concluded.	1. Active tuberculosis currently under therapy, and deemed to be noninfectious by a pulmonary specialist. 2. Positive skin test with no known history of exposure or BCG, after complete work up.
Spontaneous pneumothorax	1. Candidates with pneumothorax noted on a current or last available chest radiograph should be disqualified and should remain disqualified until the pneumothorax is completely resolved and a normal post-pneumothorax spirometry has been provided.	1. A candidate with a history of two or more pneumothoraces must be disqualified until the condition is fully evaluated by an appropriate specialist. 2. A candidate with a history of secondary spontaneous pneumothorax should be evaluated according to the severity and prognosis of the underlying lung disease.

6.0 ADDENDUM

6.1 Technical Issues in Spirometry

In performing spirometry, attention to detail is important. All technicians must be trained in the proper calibration and administration of the test as specified in the spirometry standards of the for quality control purposes (ATS, 2005) In order to have meaningful spirometry, the test needs to be both acceptable and reproducible. A summary of acceptability and reproducibility criteria can be found in the 2005 ATS *Standardization for Lung Function Testing* document. An adequate spirometry test requires a minimum of three acceptable FVC maneuvers. After three acceptable FVC maneuvers are obtained, then repeatability needs to be assessed. The two largest FVC values should be within 0.150 L of each other and the two largest FEV_1 values should be within 0.150 L of each other. If these criteria are met, then testing can be concluded. However if they are not, then testing should continue, but will usually not exceed eight trials.

Caution must be taken to ensure that predicted values are based on correct age, height, and ethnicity data before interpretations are made. All candidates except for African-Americans should be entered as "Caucasians." If the spirometry does not correct for ethnicity, the predicted volumes for African-Americans should be lowered by 10-15%. Automated spirometry machines make this correction. Recently, however, this "universal correction" has been questioned (Hankinson, Kinsley, & Wagner, 1996). At the present time, Latinos and Asians are entered as Caucasians.

To both interpret the and assess compliance, it is helpful to know if the candidate used any medication on the day of the test.

Values for the FVC and FEV_1 of 80% predicted and an FEV_1/FVC ratio of 70% are generally considered to be at the lower limit of normal (LLN). However, ATS recommends use of the LLN over percent predicted (ATS 2005). If these volumes are normal, spirometry parameters which measure low-volume flow rates (FEF 25-75, FEF 75) may still indicate small airways obstruction, especially in smokers. However, these measurements have no established relationship to functional exercise capacity and are very unreliable. If volumes are below normal, it is important to inquire about respiratory infections over the last six weeks, since these can cause lingering abnormalities.

7.0 REFERENCES

Ainsworth, B.E., et. al. (2000). Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exer,* 32, 9, S498-S516.

American College of Occupational and Environmental Medicine, (2000). Spirometry in the Occupational Setting. *JOEM*, 32, 238-245.

American Thoracic Society, (1999). Guidelines for methacholine and exercise challenge testing. *Am J Respir Crit Care Med*, 161, 309-329.

American Thoracic Society/European Respiratory Society. (2003). Standards for the diagnosis and management of individuals with alpha-1 antitrypsin deficiency. *Am J Respir Crit Care Med,* 168, 7, 818-900.

American Thoracic Society/European Respiratory Society (2005). Standardization of Lung Function Testing: Interpretative Strategies for lung function tests. *Eur Respir J*, 26, 948.

American Thoracic Society (1999). Immunobiology of asthma and rhinitis. *Am J Respir Crit Care Med*, 160. 5 Pt-1, 1778-87.

American Thoracic Society (1998). Health outcomes research in sleep apnea. *Am J Respir Crit Care Med*, 157, 1, 335-41.

Chan-Yeung, M. (1990). State of the art - occupational asthma, *Chest*, 98, 148S-161S.

Crapo, R.O. (1994). Pulmonary function testing. *NEJM*, 331, 25-35.

Hankinson, J.L., Kinsley, K.B., & Wagner G.B. (1996). Comparison of spirometric reference values for Caucasian and African American blue-collar workers. *JOEM*, 38, 137-143.

McFadden, E.R. (1995). Exercise-induced asthma. *Clinics in Chest Med*, 16, 671-682.

Tan, R.A. & Spector, S.L. (1998). Exercise-induced asthma. *Sports Med*, 25, 1-6.

CARDIOVASCULAR SYSTEM

1.0 INTRODUCTION

Although overall mortality has declined, cardiovascular disease continues to be the leading cause of death in the U.S. accounting for about 35% of all deaths in 2005, which is approximately one of every 2.8 deaths (American Heart Association, 2008). Most of these deaths are due to coronary artery disease, accounting for one of every 5 deaths. Overall prevalence of cardiovascular disease of cardiovascular disease is 37.1% in the U.S in 2005. There are many known risk factors for coronary artery disease including family history, dyslipidemia, hypertension, smoking, diabetes, obesity, and a sedentary life-style (American Heart Association, 2008). This section will deal with coronary artery disease as well as other types of heart disease including valvular heart disease, cardiomyopathies, pericardial diseases, congestive heart failure, peripheral vascular disease and arrhythmias.

Cardiovascular conditions can cause sudden loss of consciousness putting others at risk or interfere with exercise tolerance as in climbing or working in confined spaces. Some cardiovascular conditions, if they become acute, can require immediate emergent medical care or medical evacuation, neither of which may be available, particularly in remote locations and/or in severe weather.

Careful assessment is required to ensure candidates are free of any cardiovascular condition which puts themselves or others at risk.

2.0 IMPLICATIONS FOR JOB PERFORMANCE

2.1 Physical Demands

The law enforcement officer job has a variety of physically and emotionally demanding duties that have a significant impact on cardiovascular functioning. Law enforcement officers engage in vigorous activities requiring above-average degrees of fitness and cardiovascular reserve (See Endocrine Section).

2.2 Working Conditions

Consideration of working conditions during placement include:

High Temperatures - Peripheral dilation of vessels to improve radiant heat loss may increase demand on cardiac output/stamina.

Low Temperatures - Temperature maintenance is a significant contributor to metabolic needs, e.g. shivering is a significant exercise. The increase in peripheral vascular resistance and blood pressure, results in an higher myocardial work requirement.

Noise - Loud noise is associated with an increased prevalence of cardiovascular disease, typically at a level above 65-70 dB (Babisch 2000, 2006 & van Kempen, et al., 2002). This may occur through an increase in blood pressure, since there is an increase in hypertension with occupational and air traffic noise exposure (van Kempen, et al., 2002).

Irregular Work Hours - Shift work has been related to a small increase in cardiovascular risk. The longer the exposure the greater the risk.

Violent Persons - Endurance and muscular strength is required in subduing violent and aggressive individuals.

3.0 ESTIMATING AEROBIC CAPACITY

An important factor in determining an individual's ability to perform a job in terms of cardiac requirements is stamina or functional aerobic capacity. This is usually approximated by measuring work done on an exercise test. The level of work is measured in metabolic equivalents (METS). One MET is roughly equivalent to 3.5 ml O_2/kg/min. To estimate maximal oxygen consumption, or VO_2 max, multiply METS by 3.5. For example, 10 METS equals a VO_2 max of 35 ml O_2/kg/min. Aerobic capacity can be estimated by history, observing a brief period of exercise (such as stair climbing or loading bags), or formal exercise testing. In most cases actual oxygen uptake will not be directly measured but rather estimated as direct measurement is invasive. Tests include various treadmill, bicycle, and step protocols using either duration of exercise, heart rate response, heart rate recovery, or a combination of these to determine estimated VO_2 max.

It is important to estimate the stamina requirements associated with

each job. Data are available for specific job tasks as to the oxygen uptake required for those tasks. The actual job may also be rated by workers as to the level of physical abilities required using validated rating scales to determine the level of ability necessary for task performance (Fleishman & Mumford, 1991).

The aerobic capacity needed to perform law enforcement tasks such as wrestling can easily be 35 ml/kg/min., or 10 METS. In fact, extremely vigorous activities, such as pursuit and combat with multiple suspects, or running up an embankment or several flights of stairs, may require an even higher degree of aerobic capacity (Ainsworth, et al., 2000).

The amount of time that a person can continuously perform work at a given oxygen requirement depends upon the percent of the person's VO_2 max needed to do the job and his/her state of conditioning. The average person can work at his/her VO_2 max for approximately 1-3 minutes, at 80% of his/her VO_2 max for 15-30 minutes, and at 50% of his/her VO_2 max for eight hours. An individual's oxygen requirements must be considered in light of the fact that physically demanding law enforcement officer activities have been found to be in excess of two minutes in duration.

The Bethesda Conference on Cardiovascular Disease in Athletes assigned to each cardiovascular condition a set of dynamic (aerobic) and static (strength) limitations of performance (Kaplan, et al., 1994). In this way, an athlete could be limited from competition if the demands of his/her sport exceeded the limits assigned to his/her condition. The National Fire Protection Association has adapted these guidelines in determining fitness for duty for firefighters in its *Medical Requirements for Firefighters* (NFPA, 2007).

The physical demands of law enforcement officers can be described along the same lines as the demands of both athletes and firefighters. These aerobic and strength demands would be classified as high, as are wrestling, karate, boxing, and gymnastics. This breakdown allows the assignment of acceptable levels of cardiovascular disease compatible with safe and effective performance of the essential functions of the job. Finally, the American Heart Association set forth a consensus document regarding recommendations for individuals with genetic cardiovascular diseases (GCVD) including hypertrophic cardiomyopathy, long QT syndrome, Marfan's syndrome, Brugada syndrome and arrhythmogenic right ventricular cardiomyopathy (Maron, et al., 2004, Maron, 2007). It is estimated that GCVD accounts for 40% of sudden death in young athletes.

3.1 Exercise Testing

Ergometers are the preferred tool in evaluating an individual's functional aerobic capacity. The cycle ergometer is usually less expensive, occupies less space, makes less noise than a treadmill. Upper body motion is usually reduced, making it easier to obtain blood pressure measurements and to record the ECG. The fatigue of the quadriceps muscles in patients who are not experienced cyclists is a major limitation, however, because subjects usually stop before reaching their maximum oxygen uptake (Fletcher, et al., 1995). As a result, treadmills are much more commonly used for exercise testing.

Several exercise or stress tests are available and use a number of protocols. The exercise is usually increased gradually or in steps and terminated if symptoms occur or, for submaximal tests, after reaching a predetermined target exercise level. Maximal tests continue to exhaustion if no symptoms occur.

Recommendations for exercise testing equipment have been published by the American College of Sports Medicine (2006) and the American College of Cardiology/American Heart Association (Gibbons 2002). These guidelines should be used in conjunction with *Guidelines for Clinical Exercise Testing Laboratories* (Pina, et al., 1995). These guidelines are intended to apply to all laboratories that conduct graded exercise tolerance testing for adults to maximal or near maximal levels.

It is recommended that all applicants undergoing exercise tolerance tests sign an informed consent form. Such forms should be consistent with appropriate state and local laws governing consent.

3.2 Psychological stress

Psychological stress probably is a causative factor in angina, arrhythmias, and sudden death. Schiffer and his colleagues have shown that treadmill exercise testing is more sensitive than psychological testing in eliciting angina pectoris, ischemia, ST-segment depression and ventricular ectopic activity (Schiffer, et al., 1976). Since there is not a valid or reliable way to test the effect of stress, the exercise test should be used as the best reflection of the potential for psychological stress to produce significant cardiovascular abnormalities.

4.0 OUTLINE OF CONDITIONS COVERED

The cardiovascular system can be divided into the following groups of disorders to facilitate consideration of functional capacity and the ability to perform the duties of a law enforcement officer.

- **Arrhythmias**

  Sinus Bradyarrhythmias, Atrial Flutter and Fibrillation, Multifocal Atrial Tachycardia, Paroxysmal Supraventricular Tachycardia (PSVT), Wolff-Parkinson-White (WPW) Syndrome, Ventricular Premature Contractions (VPC), Ventricular Tachycardia, Heart Block, Bundle Branch Block, Long QT syndrome (LQTS), Brugada Syndrome, Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT), Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC), Pacemaker.

- **Valvular Disease**

  Mitral Valve Prolapse, Mitral Stenosis and Regurgitation, Aortic Stenosis and Regurgitation, Tricuspid Stenosis and Regurgitation, Multivalvular Disease, Valve Replacement.

- **Cardiomyopathy**

  Dilated, Hypertrophic cardiomyopathy (HCM)

- **Inflammatory Disorders**

  Myocarditis, Pericarditis

- **Coronary Artery Disease**

  Coronary Artery Bypass Graft, Angioplasty, Stent, Myocardial Infarction, Angina

- **Thrombophlebitis**

- **Lymphangitis & Lymphedema**

- **Arteritis**

- **Vascular Disease**

  Peripheral Vascular Disease, Marfan's Syndrome

- **Hypertension**

5.0 MEDICAL EVALUATION AND EXAMINATION GUIDELINES

Candidates with heart disease must be individually considered to determine their diagnosis, prognosis, risk for sudden incapacitation, and functional capacity. This information should be evaluated to determine if candidates can perform law enforcement officer duties in a safe and efficient manner without exacerbating their cardiac condition.

5.1 History

The Medical History Questionnaire should be used. Syncope, chest pain, dizzy spells or loss of balance, and other symptoms of cardiovascular disease require complete evaluation to determine cause and risk of recurrence.

5.2 Physical Examination

Vital signs are discussed in the next section. The physical examination should include an evaluation for signs of congestive heart failure (e.g., edema, rales, and increased jugular venous pulse), assessment of the heart sounds and rhythm, and a characterization of all supplemental sounds and murmurs. The carotid arteries should be auscultated for bruits. Palpation of peripheral pulses in all extremities for abnormalities is vital. Extremities should be examined for clubbing, cyanosis and capillary refill.

5.3 Routine Tests

All candidates should have their blood pressure (BP) measured in the sitting position. The equipment, whether aneroid, mercury, or electronic, should be regularly inspected and validated. Candidates should be seated quietly for at least five minutes in a chair (rather than on an examination table), with feet on the floor, and arm supported at heart level. Caffeine, exercise, and smoking should be avoided for at least 30 minutes prior to measurement. Measurement of BP in the standing position is indicated periodically, especially in those at risk for postural hypotension, prior to necessary drug dose or adding a drug, and

in those who report symptoms consistent with reduced BP on standing. An appropriately sized cuff (cuff bladder encircling at least 80% of the arm) should be used to ensure accuracy. At least two measurements should be made and the average recorded. For manual determinations, palpated radial pulse obliteration pressure should be used to estimate systolic blood pressure (SBP); the cuff should then be inflated 20 to 30 mm Hg above this level for the auscultatory determinations; the cuff deflation rate for auscultatory readings should be 2 mm Hg per second. SBP is the point at which the first of two or more Korotkoff sounds is heard (onset of phase 1), and the disappearance of Korotkoff sound (onset of phase 5) is used to define diastolic blood pressure (DBP), (Cheitlin, 2003).

All candidates over the age of 40 or those under the age of 40 with two risk factors for heart disease such as smoking, diabetes, hypertension, male gender, high cholesterol, and a family history of heart disease before age 55 should be given an exercise treadmill.

All candidates should have a resting EKG and comprehensive metabolic panel including lipids, ideally fasting, to identify those in need of life-style modification to delay onset of cardiovascular disease. While routine tests should not be used to qualify or disqualify candidates, they are useful in determining the need for exercise testing and life-style modification.

6.0 EVALUATION OF COMMON CLINICAL SYNDROMES

Individuals with cardiovascular disorders or those with abnormal findings usually present a clear picture of the types of activity that can or cannot be performed. Work and recreational activity should be discussed completely to determine whether symptoms are present at rest or with activity. The time of occurrence, intensity, duration, frequency, and the type of activities should be documented. Recent medications may have side effects which should be considered. Cardiac medications may cause dizziness, paresthesia, incoordination, change in mental status, or weakness and fatigue (Kruyer & Hickman, 1990). Beta blockers may affect maximal exercise capacity and compromise performance during a critical incident.

Candidates with a known cardiovascular disorder must submit copies of medical records for review. Date of onset and progression of the disorder, response to treatment(s), and examples of functional ability are often available from these records.

When baseline testing presents abnormal results without concomitant symptoms, risk factors for cardiac disease such as smoking, diabetes, hypertension, hyperlipidemia, and family history of heart disease before age 55 should be reviewed.

Note: In cases where a standard exercise EKG is not helpful (such as when LBBB or LVH are present, or when the exercise EKG is ambiguous) a Thallium or nuclear stress treadmill should be performed.

Some or all of the following tests should be considered to determine functional ability:

Echocardiography: Valvular disease, decreased ejection fraction, hypertrophy, or chamber enlargement confirms the presence of significant cardiovascular disease that will limit the candidate's ability to safely engage in strenuous activities. A 2-D echocardiogram with color flow doppler may be helpful in determining the functional significance of valvular abnormalities.

Holter monitor (24 hr.): No complex arrhythmia or arrhythmia that may be associated with fatigue, dizziness or loss of functional ability should be found. Candidates with frequent premature beats require diagnostic testing to establish the cause of the arrhythmia and to determine functional limitations and therapeutic regimen.

Exercise 2D Echo: An echocardiogram can be combined with an exercise stress test with the ultrasound performed before and at peak exercise. Exercise echocardiography has good sensitivity and specificity for myocardial ischemia (decreased E.F. segmental wall motion changes) (Nedeljkovic, et al., 2006).

Electrophysiologic Study: Symptomatic arrhythmias or conditions such as WPW may require specific study to determine the nature of the arrhythmia and the risks posed by the condition.

Cardiac Catheterization: Catheterization study may be required to demonstrate patent arteries to all regions of the heart when other studies are not diagnostic, when history suggests intermittent spasm, or when there is a history of coronary disease or previous surgery.

Table 1: Relationship of METS and Functional Class According to Five Treadmill Protocols

METS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Bruce	3 Minute Stages															
MPH				1.7 mph		2.5 mph		3.4 mph				4.2 mph				
Percent Grade				10%		12%		14%				16%				
Balke			3.4 Miles Per Hour													
Percent Grade				2%	4%	6%	8%	10%	12%	14%	16%	18%	20%	22%	24%	26%
Modified Balke	2.0 miles per hour		3.0 Miles Per Hour													
Percent Grade	0%	0%	0%	2.5%	5%	7.5%	10%	12.5%	15%	17.5%	20%	22.5%	25%			
Modified Naughton	2.0 Miles Per Hour						3.0 Miles Per Hour									
Percent Grade	0	1.5%		3.5%	7%	10.5%	7.5%	10%	12.5%	17.5%	20%	22.5%	25%	25%		
USAFSAM	2.0 Miles Per Hour			3.3 Miles Per Hour												
Percent Grade		0%	0%	0%	0%	5%	5%	10%	10%	15%			20%		25%	
VO_2 Consumption (ml/kg/min	3.5	7	10.5	14	17.5	21	24.5	28	31.5	35	39.5	42	45.5	49	52.5	56
Clinical Status	Symptomatic Patients															
		Diseased - Recovered, Limited														
			Sedentary Healthy													
				Physically Active Subjects												
Functional Class	4	3		2			I and Normal									

6.1 Arrhythmias

6.1.1 Recommended Evaluation Guidelines

Sinus Bradycardia and Sinus Pauses: Candidates are acceptable if there is no history of syncope. If impaired consciousness occurred more than six months ago, the candidate is acceptable. Candidates who are symptomatic with exercise should be rejected. A six-month waiting period is reasonable with respect to recurrence.

Atrial Flutter: Accept if no recurrence for six months. A six-month waiting period is reasonable with respect to recurrence.

Atrial Fibrillation: Accept if there is no structural heart disease and exercise ventricular rate increases appropriately; With structural heart disease, accept based on exercise heart rate and criteria for heart disease. Exercise heart rate must be adequate to achieve a workload necessary for the aerobic demands of the job.

Multifocal Atrial Tachycardia: Candidates should be rejected since this condition is nearly always associated with serious underlying disease.

Paroxysmal Supraventricular Tachycardia (PSVT): Accept if treatment prevents recurrences; accept if asymptomatic and episodes during exercise last less than 10 seconds since this should not impair consciousness.

Wolff-Parkinson-White Syndrome: Accept if there is no history of palpitations or tachycardia; accept with history of AV tachycardia or atrial fibrillation if no history of syncope or presyncope and if inducible atrial fibrillation rate is less than 240; accept if ablation of pathway is successful for at least 6 months. A six-month waiting period is reasonable with respect to recurrence.

Ventricular Premature Contractions (VPC): Accept if no structural heart disease and asymptomatic; reject with structural heart disease.

Ventricular Tachycardia: Accept if no structural heart disease, the rhythm is non-inducible, and last the episode was more than 6 months ago; reject if structural heart disease; reject if implantable automatic cardiac defibrillator is present. A six-month waiting period is reasonable with respect to recurrence. With underlying heart disease or if the

rhythm is inducible, there is a significant risk of sudden incapacitation, even with treatment. With an implantable defibrillator, there can be impaired consciousness.

1 Degree and 2 Degree, and Type I AV block: Accept if asymptomatic.

2 Degree, Type II, congenital 3 Degree AV block: Accept if there is no history of syncope, ventricular rate is > 40, and the QRS is narrow. These factors suggest a more stable block, with less chance of development of 3 Degree AV block with impaired consciousness.

3 Degree AV Block, acquired: Reject. Exercise heart rate will be inadequate for job demands.

Right Bundle Branch Block (RBBB), Left Bundle Branch Block (LBBB): Accept if asymptomatic.

Prolonged QT syndrome, congenital: Reject. There is a significant risk of impaired consciousness.

Brugada syndrome: Reject. Vigorous physical activity is not recommended.

Catecholaminergic Polymorphic Ventricular Tachycardia (CPVT): Reject. Vigorous physical activity is not recommended.

Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC): Reject. Vigorous physical activity is not recommended.

Pacemaker: The risk from electromagnetc radiation or mobile phone transmission is small, however, the risk of pacemaker failure due to trauma is significant. Reject, if pacemaker dependent.

6.2 Valvular Diseases

It is occasionally necessary to recommend that asymptomatic individuals with heart disease limit their activities to those that require no more than moderate dynamic or static exertion (6 METS) (Cheitlin, et al., 1985).

Asymptomatic individuals require testing to determine their functional capacity and associated risks. Echocardiography might reveal progression of valvular disease. Ambulatory monitoring may show

significant cardiac arrhythmias, and cardiac stress testing may reveal inappropriate blood pressure response, arrhythmia, cardiac ischemia, or poor physical conditioning.

Mitral Valve Prolapse Symptoms may include palpitations, fatigue, dyspnea, syncope, atypical chest pain, and episodes of supraventricular tachycardia. A small proportion of patients experience CVAs, TIAs, seizures, or episodes of amaurosis fugax. Patients with severe myxomatous change and thickened leaflets are at greatest risk of embolic events. It is estimated that 4,000 patients die from MVP-associated sudden death per year. Men and patients over 45 years of age are at increased risk for complications such as infective endocarditis and severe mitral regurgitation. Fifteen percent (15%) of patients with MVP will go on to develop mitral regurgitation with heart failure and may need to undergo surgical valve replacement.

Mitral Stenosis: Accept if the pulmonary artery pressure is less than 50 mm Hg, and the valve orifice is greater than $1.1 cm^2$. In addition, no anticoagulation with Warfarin is permissible.

Mitral Regurgitation: Accept if there is no or mild left ventricular enlargement and normal left ventricular function.

Mitral Valve Prolapse: Accept if there is no arrhythmogenic syncope, family history of sudden death due to Mitral Valve Prolapse, complex ventricular tachyarrhythmias, especially with exercise, or history of embolus, and the criteria met for mitral regurgitation.

Aortic Stenosis: Accept if the aortic valve gradient is less than 40 mm Hg and the left ventricular ejection fraction is normal.

Aortic Regurgitation: Accept with moderate insufficiency and moderate left ventricular enlargement if the left ventricular ejection fraction is normal.

Tricuspid Regurgitation: Accept if the right atrial pressure is less than 20 mm Hg and the right ventricular pressure and size are normal.

Tricuspid Stenosis: Accept if asymptomatic.

Multivalvular Disease: Accept based on passing all separate criteria.

Valve Replacement. - Accept if left ventricular ejection fraction is normal and there is no anticoagulation with Warfarin.

6.3 Cardiomyopathy

The New York Heart Association system (1964) for classifying cardiovascular diseases includes functional classifications.

Table 2: New York Heart Association Cardiovascular Functional Classification System (1964)

Class I	Ordinary physical activity does not cause fatigue, palpitation, dyspnea or anginal pain. Maximum oxygen consumption is 24.5 ml or more O_2/kg/min.
Class II	Cardiac disease results in slight limitation of physical activity. Maximum oxygen consumption is 17.5 ml to 24.5 ml O_2/kg/min.
Class III	Cardiac disease results in marked limitation of physical activity. Maximum oxygen consumption is 7 ml to 17.5 ml O_2/kg/min.
Class IV	Cardiac disease results in inability to do any physical activity without discomfort. Maximum oxygen consumption is less than 7 ml O_2/kg/min.

As indicated in this table, functional classes II - IV are symptomatic with activity. Therefore, individuals falling within these classification ranges would be unable to safely perform the more strenuous law enforcement officer activities (e.g., subduing combative subjects, running up stairs). For example, the functional classification (representing the heart's ability to deliver an adequate amount of oxygenated blood to the body) indicates that those in Class II are unable to perform activities that require a maximum oxygen consumption of more than 22 ml O_2/kg/min. (6 METS). Since activities such as wrestling require performance at a level of 10 METS or greater, a Class II individual would be unable to safely perform these activities (Sidney & Blumchen, 1990).

HCM or IHSS is an important cause of sudden death in young adults. It is recommended that individuals with this condition limit their activities to those equivalent to low intensity sports (3-4 METS) (Kaplan, et al., 1994).

6.3.1 Recommended Evaluation Guidelines

Hypertrophic Cardiomyopathy (HCM) also known as Idiopathic Hypertrophic Subaortic Stenosis (IHSS) or Hypertrophic Obstructive Cardiomyopathy (HOCM): Not acceptable. Vigorous physical activity is not recommended.

Dilated Cardiomyopathy: Acceptable if Class I (NYHA), and meets all criteria for CAD and arrhythmias.

6.4 Inflammatory Disorders

6.4.1 Recommended Evaluation Guidelines

Myocarditis: Defer until six months after onset. Acceptable if no unacceptable arrhythmias and normal left ventricular ejection fraction.

Pericarditis: Defer until no evidence of active disease by history, examination, and ECG. Unacceptable if constrictive pericarditis.

6.5 Coronary Artery Disease

6.5.1 Recommended Evaluation Guidelines

Coronary Artery Disease: Acceptable if normal left ventricular ejection fraction, exercise tolerance of at least 10 METS, no unacceptable exercise-induced arrhythmias, no exercise-induced ischemia, and no coronary artery obstructions greater than 50% luminal diameter. This applies whether or not revascularization has occurred.
Candidates with cardiovascular disease must be symptom-free to perform the more strenuous job duties of a law enforcement officer. Moreover, even asymptomatic individuals with cardiovascular disease may be found to lack the physical capacity to perform the required job duties, or may be therapeutically restricted from performing maximal physical activities.

Therefore, it is imperative to use functional testing to ensure that job-related physical activities can be performed in a manner safe to both the individual and the public.

For candidates with angioplasty or coronary bypass surgery, the candidate may be evaluated for fitness to work six months post-surgery.

Medical records, including the surgical and medications history, should be obtained. The candidate should be Class I (NYHA), have normal blood pressure, and be certified by a cardiologist as successfully demonstrating completion 10 METS on a graded exercise test without evidence of ischemia. Periodic (annual) reevaluation of these individuals should be required.

6.6 Thrombophlebitis

Varicose Veins: - Varicose veins are those that are abnormally dilated due to congenitally weak valves. Varicose veins become dilated when these one way valves in the veins break down and allow the blood to pool instead of returning to the heart at a normal rate. The prominence, dilation and tortuosity of varicose veins in the lower extremities are increased by long periods of motionless standing, sitting or pregnancy.

Thrombophlebitis of the superficial veins: This inflammation is due to blood clots in the veins. Thrombophlebitis of the superficial veins is common in varicose veins of the legs. Obesity, dehydration, and immobility may precipitate an episode of thrombophlebitis. The skin over the veins becomes red and tender. The condition in the superficial veins usually resolves without any serious complications.

Thrombophlebitis of the deep veins: This thrombophlebitis is characterized by pain in the calf, groin, thigh or back of the knee. Fever and elevation of white blood cell count are often present. Once the valves of deep veins with thrombophlebitis are damaged they become incompetent, which results in the development of superficial varicose veins. Pulmonary embolism is a serious complication of deep vein thrombophlebitis.

Skin discoloration (brown): Itching, redness, and scaling of the skin indicate inadequate return of blood from the affected extremity to the central circulation. Chronic edema may signify prior deep vein thrombophlebitis with residual venous incompetence.

6.6.1 Recommended Evaluation Guidelines

Accept if asymptomatic and no history of deep venous thrombosis.

6.7 Lymphangitis & Lymphedema

Lymphangitis: Acute lymphangitis is characterized by red streaks along the course of the lymphatics and is usually the result of skin infection.

Lymphedema: Lymphedema is a collection of abnormally large amounts of lymph fluid in a particular part of the body. This usually occurs because of damage to the lymph vessels which drain the fluid.

6.7.1 Recommended Evaluation Guidelines

Accept if asymptomatic.

6.8 Arteritis

Arteritis: An arteritis is a condition in which the walls of the arteries are inflamed. Arteries in any part of the body may be affected by several types of arteritis, often seen as a component of an autoimmune disease.

Vibration Induced Arterial Disease: - Vibration may induce spasms of the arteries of the digits, accompanied by pain and pallor. The resulting changes may become chronic.

Aneurysmal Disease: Aneurysms are bulging dilated segments of blood vessels. Small asymptomatic aneurysms of the peripheral vascular system may go undetected and will not often interfere with one's ability to work. An aneurysm that is significantly enlarged or causing symptoms should be evaluated by a physician for possible treatment prior to job placement.

6.8.1 Recommended Evaluation Guidelines

Any prior arteritis or aneurysm needs thorough evaluation. Accept if asymptomatic and no chronic arteritis exists. Reject if systemic arteritis exists.

6.9 Vascular Diseases

Peripheral Vascular Occlusive Disease (PVOD): Frequently, the inside diameter of the arteries becomes smaller with aging. Other factors, such as smoking, diabetes mellitus, hypertension, high cholesterol, high triglycerides, and genetic predisposition may accelerate the shrinking of the inside diameter of the arteries. This process of narrowing is called

atherosclerosis. When the inside diameter becomes too small, the blood supply and oxygenation to a particular part of the body becomes inadequate. This is known as peripheral vascular occlusive disease when it involves body parts other than the heart, lungs, or brain.
An extremity affected by PVOD may become painful during exercise as the muscles do not receive sufficient oxygen. The pain is known as intermittent claudication, and it is often the first symptom of arteriosclerosis. Ulceration, gangrene and delayed healing are common and serious complications of PVOD. Prevention of such complications requires avoidance of trauma.

Marfan's Syndrome: Marfan's syndrome is a congenital condition where there is a defect in the connective tissue. Marfan's syndrome affects multiple body parts, including the heart valves and aorta, and are predisposed to cardiovascular problems. Symptoms can include shortness of breath, dizziness, chest pain, palpitations. These can happen due to valvular prolapse, aortic dilatation or dissection. During intense physical activity, the stress placed on the aorta can promote aortic enlargement (Maron, et al., 2004; Maron, 2007).

6.9.1 Recommended Evaluation Guidelines

Careful identification of peripheral arterial pulses, their amplitudes and pressures, is useful in grading peripheral arterial conditions. Pulses may be diminished in any affected extremity (arm or leg). The blood pressure in an extremity can be carefully mapped by using a blood pressure cuff of the appropriate size and a doppler device. The blood pressure in a diseased artery will be lower than expected, and the degree of reduction of the blood pressure is an approximate indication of the degree of narrowing of the inside diameter of the artery.
Palpation and auscultation for bruits of the cervical carotid arteries may reveal disease in these arteries. Individuals with disease of the carotid arteries may present with fainting, transient ischemic attacks, or small strokes and should be evaluated under the Neurological System.

Marfan's Syndrome: Reject. Vigorous physical activity is generally not recommended, even in patients with no or mild aortic dilatation on echocardiogram, due to the risk of worsening aortic enlargement. The diagnosis of Marfan's syndrome is made with the combination of a family history of Marfan's syndrome, examination of the musculoskeletal system for extremity/trunk ratio, slit lamp examination by ophthalmologist and an echocardiogram. A consultation with a medical geneticist may be required.

6.10 Hypertension

Hypertension is defined as a resting blood pressure greater than or equal to 140 mm Hg systolic pressure or greater than or equal to 90 mm Hg diastolic pressure. The classification of BP for adults aged 18 and older is based on the average of two or more properly measured, seated BP readings on each of two or more office visits. The degree of hypertension is defined by the systolic or diastolic readings as shown in Table 3 (Joint National Committee, 2003).

Table 3: Blood Pressure Classification System

BP Classification	SBP mm HG	DBP mm HG
Normal	<120	and <80
Pre-hypertension	120-139	or 80-89
Stage 1 hypertension	140-159	or 90-99
Stage 2 hypertension	≥160	or ≥100

Stressors. Certain psychological situations and physical activities are particularly dangerous for the hypertensive individual. Job stress, such as situations in which the individual is "caught in the middle" may produce or exacerbate high blood pressure (Ely & Mostardi, 1986). Physical activities that demand repeated high levels of static strength until fatigue halts the activity can produce acute blood pressure elevations and, when left ventricular dysfunction is present, can result in serious cardiac dysrhythmias. Blood pressure elevations can be more extreme and sustained for those with hypertension than or the non-hypertensive under the same circumstances (Zabetakis, 1984).

Strenuous activities, such as pushing vehicles, lifting heavy objects, moving incapacitated persons, and subduing combative subjects are likely to worsen hypertension (Mustacchi, 1990). Situations that cause a threat to life, fear of severe bodily harm, serious confrontational situations, and/or responsibility for the life and welfare of others are among those that have been identified as maximally stressful to individuals (Graham, 1945).

Complications: The complications of hypertension can be severe and even fatal. Severe hypertension can cause cerebral edema, headache, vomiting and stroke. The degree of hypertension can rapidly progress

to severe levels as a result of physical or mental stress. Aggravation of hypertension can cause irreversible and rapidly progressing damage to the arteries of the heart, brain or kidneys, leading to heart attack, stroke or kidney failure.

The prognosis of untreated hypertension is extremely poor. Mortality is increased with the severity of hypertension. The average diastolic blood pressure in men at age 45 years is 78 mmHg. The mortality rate of this group is 300% greater than normal if average pressure is elevated to 152/95 (Stage 1 hypertension) and remains untreated. Blood pressure, rather than age, appears to be a more significant factor in the mortality rate. By the time a typical hypertensive individual develops complications, he/she has already survived three-fourths of his/her hypertensive life span.

It has been demonstrated, however, that treatment of even mild hypertension makes dramatic changes in prevention of major morbidity and mortality from stroke, heart disease, kidney failure, and retinal disease.

Medications: Use of antihypertensive medications commonly produces side effects that vary in nature and severity. Multiple effects may be experienced by an individual as additional medications are required to achieve control (Croog, et al., 1986). Commonly experienced side effects include sleepiness, fatigue, dizziness, cough, severe nasal stuffiness, blurred vision, gout or hypotension from over treatment (Schoenberger, et al., 1990). Problems of control result from patients discontinuing medication because of side effects. Additionally, mild to moderate hypertension is often asymptomatic, leading many individuals to discontinue medication or to ignore other treatment programs (Cramer, et al., 1989).

Secondary hypertension is rare: nevertheless evaluation should seek to eliminate this possibility. Additional diagnostic procedures may be indicated to discover secondary hypertension (e.g. renal parenchymal disease, renovascular disease, coarctation of the aorta, primary aldosteronism, Cushing's syndrome, or pheochromocytoma). Applicants demonstrating evidence of complications should be considered unacceptable for safety classifications that are legally presumed to aggravate heart disease.

When suggested by the physical demands of the classification, it may be advisable to check the applicant's blood pressure response to exercise by performing a cardiac stress test, or by monitoring blood

pressure for 24 hours during the exposure of interest.

Risk Factors. Risk factors for hypertension include those that cannot be altered including advanced age, male sex, and ethnicity (black). Those risk factors that can be modified include obesity, alcohol consumption, salt consumption, cigarette smoking, and oral contraceptives. Risk factors potentially related to the work place include physical and psychological stress. These have been demonstrated to elevate the blood pressure of exposed individuals, especially in the short term. When considering an applicant, the physical and psychological stress that is likely to be encountered during employment must be taken into account.

Presumption of Injury for Safety Classifications. Presumptive laws exist in certain states that complicate the examining physician's task when evaluating an applicant with hypertension for a safety classification. These laws specify that certain disabling conditions that develop in the course of employment (i.e., heart, lung, hernia and associated medical conditions) are presumed to be job related, without regard to preexisting conditions, for public safety personnel. Therefore, if a public safety employee develops heart or lung disease, it is presumed to be job related, even if he or she has a heart attack or develops pneumonia while on a skiing vacation, or even after retirement. The presumptions were enacted into the workers' compensation statutes in the 1930's, predating current medical evidence that certain medical conditions such as high blood pressure can increase the risk of developing cardiovascular disease, completely without the benefit of controlled studies to indicate whether public safety employees were more likely than other groups of employees to develop the conditions specified in the law.

Because the presumptions have no empirical medical basis, it becomes difficult to apply the theory of job-related medical guidelines to the conditions specified in the presumptions. In light of this, the medical guidelines committee has tailored the medical guidelines for public safety positions to reflect this medical-legal dilemma.

Exercise and Hypertension. Extreme exercise, especially activities like weight training, may produce extremely elevated blood pressure during exercise. There may also be a sustained elevation of blood pressure after exercise. This is true despite the fact that regular exercise does lower blood pressure in hypertensive patients. Strenuous activity, especially by those with severe hypertension, should be only done cautiously and under medical guidance.

6.10.1 Recommended Evaluation Guidelines

All candidates should be questioned regarding the onset of their hypertension, events associated with high readings and family history of hypertension. A through history regarding diabetes, and cardiovascular disease in the family, personal history of cardiovascular symptoms, drug and alcohol use, level of physical activity, and diet. Candidates should be questioned about current and past medications, side effects, and compliance with prescribed medical treatment.

Candidates with hypertension requiring medication for control should have their blood pressure measured in the sitting, standing, and lying position to rule out orthostatic hypotension. Pupil dilation to permit evaluation of the fundus for hypertensive retinopathy is necessary. The physical examination should include weight, funduscopic exam for evidence of retinopathy, cardiac examination, auscultation of abdomen and neck for bruits, and palpation of kidneys.

Other testing should include urine analysis and serum creatinine to evaluate for renal disease; ECG; cholesterol and triglycerides (as part of coronary artery disease risk factor assessment); and serum glucose to evaluate for diabetes.

GROUP I: ***NORMAL BLOOD PRESSURE (LESS THAN 120 mm Hg SYSTOLIC AND LESS THAN 80 mm Hg DIASTOLIC)***

If there is no evidence of hypertension, no restrictions are necessary.

GROUP II: ***PRE-HYPERTENSION BLOOD PRESSURE (120 - 139 mm Hg SYSTOLIC OR 80 - 89 mm Hg DIASTOLIC)***

Pre-hypertension is not a disease category. Candidates who are pre-hypertensive should be firmly and unambiguously advised to practice lifestyle modification in order to reduce their risk of developing hypertension in the future. No restrictions are necessary.

Drug therapy is not indicated unless candidates have diabetes or kidney disease and fail to reduce their BP to 130/80 mm Hg or less with lifestyle modification.

GROUP III: ***STAGE I HYPERTENSION GREATER THAN 139 mm Hg. SYSTOLIC OR 89 mm Hg. DIASTOLIC) IS PRESENT OR BLOOD PRESSURE IS CONTROLLED (EQUAL or LESS THAN 90 mm Hg. DIASTOLIC) ON MEDICATION***

An exercise EKG should be performed. Candidates are placed in either Level 1 or 2.

Level 1 If diastolic blood pressure remains below 100 mm Hg. throughout testing, and systolic blood pressure remains below 240 mm Hg., no activity restriction is necessary if exercise is completed through at least 12 METS of activity and no evidence of ischemia or arrhythmia is found.

Level 2 If candidates with diastolic blood pressure rising 10 mm Hg. or more, or their systolic blood pressure reaches 240 mm Hg. or more with exercise. The candidate should be restricted from performing activities which are physically demanding and/or have public health and safety implications.

GROUP IV: ***STAGE 2 HYPERTENSION (105-114 GREATER THAN 159 mm Hg. SYSTOLIC OR 100 mm Hg. DIASTOLIC)***

The risk of incapacitation and injury to the candidate or others is significant and medical treatment is required. The candidate should be restricted from performing activities which are physically demanding and/or have public health and safety implications.

Note: The World Health Organization and International Society of Hypertension recommend that diastolic blood pressures of 90 mm Hg. or above should be repeated at least twice over the subsequent four week period of time. Those with results over 100 mm Hg. should commence drug treatment. Those with values below 100 mm Hg. should commence behavioral intervention and observation for three months. If after three months their values are still in excess of 95 mm Hg., drug treatment should be considered; those below this level should continue with behavioral intervention and observation.

Given the above guidelines, it is possible that candidates may move from one of the above groups with treatment, or when treatment is altered or abandoned. The evaluation protocol should therefore begin after the candidate has shown stability for at least three months in Group I or II or Group III Level 1.

7.0 REFERENCES

Ainsworth, B.E., Haskell, W.L., Whitt, M.C., Irwin, M.L., Swartz, A.M., Strath, S.I., O'Brien, W.O., Bassett, D.R., Schmitz, K.H., Emplaincourt, P.O., Jacobs, D.R. (2000). Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exer*, S498-S514.

Albert, C.M., Mittleman, M.A., I-Mee Lee, C.U., Hennekens, C.H., & Manson, J.E. (2000). Triggering of sudden death from cardiac causes by vigorous exertion. *NEJM*, 343, 19, 1355-61.

American College of Sports Medicine. (2006). *Guidelines for Exercise Testing and Prescription* (7th ed.). Philadelphia, PA: Williams & Wilkins.

American Heart Association (2008). *Heart Disease and Stroke Statistics: 2008 Update.* (http://www.amhrt.org).

Babisch, W. (2006). Transportation noise and cardiovascular risk: updated review and synthesis of epidemiological studies indicate that the evidence has increased. *Noise Health*, 8, 30, 1-29.

Babisch, W. (2000). Traffic noise and cardiovascular disease: Epidemiological review and synthesis. *Noise Health*, 2, 8, 9-32.

Cheitlin, MD, et al., ACC/AHA/ASE. (2003). A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *J Am Coll Cardiol*, 42, 954-970.

Cheitlin, M.D., Parmley, W.W., & Swan, H.J. (1985). Task Force II: Acquired valvular heart disease. *JACC*, 6, 1209-1214.

Cramer, J.A., Mattoson, R.H., Prevey, M.L., Scheyer, R.D., Ouellette,V.L. (1989). How often is medication taken as prescribed? A novel assessment technique. *JAMA*, 262, 1472.

Criteria Committee for the New York Heart Association.(1964). *Diseases of the Heart and Blood Vessels: Nomenclature and Criteria for Diagnosis* (6th ed). Boston: Little Brown and Company.

Croog, S.H., Levine, S. Testa, M.A., Brown, B., Bulpitt, C.J., Jenkins, C.D., Klerman, G.L., & Williams, G.H. (1986). The effects of antihypertensive therapy on the quality of life. *NEJM*, 314, 1657-64.

Ely, D.L., & Mostardi, R.A. (1986). The effect of recent life events stress, life assets, and temperament pattern on cardiovascular risk factors for Akron city police officers. *J of Human Stress*, (Summer).

Fleishman, E.A. & Mumford, M. (1991). Evaluating classifications of job behavior: A construct validation of the ability requirements scales. *Personnel Psychology*, 44, 523.

Fletcher, G.F., Balady, G., Froelicher, V.F., Hartley, H.L., Haskell, W.L.,& Pollock, M.L. (1995). Exercise standards: A statement for healthcare professionals from the American Heart Association. *Circulation*, 91, 580-615.

Fox, S.M. III, Naughton, J.P., & Haskell W.L. (1971). Physical activity and the prevention of coronary heart disease. *Annals of Clinical Research*, 3, 404-432.

Froelicher, V.F., Yanowitz, F., Thompson, A.J., Lancaster, M.C. (1975). Treadmill Exercise Testing at the USAF School of Aerospace Medicine: Physiological Response in Aircrewmen and the Detection of Latent Coronary Artery Disease, DTIC # ADA011606.

Frohlick, E.D., Grim, C., & Labarthe, D.R.. (1988). Recommendations for human blood pressure determination by sphygmomanometers. Report of a special task force appointed by the Steering Committee, American Heart Association. *Hypertension*, 11, 209A-222A.

Gibbons R.J., Balady, G.J., Beasley, J.W., Bricker, J.T., Duvernoy, W.F.C., Froelicher, V.F., Mark, D.B., Marwick, T.H., McCallister, B.D., Thompson, P.D., Winters, W.L., & Yanowitz, F.G. (1997).ACC/AHA Guidelines for Exercise Testing: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Exercise Testing). *JACC*, 30, 260-315.

Graham, J.D.P. (1945). High blood pressure after battle. *Lancet*, February, 239-40.

Hylek, E.M. & Singer, D.E. (1994). Risk factors for intracranial hemorrhage in outpatients taking warfarin. *Ann Intern Med*, 120, 897-902.

Irnich, et. al., (1996). Electromagnetic interference of pacemakers by mobile phones. *Clin Electrophysiol*, 10, 1431-1446.

Joint National Committee. (2003). The 2003 report of the joint national committee on detection, evaluation, and treatment of high blood pressure. *Hypertension*, 42, 1206-52.

Kaplan, N.M., Deveraux, R.B., & Miller, J.S. (1994). 26th Bethesda conference: recommendations for determining eligibility for competition in athletes with cardiovascular abnormalities: January 6-7. *JACC*, 24, 885-88.

Kruyer, W.B., & Hickman, J.R. (1990). Medication-induced performance decrements: Cardiovascular medications. *Cardiovascular Medications*, 32, 342-349.

Maron, B.J., et al. (2004). Recommendations for physical activity and recreational sports participationfor young patients with genetic cardiovascular diseases. *Circulation*, 109, 2807-2816.

Maron, B.J. (2007). Hypertrophic cardiomyopathy and other causes of sudden cardiac death in young competitive athletes, with considerations for preparticipation screening and criteria for disqualification. *Cardiol Clin*, 25, 3, 399-414.

Mina, A.A., et al., (2003). Complications o fpreinjury warfarin use in the trauma patient. *J Trauma*, 54, 842-847.

Mustacchi, P. (1990). Stress and hypertension. *Western J Med*, 153, 180-185.

Myerson, S.G. and Mitchell, A.R. (2003). Mobile phones is hositals. *BMJ*, 326, 460-461.

National Fire Protection Association. (2007). *Medical Requirements for Fire Fighters: 2007 Edition*. Quincy, MA: NFPA.

Nedeljkovic, I., Ostojic, M., Beleslin, B., Djordjevic-Dikic, A., Stepanovic, J., Nedeljkovic, M., Stojkovic, S., Stankovic, G, Saponjski, J., Petrasinovic, Z., Giga, V., & Mitrovic, P. (2006). Comparison of exercise, dobutamine-atropine and dipyridamole-atropine stress echocardiography in detecting coronary artery disease. *Cardiovasc Ultrasound*, 3, 4, 22.

Pina, I.L., Balady, G.J., Hanson, P., Labovitz, A.J., Madonna, D.W., Myers, J. (1995). Guidelines for clinical exercise testing laboratories: A statement for healthcare professionals from the Committee on Exercise and Cardiac Rehabilitation. *Circulation*, 1, 91, 912-21.

Rodney, D.A. et al., (2001). Exercise standards for testing and training: a statement for healthcare. *Circulation*, 104, 1694-1740.

Schiffer, F., Hartley, L. H., Schulman, C. L., & Abelmann, W. H. (1976). Quiz electrocardiogram: A new diagnostic and research for evaluating the relations between emotional stress and ischemic heart disease. *Am J Cardiol*, 37, 41-47.

Schoenberger, J.A., Croog, S.H., Sudilovsky, A., Levine, S., & Baume, R.M. (1990). Self-reported side effects from antihypertensive drugs. A clinical trail. *Am J Hypertens*, 3, 123-32.

Sidney, M.J., & Blumchen, G. (1990). Metabolic equivalents (METS) in exercise testing, exercise prescription, and evaluation of functional capacity. *Clin Cardiol*, 13, 555-565.

van Kempen, E.E., Kruize, H., Boshuizen, H.C., Ameling, C.B., Staatsen, B.A., & de Hollander, A.E. (2002). The association between noise exposure and blood pressure and ischemic heart disease: a meta-analysis. *Environ Health Perspect*, 110, 307-17.

Vasan, R.S., Larson, M.G., Leip, E.P., Evans, J.C., O'Donnell, C.J., Kannel, W.B., & Levy, D. (2001). Impact of high-normal blood pressure on the risk of cardiovascular disease. *NEJM*. 234, 1291-1297.

Zabetakis, P.M. (1984). Profiling the hypertensive patient insports. *Clinics in Sports Med*, 3, 137-152.

ENDOCRINE SYSTEM

1.0 INTRODUCTION

The endocrine system plays a very important role in maintaining the internal environment of the organism and have effects on development, growth and metabolism. A variety of glands produce secretions called hormones which travel via the circulatory system to target organs. These hormones influence and integrate the activities of a variety of organs. The endocrine system is comprised of the hypothalamus, anterior pituitary, pineal, thyroid, parathyroid, adrenal, pancreas, ovaries and testes. The endocrine system is of great importance in the occupational setting because of the increasing prevalence of the most common endocrine disease, diabetes mellitus.

According to the CDC (2007), approximately 23.6 million Americans have diabetes or 7.8% of the population. Of this number, 17.9 million are diagnosed, leaving 5.7 million people with undiagnosed diabetes. The direct and indirect costs of medical care associated with diabetes in 2002 were an estimated $174 billion. Indirect costs such as disability, work loss, and premature mortality account for $58 billion dollars (National Institutes of Health, 2007).

Endocrine disorders can arise from excess or deficiency of the involved hormone, but enlargement of the endocrine glands may not be associated with functional disorders. Decreased function may be due to inflammation or other destructive lesions such as hemorrhage or neoplastic invasion. Hyperfunction may be associated with neoplastic or non-neoplastic proliferation which may be accompanied by the enlargement of the gland itself. Disruption of hormone transport, metabolism, delivery or synthesis can also account for either decreased or increased function of a part of the endocrine system due to high regulatory and feedback loops within the system. Metabolic disturbances such as iodine deficiency resulting in goiter, or endocrine disruption by certain chemicals can also cause endocrine dysfunction.

2.0 OUTLINE OF HIGHLIGHTED CONDITIONS

- Diabetes Mellitus
- Parathyroid Disorders

- Thyroid Disorders
- Adrenal Disorders
- Obesity

3.0 IMPLICATIONS FOR JOB PERFORMANCE

3.1 Physical Demands

Jobs which require moderate to high levels of muscular tension (static strength), muscular endurance (dynamic strength), and cardiovascular endurance (stamina) place an increased load on the metabolic system. Strenuous exercise is a common precipitator of hypoglycemia or low blood sugar. Studies by MED-TOX demonstrate that the law enforcement officer occupation includes a variety of physically and emotionally demanding job duties that require proper endocrine function. See the job analysis report for a listing of these tasks.

3.2 Working Conditions

In addition to physical tasks, the working conditions in which these tasks are performed can complicate the control of diabetes and require careful consideration. Working conditions include:

High Temperatures - Law enforcement officers must work in high temperatures which are associated with an increased risk of a hypoglycemic reaction, especially if physical activity is associated with the high temperature.

Heights - Law enforcement officers must work at heights which increases the probability of a falling injury. Individuals with symptoms that impair coordination or cognitive function should avoid working at heights where the potential of serious injury is present.

Moving Objects - Law enforcement officers are required to work around moving objects such as vehicles, obstacles, and other people. Work requiring continuous vigilance may indicate an unacceptable risk for persons with coordination or cognitive dysfunction.

Driving - Law enforcement officers spend a considerable amount of time driving and it is generally considered an essential job task. The Maryland Motor Vehicle Administration (MVA) and the U.S. Department

of Transportation Motor Carrier Safety Regulations 49 CFR 391.41 restricts the issuance of a commercial driver's license to any person who has an established medical history or clinical diagnosis of diabetes mellitus currently requiring insulin for control unless that person has obtained a medical waiver (DOT, 2003, MVA, 2008).

Working Alone - Job analysis of the occupation of law enforcement officers has documented that officers are frequently separated from their partner and required to work alone. Working alone can be hazardous to persons with diabetes should they have a hypoglycemic episode requiring the assistance of others.

Irregular or Extended Work Hours - Law enforcement officers are required to work unpredictable and extended work hours and/or rotating shifts. This can interfere with the careful planning of meals, ingestion of medication, and blood glucose testing.

Violent Persons - Law enforcement officers work involves contact with violent and dangerous persons. This should be avoided by persons who are dependent on insulin since an unpredictable increase in physical activity can result in episodes of hypoglycemia placing the worker at a significantly increased risk of injury.

Respirator - Some officers may be required to wear respirators, including SCUBA, which can markedly increase energy consumption and potentially place the worker at an increased risk for a hypoglycemic reaction.

4.0 MEDICAL EVALUATION AND EXAMINATION GUIDELINES

4.1 Medical History

Use the Medical History Questionnaire found in the Appendix.

4.2 Candidate Interview

The medical history should be reviewed with the candidate. Syncope, chest pain, dizzy spells, loss of balance and other symptoms indicative of a possible medical condition require in depth review with the candidate to determine the cause and diagnostic status. The examining physician must request and review relevant medical records to determine status of medical condition(s). In the case of diabetes, review of the candidate's treating physician's completion of *Physician*

Evaluation Form for Diabetes (See Apppendix) is essential for determination of work status.

4.3 Physical Examination

The recommended physical examination protocol includes the areas of usual focus for screening of endocrine dysfunction such as: vital signs (pulse, height and weight) and examination of the skin, nailbeds, head, eyes and palpation of the thyroid gland. Calculation of the Body Mass Index (BMI) may assist in determining level of obesity.

4.4 Routine Tests

The recommended candidate's 8 hour fasting blood chemistry panel (See Protocol), includes the areas of usual focus for laboratory screening of endocrine dysfunction such as measurements of calcium, sodium, potassium, and glucose.

5.0 EVALUATION OF ENDOCRINE CONDITIONS

5.1 Diabetes Mellitus

Diabetes is generally divided into two types. Type 1 is characterized by *insulin deficiency*, and requires treatment with insulin. Type 2 is characterized by *insulin resistance* which creates a relative insulin deficiency. It may be treated with diet modification, exercise, oral agents, and/or insulin. After a number of years, persons with type 2 diabetes are likely to develop insulin deficiency and require treatment with insulin.

The current criteria for the diagnosis of diabetes include one of the following:

- Fasting plasma glucose = 126 mg/dl (7.0 mmol/l). Fasting is defined as no caloric intake for 8 hours.

- Symptoms of hyperglycemia and a random plasma glucose = 200 mg/dl (11.1 mmol/l). Symptoms can include polyuria, polydipsia and unexplained weight loss

- 2 hour plasma glucose = 200 mg/dl (11.1 mmol/l) during an oral glucose tolerance test. Test should be performed using World Health Organization (WHO) standards using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water (ADA, 2009).

Diabetes has major implications for the safe and effective performance of law enforcement officer duties because of both chronic and acute complications involving several major organ systems.

5.1.1 Job-Relevant Chronic Complications of Diabetes

Visual. Diabetic retinopathy is the most frequent cause of new cases of blindness among adults aged 20-74 years. During the first two decades of disease, nearly all patients with type 1 diabetes and >60% of patients with type 2 diabetes have retinopathy (Fong, 2004). Diabetic retinopathy can threaten central vision. Diabetic retinopathy is classified in four stages. It will progress through three non-proliferative stages (mild, moderate, and severe) and then comes the 4th stage, proliferative retinopathy. In the presence of proliferative or severe non-proliferative diabetic retinopathy, vigorous aerobic or resistance exercise may be contraindicated because of the potential risk of triggering vitreous hemorrhage or traction retinal detachment (ADA, 2006). The risks of these complications can be substantially reduced by laser pan retinal photocoagulation (PRP).

Diabetic retinopathy can also cause a predominantly blue-yellow color vision deficiency (Utku and Atmaca, 1992; Lakowski, et al., 1972), and impairment of contrast sensitivity (Banford, et al., 1994). Several studies indicate that impairments of color vision and contrast sensitivity may occur before the retinopathy is clinically visible (Kurtenbach, et al., 1994; Hardy, et al., 1992).

Neurological. Diabetes can cause both peripheral and autonomic neuropathy. In the presence of severe peripheral neuropathy, consideration of limiting weight-bearing exercises such as jogging is encouraged. Autonomic neuropathy can increase the risk of exercise-induced injury by decreasing cardiac responsiveness to exercise, postural hypotension, impaired thermoregulation due to impaired skin blood flow and sweating, impaired night vision due to impaired papillary reaction, and impaired thirst, which increases the risk of dehydration and gastroparesis with unpredictable food delivery. Autonomic neuropathy is also strongly associated with coronary vascular disease (CVD) in people with diabetes. Individuals with

diabetic autonomic neuropathy should undergo cardiac investigation before beginning physical activity more intense than that to which they are accustomed (ADA, 2006).

Renal. Diabetes is the most common cause of end stage renal disease in the U.S. Nephropathy is different in type 1 and type 2 diabetics. Renal disease may already be present upon diagnosis of type 2 diabetic due to the asymptomatic nature of the disease. The earliest clinical evidence of diabetic nephropathy is the appearance of low, but abnormal levels of albuminuria, referred to as microalbuminuria (ADA, 2004b). Microalbuminuria is less predictive of diabetic nephropathy progression in type 2 diabetics. The best treatment for renal complications is prevention, with proper control of blood pressure, glucose, cholesterol and administration of medications (ACE Inhibitors or ARBs). ACE Inhibitors and ARBs have been shown to decrease progression of microalbuminuria.

Cardiovascular/Stroke. Heart disease and stroke are responsible for 65% of diabetes related deaths. Diabetics have a 2-4 fold increase in strokes and cardiac related deaths than non-diabetics. The Framingham Heart study showed an increase in peripheral arterial disease, congestive heart failure, myocardial infarction, coronary artery disease and sudden death in diabetics. Diabetes is well recognized as a major risk factor for coronary disease and silent ischemia. Additionally, it may cause impaired aerobic work capacity (Benbassat, et al., 2001; Wanke, et al., 1992). The magnitude of the aerobic impairment may be of relevance to the performance of law enforcement duties. The study by Jensen, et al., (1998) found that the $VO_{2\ max}$ in young type 1 diabetic subjects (mean age = 30) type 1 diabetic subjects with only microalbuminuria (30-300 mg/24 hrs) was 28 ml O2/kg/min compared to 42 ml O2/kg/min (12 METS) in nondiabetic subjects.

It is important to note that the prevalence rates of these chronic complications are determined by the duration of the disease (Orchard, et al., 1990) and the level of glycemic control. In the Diabetes Control and Complications Trial (DCCT, 1993) and the UK Prospective Diabetes Study Group (1988) trials, treatment regimens that reduced average A1C levels to approximately 7% were associated with significantly fewer microvascular complications (renal, eye and nervous system). Epidemiological studies also support the potential of good diabetic control to reduce the incidence of cardiovascular disease (Lawson, et al., 1999; Stratton, et al., 2000).

5.1.2 Job-Relevant Acute Complications of Diabetes

Hypoglycemia. The American Diabetes Association (ADA) defines hypoglycemia as a blood glucose level < 70 mg/dL (ADA, 2005). In the acute setting, hypoglycemia can occur due to a relative excess of insulin or oral hypoglycemic medications. If not treated by ingestion of glucose, hypoglycemia will impair the performance of a law enforcement officer due to the rapid development of cognitive impairment. Functions that are most affected by hypoglycemia include rapid decision-making, sustained attention, analysis of complex visual stimuli, "mental flexibility," memory of recently learned information, and eye-hand coordination (Deary, 1999), Hypoglycemia can also cause increased irritability and anger (Deary, 1999). As hypoglycemia progresses to what is commonly called "severe" levels, frank confusion ensues which prevents self-treatment. If assistance is not forthcoming, the development of seizures, coma, and death can result.

For a given individual, the risk of impairment due to hypoglycemia on duty depends on two factors: the individual's glycemic threshold for impairment, and the likelihood of dropping below this threshold while on duty.

The blood glucose level at which cognitive impairment begins varies considerably among individuals. However, several research studies have demonstrated significant neuropsychological and driving simulation impairments in 12-19% of subjects at blood levels as high as 65 mg/dl (Cox, et al., 2000; Gonder-Frederick, et al., 1994). Other studies have documented statistically significant decrements in cognitive function tests among groups of subjects at 60 mg/dl (Gschwend, et al., 1995) and at 55 mg/dl (Fanelli, et al., 1998).

The major job-related factor that increases the risk of hypoglycemia for law enforcement officers is the disruption of meals (DCCT, 1991). This is especially true for officers whose treatment regimen involves injecting regular insulin 30-45 minutes prior to meals, or those who use an intermediate acting insulin (such as NPH) that is expected to peak postprandially.

Additionally, when hypoglycemia develops in a law enforcement officer, the demands of the job may distract or prevent the officer from responding appropriate to warning symptoms. For example, this could easily occur while responding to a call which requires high speed pursuit driving, searching a building for an armed suspect, or when involved in confrontational situations.

Unanticipated exercise may also be a risk factor for hypoglycemia. However, this depends on the duration and intensity of the exercise. Exercise at moderate levels for more than 30 minutes will lower blood sugars. However, intense exercise of short duration (< 15 minutes) has the opposite effect, resulting in sustained elevation of blood sugar for up to two hours (Sigal, et al., 1994); Mitchell, et al., 1988; Kjaer, et al., 1990). Since the vast majority of law enforcement officer critical events involve intense exertion for a short period of time (< 10 minutes), hypoglycemia would not be expected to occur.

Driving is a task that does have a significant metabolic demand and may lower blood glucose. One study of type 2 insulin-dependent drivers showed significantly higher dextrose infusion rates ($p = 0.02$), more autonomic symptoms ($p < 0.05$), increased heart rates ($p < 0.001$), a trend for greater epinephrine release ($p = 0.09$), and more frequent hypoglycemic self-treatment by drivers than controls ($p < 0.001$) (Cox, et al., 2002b).

Notwithstanding the job-related factors that can increase the risk of hypoglycemia, the likelihood that a diabetic law enforcement officer will experience glycemic levels of 70 mg/dl or lower on the job depends primarily on the medication used.

The risk of having glycemic levels of < 70 mg/dL is highest for officers who use insulin. A great deal of research has attempted to identify individual risk factors for hypoglycemia among insulin users. This research indicates that patients who either have hypoglycemia unawareness, or who have had a recent occurrence of severe hypoglycemia (SH), an episode requiring assistance from another person, are at exceptionally high risk. For example. MacLeod, et al., (1993), found that 93% of patients with hypoglycemia unawareness had experienced an episode of severe hypoglycemia (SH) in the preceding year. In the DCCT study (1997), an episode of SH was shown to result in an elevated risk for a second event for the next three years (See Table 1).

Table 1: Annual Risk of a Recurrent Major Hypoglycemic Event after an Initial Occurrence

	Conventional Therapy		Intensive Therapy	
Years After Initial Event	Severe Hypoglycemia	Seizure/ Coma	Severe Hypoglycemia	Seizure/ Coma
0	42%	27%	52%	32%
1	17%	10%	31%	19%
2	15%	5%	27%	7%
3	7%	3%	8%	12%
4	8%	5%	9%	16%

Data derived from DCCT Research Group, 1997.

Secondary risk factors for hypoglycemia include low hemoglobin A1C, use of intensive insulin therapy, (i.e., $\geq$ three injections per day or use of an insulin pump), and autonomic dysfunction. However, formulas which considered these factors as well as the frequency of SH and hypoglycemia unawareness have been shown to predict, at most, only 18% of future severe hypoglycemic episodes (Gold, et al., 1997). Their predictive value for the occurrence of glycemic levels of $<$ 70 mg/dl would be considerably less.

A research group at the University of Virginia has taken a different approach to the prediction of hypoglycemia. Over the last ten years, they have developed software that can be used to analyze routinely collected blood glucose (BD) meter data. Based on 4-6 weeks of data, the software generates a Low Blood Glucose Index (LBGI), which has been shown to independently predict 55% of the episodes of SH over the ensuring several months (Kovatchev, et al., 2003; Kovatchev, et al., 1998). Adding recent SH episodes and A1C levels to the statistical model added an additional 7% of future SH episodes. The index has also been shown to be very effective in predicting the incidence of blood sugars in the range of 39-55 mg/dl. Table 2 shows that the LBGI can be used to categorize patients into likelihood groups for recurrent blood sugars in this range. However, even in the lowest risk group (LBGI $<$1.1)), type 1 diabetic subjects were still observed to have blood sugars $\leq$55 mg/dl an average of 1 1/2 times per month.

Table 2: **Number of Prospectively Observed Hypoglycemic Episodes (39-55 mg%) Per Person Per Month by Risk Category and Type of Diabetes**

Diabetes Type	LBGI Value			
	<1.1	1.1-2.5	2.6-5.0	>5.0
Type 1 (n=48)	1.47	2.56	6.20	11.50
Type 2 (n=48)*	0.38	0.65	5.91	11.00

* Treated with insulin.

Data derived from Kovatchev, et al., 2002.

While studies indicate that type 2 diabetic subjects on insulin therapy are at lower risk for SH than type 1 diabetics, their risk of having glycemic levels of < 70 mg/dl remains high. Annual rates of symptomatic SH appears to range from 2-12% per year (Leese, et al., 2003; UKPDS, 1998; Hepburn, 1993; Abraira, et al., 1995). Chwartz, et al., (1998) followed a group of 118 type 2 diabetic subjects (mean age 56 years) for six months. During this period, 8% had BG meter values $\leq$50 mg/dl despite an average A1C of more than 9%. Glargine (trade name Lantus) is a long-acting insulin for use by persons with type 2 diabetes. While this does reduce the risk of hypoglycemia compared to NPH, Rosenstock, et al., (2001) observed that 7% of patients using glargine had episodes of blood glucose <36 mg/dl over a 28-week observation period. As with type 1 diabetes, the best individualized predictor of future hypoglycemic episodes is the LBGI. However, even in the lowest risk group (LBGI <1.1), type 2 subjects using insulin were still observed to have blood sugars $\leq$55 mg/dl an average of 0.4 times per month or nearly five times per year (See Table 2).

To summarize, research has indicated that the use of insulin by law enforcement officers creates a significant risk of hypoglycemia on the job regardless of individual risk factors, state-of-the-art assessment tools, or diabetes type.

Use of oral medications. There are several classes of oral medications available for the treatment of type 2 diabetes. (Table 3). Hypoglycemia is of concern primarily for two of these classes -sulfonylureas, and meglitinides. The incidence of hypoglycemia is very low if any of the following classes of medications are used as mono therapy: biguanides

(Glucophage), alpha-glucosidase inhibitors (Precose, Glyset), or Thiazolidinediones (Actos, Avandia) (Holstein & Egberts, 2003).

Table 3: **Oral Diabetic Medication Classifications**

Class	Example Medications
Biguanides	Metformin (Glucophage)
Sulfonylureas	Glyburide (Micronase), glipizide (Glucotrol), glimepiride (Amaryl)
Meglitinides	Nateglinide (Starlix), repaglinide (Prandin)
Thiazolidinediones	Rosiglitazone (Avandia), pioglitazone (Actos)
Dipeptidyl peptidase-4-inhibitors	Sitagliptin (Januvia), sasagliptin (Onglyza)
Glucagon-like peptide analog	Exenatide (Byetta)
Alpha-glucosidase inhibitors	Acarbose (Precose), miglitol (Glyset)

For the second generation sulfonylureas that are in common use (glyburide, glipizide, and glimepiride), the reported incidence rates of hypoglycemia are highest with glyburide (Holstein & Egberts, 2003). For this drug, the incidence of SH has been reported to be 0.6-1.6% per year (Sugarman, 1991; Holstein, et al., 2001; UKPDS, 2001). This compares to a rate of 0.09% for glimepiride (Holstein, et al., 2001). The hypoglycemic rates for glipizide have been reported to be similar to glimepiride (Clark & Goldberg, 1997).

While the occurrence of SH with sulfonylureas does not appear to be a major concern, the same cannot be said for the occurrence of glycemic levels of < 70 mg/dl. Studies indicate that patients who take sulfonylureas frequently complain of hypoglycemia. The UK Prospective Diabetes Study Group (1998) found that symptomatic self-treated hypoglycemia occurred in 16-21% of patients annually. Jennings, et al., (1989) found that 20% of patients (age range 40-65) reported hypoglycemic symptoms over a 6-month period. Among subjects in a series of five one-year clinical trials, 20% of those using glyburide and 19% of those using glipizide reported mild or moderate hypoglycemia (Novo Nordisk, 2004).

In these studies, subjects did not measure their glycemic levels at the time of their symptoms. Therefore, their perception of hypoglycemia may not always indicate a glycemic level of = 70 mg/dl. Korzon-Burakowska, et al., (1998) observed that the average plasma glucose threshold at which hypoglycemic symptoms first developed in a group of seven poorly controlled type 2 diabetic subjects (mean A1C = 11.3) was 65 mg/dl. After improvement in their control to an average A1C level of 8.1, their threshold dropped to 54 mg/dl.

Most studies indicate that age > 60 and taking drugs that potentiate the effects of sulfonylureas are risk factors for hypoglycemia. Nevertheless, the absence of these risk factors in the typical law enforcement candidate does not warrant that the hypoglycemic risks associated with sulfonylureas be ignored. Regarding age, the average age of the participants in the UK Prospective Diabetes Study Group (1998) study was only 54 years. Furthermore, Leese, et al., (2003), found no difference in age between type 2 diabetes subjects who had SH vs. those who did not. Regarding potentiating medications, Jennings, et al., (1989) reported that 75% of patients reporting hypoglycemic symptoms with sulfonylureas were not taking potentiating medications.

Finally, the risk of hypoglycemia with sulfonylureas increases if a meal is missed or food intake is reduced (Stahl & Bergfer, 1999; Seltzer, 1989). Damsbo, et al., (1999) measured afternoon glycemic levels in 41 patients (mean age 58 years) who skipped lunch. Four complained of hypoglycemic symptoms and two were asymptomatic but had measured blood sugars levels of < 45 mg/dl. Burge, et al., (1998) did not observe any glycemic levels < 50 mg/dl after subjects were fasting for 23 hours. However, these patients started the fasting period with a mean glycemic level of about 170 mg/dl. For the lower quartile who started the fast at a glycemic level of 104 mg/dl, the average dropped to 71 mg/dl. Therefore, it is very likely that some of these patients experienced hypoglycemic levels of concern for officers.

The meglitinide class of medications, repaglinide and nateglinide, act similarly to sulfonylureas with similar or less efficacy, possibly less hypoglycemia and increased cost.

Prandin (Repaglinide) is a medication that is designed to treat postprandial hyperglycemia. It has a duration of action of only 2-3 hours and is taken just prior to meals. It offers an advantage over sulfonylureas in that meals can be missed or delayed with a lower risk of hypoglycemia (Damsbo, et al., 1999; Mafauzy, 2002). Perhaps for this reason the incident of SH with Prandin has been reported to be

approximately half of that with sulfonylureas (Schatz, 1999; Kristensen, et al., 2000). However, in one-year comparative trials, the overall incidence of hypoglycemia in patients who use Prandin was observed to be fairly equivalent to those who use sulfonylureas (Schatz, 1999; Novo Nordisk, 2004).

Starlix (Nateglinide) is also a short acting hypoglycemic designed to be taken with meals. However, its hypoglycemic effect has a more rapid onset and shorter duration than Prandin. Consequently, Starlix is also associated with less hypoglycemia than the sulfonylureas. However, the incidence of hypoglycemia is still high enough to be of concern to the employer. In an eight-week clinical trial, Hollander, et al., (2001), found that 12% of subjects complained of hypoglycemic symptoms. Hypoglycemia was confirmed by self-monitoring of blood glucose in 3% of the subjects (levels not given). Saloranta, et al., (2002), found that 5% of patients using Starlix experienced symptomatic hypoglycemia with documented blood sugars <60 mg/dl during a 24-week study.

While hypoglycemia may be due to diabetic medications or insulin, it is important to recognize that hypoglycemia may be a result of other chronic conditions. Other drugs, including ethanol and some pain medications (salicylates) or antibiotics (sulfonamides) are able to cause hypoglycemia. Hypoglycemia can be seen in a starvation state. Hypoglycemia is seen in severe liver, renal or cardiac disease, however these conditions would be unexpected for a candidate. Several tumors, including insulinoma are capable of causing hypoglycemia.

Hyperglycemia. Acute hyperglycemia is of potential concern because it may be a harbinger of diabetic ketoacidosis (DKA), or may produce cognitive impairment, fatigue, increased urination, and blurred vision. All persons with diabetes are at risk for having high sugars especially after meals. However, the frequency at which this will occur depends on the overall level of disease control. In a study of type 2 diabetic subjects who were either diet-controlled ($n=84$) or taking oral agents ($n=134$), Erlinger and Brancati (2001) observed that average postprandial glucose levels rose dramatically if A1C levels were $>7\%$. At A1C level of $<7\%$, the mean two-hour postprandial glucose level was 185 mg/dl. At A1C levels of 7-7.9%, the mean rose to 325 mg/dl; at A1C levels of 8%, or higher, the mean was 402 mg/dl.

Diabetic Ketoacidosis (DKA). DKA can develop in an individual with type 1 diabetes who has been insulin-deficient for a number of hours. This can potentially be precipitated by exercise. For this reason the ADA recommends that someone with type 1 diabetes to refrain from

exercising with a fasting blood glucose level >250 mg/dl and ketones in the urine. Diabetics with blood glucose of 300 mg/dl are cautioned against activity. (ADA, 2004a). However, it seems highly unlikely that short bursts of activity (i.e., <15 minutes) associated with critical tasks would be a major factor of causing ketoacidosis to occur in an officer.

Cognitive Impairment. The hyperglycemic level at which cognitive impairment is likely to develop is not clear. One study found that the time to complete subtractions significantly slowed above 270 mg/dl (Cox, et al., 2002a). Cognitive performance was decreased in type 1 and type 2 diabetics with blood glucose > 270 mg/dl (15 mmol/l) (Cox et al, 2005). However, older studies found no significant impairment during neurocognitive testing in the 300-380 mg/dl range (Draelos, et al., 1995); Hoffman, et al., 1989; Gschwend, et al., 1995; Holmes, et al., 1986). The disparity in results is likely due to the lack of consensus in testing for cognitive function. Incidentally, the US FMCSA (2003) requires that diabetic commercial drivers, who use insulin, stop driving when their blood sugar exceeds 400 mg/dl.

Fatigue. Patients often report fatigue when their diabetes is chronically in poor control. However, there are very few studies documenting the hyperglycemic level at which this is expected to occur. Weinger, et al., (1995) found no significant increase in the mean intensity of fatigue complaints at blood sugars of 380 mg/dl in 42 type 1 diabetic subjects during an insulin-clamp study. Twenty-nine percent of her subjects did complain of feeling tired or weak, but an equal percentage reported feeling more energetic.

Increased Urination. Weinger, et al., (1995) found that urination was significantly increased at 380 mg/dl, affecting 39% of her subjects. More frequent or urgent urination could interfere with maintaining effective patrol during or surveillance activities.

Blurred Vision. Myopic shifting is a common presenting symptom of diabetes. The inverse phenomenon - hyperopic shifting - has been repeatedly observed with the initial treatment of uncontrolled diabetes (Okamoto, et al., 2000; Saito, et al., 1993), and has led to the general recommendation that persons with new onset diabetes wait until their blood sugar has stabilized before obtaining new prescription spectacles.

Several studies indicate that the magnitude of the myopic shifting expected with hyperglycemia could cause a candidate with poorly controlled diabetes to intermittently not meet an employer's vision requirements. Gwinup, et al., (1976) administered a 25-gram dose of

glucose intravenously to a group of six type 2 diabetic subjects who initially had a blood glucose of <150 mg/dl. Myopic shifting was observed within 15 minutes and peaked at approximately -0.75 D at 45 minutes after the glucose infusion. While the authors did not repeat measurements of blood sugars after the infusion, they noted that a rise in blood sugar of 150 mg/dl would be expected based on prior work by Amatuzio, et al., (1953). Therefore, they estimated the rate of myopic change to be -0.5 D per 100 mg/dl increasing blood sugar. A second study measured refractions and glycemic levels in seven nondiabetic subjects were given an oral glucose load with suppression of their insulin secretion by somatostatin (Furushima, et al., 1999). As average glucose levels rose from 70 to 279 mg/dl, the average change in refraction was -1.93 D, or approximately -0.9 D per 100 mg/dl. Unfortunately, neither of these studies conducted repeated direct measures of the subject's uncorrected visual acuity as glycemic levels rose. However, the myopic shifting observed would be expected to cause visual acuity to fall into the 20/50-20/70 range at glycemic levels of 300 mg/dl.

One study that conducted repeated direct measurements of visual acuity found that acuity remained stable when hyperglycemia was experimentally induced to an average level of 274 mg/dl in 20 diabetic subjects (Mangouritsas, et al., 1995). However, this study found that contrast sensitivity was significantly reduced during the hyperglycemic stage.

These vision studies would seem to support an upper glycemic limit of 300 mg/dl in order to ensure adequate visual acuity. However, the studies small sample sizes, use of nondiabetic subjects, and/or the use of indirect estimates of acuities and glycemic levels severely limits their reliability for quantitative purposes. Of note is that only 5% of the subjects in the Weinger (1995) study complained of blurry vision at 380 mg/dl.

In summary, it appears reasonable to require law enforcement officers to maintain glycemic levels below 300 mg/dl while on duty. This level is set for a variety of reasons including maintenance of visual acuity, cognitive impairment and an exercise precaution at that level as recommended by the American Diabetes Association (ADA, 2006). Even though DKA would not be expected to occur with a short burst of activity, blood sugars are expected to rise with activity which can result in other problems such as myopic shift. The ideal HBA1c is <7% for law enforcement officers, and their postprandial glucose levels are not expected to exceed 200 mg/dl. It is more prudent to err on the side of

caution for law enforcement officers and the public.

5.1.3 Basis for Individualized Risk Assessment

An individualized assessment is necessary to determine the presence and significance of potential acute and chronic complications. This will require more extensive testing than is routinely conducted on nondiabetic candidates. Communication with the candidate's personal care physician will help in this assessment (See Appendix for *Physician Evaluation Form for Diabetes*).

The major acute risks of hypo- and hyperglycemia were previously described above. The only candidates who are not at significant risk of experiencing either hypo- or hyperglycemia as law enforcement officers are those who have type 2 diabetes controlled by either diet, oral medications besides sulfonylureas and metglitinides, and who also have an A1C $<7\%$. For other candidates, requiring methods to reduce the risk of impairment on duty can be justified to ensure the safe and effective performance of the essential duties of the job.

5.1.4 Methods of Reducing Risk for Hypo- and Hyperglycemia

There are several methods that potentially can reduce the risk of hypo- and hyperglycemia occurring while on duty or mitigate the resulting impairment. The purpose of the following analysis is to determine which are reasonable and effective.

Glucose Tablets. Hypoglycemia can be self-treated by ingestion of 15-20 grams of carbohydrate. Glucose tablets can be easily carried by an officer. However, carrying these tablets will not sufficiently reduce the risk of impairment on duty. Using a driving simulator, Cox, et al., (2000), has shown that diabetic subjects who are provided with a food source will not reliably consume food to prevent their blood sugars from dropping below 66 mg/dl. The mean blood glucose level at which subjects would treat themselves or stopped driving was 49 mg/dl, and 43% of the severely impaired subjects took no corrective action. Failure to use an available glucose source was not solely due to hypoglycemia unawareness. When blood glucose levels were in the 50-59 mg/dl range, 33% of the subjects detected their hypoglycemia and 22% detected their driving impairment, yet only three percent took corrective action.

Self-Monitoring of Blood Glucose (SMBG). Frequent SMBG can lead to detection and correction of dangerously low or high blood sugars, and

in theory should reduce the risk of hypoglycemia on the job. However, for this to be the case, the following considerations regarding SMBG must be addressed:

Frequency of Testing. Despite testing at commonly recommended frequencies (3-4 times per day), persons with insulin dependent diabetes can still experience SH at high frequencies. In the DCCT (1997) study, the intensively treated group was instructed to perform SMBG four times a day, and to awaken at 3 AM to do SMBG at least once a week. Despite this monitoring, SH still occurred at a rate of 0.6 episodes/patients per year. Cox, et al., (1999) found no difference in the frequency of SMBG/day between a group of patients who reported at least two episodes of SH in the past year vs. a group with no SH in the past year (3.5 tests/day vs. 3.8 tests/day). Therefore, testing 3-4 times a day or every 4-5 hours will not prevent hypoglycemia from occurring. Additionally, traditional recommendations for testing before meals will not detect postprandial hyperglycemia.

Consequently, to effectively prevent an on-the-job impairment for officers using insulin, testing will have to be more frequent to be ideal. With this set as a goal, the occasional short delays in testing caused by situations beyond the control of the officer should not pose a major risk.

For officers using sulfonylureas, a lower risk of hypoglycemia warrants less frequent testing. A pre-shift test is needed to determine the officer's fitness to begin the shift. Testing every four hours thereafter should significantly lower the risk of impairment on the job. Testing at two hours after meals to detect hyperglycemia is also indicated if A1C levels are $\geq 7\%$.

For officers on meglitinides, the risk of hypoglycemia would be expected to be greatest in the postprandial period as glycemic levels drop. These officers should be required to conduct a pre-shift test and a test at least two hours after meals.

For officers on non-hypoglycemic medication or diet, detection of hyperglycemia would warrant a pre-shift test followed by testing at two hours after each meal unless A1C levels are $<7\%$.

Performance Characteristics of the BG Meter. There are a large number of BG meters on the market. To ensure the integrity of the information that is reviewed by the health professional, the BG meter must meet the following requirements:

- Be downloadable to software in the health professional's office,
- Not allow the patient to change recorded values, dates, or times and;
- Automatically recognize and record when control solutions are placed on the testing strip.

The candidate should review these BG meter requirements with his treating physician to ensure that his/her BG meter is acceptable.

Action Threshold for Intervention. The American Diabetes Association (ADA) defines hypoglycemia as a blood glucose level < 70 mg/dL (ADA, 2005). At this level, treatment to raise the blood glucose can be considered.

Impairment from hypoglycemia may begin to occur when blood sugars drop below 70 mg/dl. Action to raise glycemic levels is warranted to provide a margin of safety while performing safety-related tasks. Unfortunately, there are no studies available to assist in the selection of an appropriate threshold at which action should be taken.

A review of the available literature shows that there is no consensus regarding the action threshold for hypoglycemia among drivers. The FMCSA requires that commercial drivers who are treated with insulin (types 1 and 2) take corrective action at glycemic levels of < 100 mg/dl (DOT, 2003).

Individualized assessment, review of the latest treatment guidelines for hypoglycemia and discussion with the treating physician can help determine a proper threshold based upon the candidate's treatment and past hypoglycemic episodes. It is suggested that the threshold for insulin dependent diabetics be 100 mg/dL. In general, persons with type 1 diabetes demonstrate faster descent into hypoglycemia than those with type 2 on insulin (Kovatchev, et al., 2002). Type 2 diabetic subjects on oral hypoglycemic agents are more likely to descend even more slowly. Therefore, it would be reasonable to require, in general, that persons with insulin dependent diabetes take corrective action when their glycemic levels are less than 100 mg/dL. However, if individual review of historical SMBG data indicates evidence of recurrent rapid glycemic descents, the evaluating physician could be justified in recommending a higher action threshold. For persons with type 2 diabetes on oral medications, a lower action threshold may be warranted.

Action levels for hyperglycemia should be set at 300 mg/dl based on the considerations described above.

Appropriate Interventions. To reduce the risk of impairment on the job, aggressive intervention is justified if blood sugars are found to be outside the safe ranges. If the blood sugar is below the hypoglycemic intervention threshold but above 70 mg/dl, 15 grams of fast acting carbohydrate should be ingested. Fifteen minutes later, the blood sugar should be retested. If the glycemic level is still below the action threshold, another 15 grams of fast acting carbohydrate should be ingested. Once the blood glucose has returned to normal, the individual should consume a meal or snack to prevent recurrence (ADA, 2009).

If the glycemic level drops to 70 mg/dl or lower, the officer must be restricted from safety-related duties until levels increase to the hypoglycemic threshold and have been maintained for at least 30 minutes. This is necessary to allow delayed recovery of cognitive functioning (Gonder-Frederick, et al., 1994; Lingren, et al., 1996). If SH occurs either on or off-duty, the officer should be placed on restricted duty until the risk of recurrence can be assessed by the employer's occupational medicine physician. The risk criteria for returning such an officer to full duty should be the same as that used in pre-placement assessments.

For glycemic excursions above the hyperglycemic threshold, the officer should be restricted from safety-related duties until his/her blood sugar has dropped below the threshold. Testing every 30-60 minutes would be appropriate.

If the candidate is willing to comply with these requirements, then it is likely that SMBG would significantly reduce the risk of impairment on the job.

Basal-Bolus Regimens. Older insulin regimens typically involve injecting two shots a day with each shot combining a short-acting insulin such as regular with an intermediate acting insulin such as NPH. The NPH in the morning dose is intended to provide coverage for the glycemic load consumed at lunch. However, if lunch is missed or disrupted (a not-unlikely event for officers), there is a significant risk of hypoglycemia. This risk can be substantially reduced if a basal-bolus regimen is used. A basal-bolus regimen typically involves a long-acting insulin given once a day (insulin glargine) or a continuous constant infusion of insulin (See: "Insulin Pumps" below) supplemented by ultrarapid insulin (insulin aspart or lispro) taken at each mealtime. Unlike regular insulin, which should

be taken 30-45 minutes before a meal, insulin aspart and lispro can be effective when taken as the meal arrives or minutes after eating has commenced. Therefore, basal-bolus regimens greatly increase flexibility in the timing of meals, making it safer for an officer to delay a meal in the event of an emergency. For this reason, a basal-bolus regimen should be required for candidates who use insulin, unless the employer places their officers "off radio" during meals.

5.1.5 Miscellaneous Issues

Alternate site testing. Some BG meters are able to analyze blood obtained from sites other than the fingers It is generally well established that glucose values obtained from alternate sites may not reflect current values when glycemic levels are rapidly changing (ADA, 2003). At these times, the detection of hypoglycemia may be delayed for 15-20 minutes if alternate sites are used. For these reasons, alternative site testing should not be considered acceptable for monitoring officers.

Insulin Pens. Insulin pens eliminate the need for officers to carry syringes and vials. These are compact and facilitate precise dosing. While the cost is somewhat higher, use of pens for administration of insulin while on duty should be strongly encouraged.

Insulin Pumps. Insulin pumps consist of a pager-sized insulin storage and pumping device which is connected to a plastic cannula attached to a small needle. The needle is inserted subcutaneously, usually into the abdomen. The devices provides a continuous basal infusion of insulin, which is supplemented by pre-meal boluses that are controlled by the patient. This allows for more physiologic dosing of insulin and more flexibility in the timing of meals. It is expected that the pump could be used successfully by officers. Dislodgement of the needle is possible due to trauma, but this would result in slowly rising glycemic levels that would be detectable by the frequent SMBG performed by the officers who use insulin. Officers who choose to use a pump should be strongly encouraged to carry an insulin pen as a back-up in case their infusion cannot be easily reestablished.

5.1.6 Recommended Evaluation Protocol

The evaluation protocol consists of three phases:

The first phase assesses the need for work restrictions due to chronic complications or recent episodes of severe hypoglycemia, seizure, or

coma.

The three-month duration second phase of Simulated On-Duty Testing evaluates the candidate's ability to maintain his/her glycemic levels in the range (71-299 mg/dl) that will not require frequent periods of restricted duty.

The third phase requires the candidate to review and sign a pre-placement agreement which obligates them to perform SMBG while on duty as a condition of employment. The agreement also requires the candidate to take appropriate action for blood sugars that are out of range and to provide the employer's designated health professional with access to relevant medical records after hire.

5.1.6.1 History and Record Review

The screening physician should obtain detailed information regarding the candidate's medication regimen, symptoms, and complications of diabetes, use of SMBG, and prior episodes of hypoglycemia with particular emphasis on severe episodes in the previous three years that required assistance of others or resulted in seizure or coma. The physician should download results from the candidate's BG meter if possible, or manually scan the data. Blood sugars below 70 mg/dl or above 300 mg/dl should be discussed with the candidate.

Medical, laboratory, and pharmacy records from the last three years should be obtained from all health care providers. Examinations and testing for retinopathy and nephropathy (microalbuminuria) should be noted. If a retinal examination with dilated pupils has not been completed by an ophthalmologist in the past year, it should be required for all candidates with type 2 diabetes and those with type 1 diabetes for five years or more (ADA, 2009).

In many situations, communication must be made with the candidate's personal physician to evaluate the adequacy of diabetic control because glucose values can vary greatly depending upon the relationship to eating, compliance, emotional state, the presence of illness and the like.

5.1.6.2 Special Examination Recommendations for Diabetic Candidates

Eyes. In addition to pseudoisochromatic plate testing, routine color vision testing for candidates with diabetes should include the Farnsworth Munsell D-15 or other test that specifically assesses the

presence of blue-yellow color vision deficiency. A history of laser photocoagulation would warrant formal perimetry testing conducted by a vision specialist.

Neurological. Screening for peripheral neuropathy should include testing of the deep tendon reflexes, vibratory testing, testing of position sense, and touch sensation. The latter should be done with a Semmes-Weinstein 5.07 (10 gm) monofilament.

Cardiovascular. Orthostatic blood pressure should be measured (See Carlson, 1999 for protocol and interpretative recommendations). Postural hypotension (defined as an orthostatic fall in systolic blood pressure in excess of 20 mmHg) or resting tachycardia (heart rate > 100 bpm, not otherwise explained) is suggestive of autonomic neuropathy. The physical examination should included palpation of pedal pulses and observation of distal extremity hair to evaluate the presence of peripheral vascular disease. To detect silent ischemia, cardiac stress testing is recommended if any one of the following are present (ADA, 2004a):

- Age $\geq$35 years
- Age $\geq$25 years, and either type 2 diabetes > 10 years or type 1 diabetes > 15 years.
- Any additional risk factor for coronary artery disease such as smoking, obesity, hypertension, family history of early coronary artery disease (heart diseases in males < 55, females < 65) or elevated cholesterol).
- Evidence of microvascular disease such as retinopathy or nephropathy.
- Peripheral vascular disease.

Additionally, to detect significant diabetes-related aerobic impairment, candidates with autonomic neuropathy, peripheral neuropathy, microalbuminuria, poor control (HbA1c > 10%) should also be given a cardiac stress test and should be required to complete to at least 10-12 METs.

Routine Testing. If the candidate does not have an HbA1c or urinary microalbumin test done within the past six months, he should obtain these tests from his/her primary physician and bring the results in prior

to clearance. Note that a proper test of microalbuminuria requires a 24 hour urine collection.

Based on the medical record review and the above testing results, restrictions would be warranted if any of the following conditions are detected:

Untreated or unstable severe non-proliferative or proliferative retinopathy. These candidates should be restricted from heavy lifting, wrestling, or jarring activities, such as jumping off walls or exposure to head trauma. These restrictions could be reconsidered after successful laser photocoagulation, assuming that postoperative visual acuity fields meet the vision requirements.

Color Vision Deficiency. Candidates who fail the Farnsworth D-15 should be restricted from law enforcement duties requiring rapid and accurate color identification and high speed emergency driving.

Coronary disease. Unless adequate fitness ($\geq$10-12 METs), without ischemic change or hypertensive response is demonstrated, candidates should be restricted from physical activities. Refer to the Cardiology section for more details.

Exercise impairment. If 10-12 METs is not obtained on treadmill testing, restrictions can be based on the measured maximum aerobic capacity of the candidate. However, candidates should be encouraged to increase the intensity of their physical training, and be offered retesting at a later time.

One or more episodes of severe hypoglycemia in the last three years. Table 1 indicates that the risk of recurrence in the next year is 15-52% for these candidates, which far exceeds an acceptable risk level for on duty incapacitation. This is true even considering that approximately half of the episodes of severe hypoglycemia observed in the DCCT trial occurred while asleep (DCCT, 1991), and that only a third of a person's waking hours are spent at work. Therefore, restricting these candidates from safety-related duties is warranted.

Seizure or coma in the last two years. Seizures and/or coma are severe consequences of hypoglycemia. Table 1 indicates that the risk of recurrence of these events in the next year is 10-32%. Even if this annual risk is reduced by factoring in nocturnal and off-duty episodes (thereby reducing the estimate by a factor of 6), the on duty annual risk still remains above an acceptable level.

Loss of protective sensation in the feet. To prevent ulcerations and fractures, candidates with severe peripheral neuropathy should be restricted from jogging and other traumatic weight-bearing exercises. However, candidates with severe peripheral neuronopathy would likely have significant physical findings on exam that would necessitate extensive restrictions from safety sensitive duties and, perhaps, disqualification by the employer.

Postural hypotension. If this condition is symptomatic, these candidates would need to be restricted from law enforcement duties.

Use of two-shot insulin regimen. To prevent hypoglycemia, these candidates would need to be restricted from assignments that could result in meal disruption.

If there are no findings that warrant restrictions, or if the restrictions indicated above can be accommodated by the employer, then the evaluation can proceed to the Simulated On-Duty Testing. However, prior to doing so, the occupational medicine physician should explain to candidates with HbA1c $>7\%$ that they will be required to conduct more rigorous and frequent SMBG while on duty. They should be encouraged to see their health care provider to determine if their therapeutic regimens can be intensified in order to achieve an HbA1c level of $\leq 7\%$, as recommended by the American Diabetes Association (ADA, 2009).

Additionally, candidates using a two-shot insulin regimen should have the opportunity to change to a basal-bolus regimen if the hiring agency does not allow officers to go "off radio" during meals. If the therapeutic regimen is changed, the Simulated On-Duty Testing evaluation should be deferred until the candidate is stabilized on the new regimen.

5.1.6.3 Simulated On-Duty Testing

Simulated On-Duty Testing involves a three-month prospective individual determination (See Table 4) to evaluate glucose control and self-monitoring. With the exception of those candidates who meet the conditions specified under Group 1, Level 1 (See below), all candidates will be required to perform SMBG while on duty, and to maintain their blood sugars between 70 mg/dL and 300 mg/dl. Since many candidates will find it difficult to achieve 100% compliance with this target range, and excursions will result in periods of restricted duty, the physician should advise the employer regarding how often periods of restricted duty are likely to occur.

To make this assessment on an individualized basis, the occupational medicine physician should require the candidate to undergo a prospective observation period of at least three months duration that simulates on-duty SMBG testing requirements. To accomplish this, the candidate should be required to perform the following:

1. Obtain an approved BG meter with the requirements stated previously in section 5.1.4. The screening physician should recommend that this meter be used exclusively for required testing under this protocol, and that other testing be done on the candidate's pre-existing BG meter. This ensures that the memory capacity of the required BG meter will not be exceeded, and facilitates review of required testing by the screening physician.

2. Select five days of the week that will be simulated on-duty days. (This assumes that the candidate will be working 8-hour shifts; four days could be selected for 10 hour days; three days for 12-hour shifts). The days selected cannot be changed by the candidate once the observation period begins without prior approval from the screening physician.

3. Select the times that the work shift will start and end. This cannot be changed by the candidate once the observation period begins without prior approval of the occupational medicine physician.

4. Select the time that "on-duty" meals will start (only for candidates who do not use insulin). This cannot be changed by the candidate once the observation period begins without prior approval by the occupational medicine physician.

5. Select a start date for the observation period.

6. Perform SMBG within +/- five minutes of the testing times specified by the physician. A short testing window is necessary to prevent candidates from "pretesting" with an alternate BG meter and manipulating their glycemic level prior to testing with the designated BG meter. These testing times should clearly be communicated to the candidate before the observation period commences. The recommended frequency of testing other than the observation period is as follows:

GROUP I: CANDIDATES WHO DO NOT USE INSULIN

Level 1: Controlled with diet and/or a biguanide (Glucophage), alpha-glucosidase inhibitor (Precose, Glyset), or thiazolidinedione (Actos, Avandia); and HbA1c $\leq$7%, or historical glycemic levels are between 70 mg/dL and 300 mg/dL.

No on-duty SMBG is necessary. Therefore, the candidate's evaluation may proceed.

Level 2: Controlled with diet and/or biguanide (Glucophage), alpha-glucosidase inhibitor (Precose, Glyset), or a thiazolidinedione (Actos, Avandia); but HbA1c $\geq$7%, or historical glycemic levels are occasionally >300 mg/dl. Also includes all candidates who use a meglitinide (Prandin or Starlix).

The observation period should include testing at the shift start time and at two hours after "on-duty" meals.

Level 3: Controlled with a sulfonylurea, and HbA1c <7%, and historical glycemic levels are between 70 mg/dL and 300 mg/dL.

The observation period should include testing at the shift start time and every four hours thereafter. No testing at the end of the shift is needed.

Level 4: Controlled with sulfonylurea, but HbA1c $\geq$7%, or historical glycemic levels are >300 mg/dl.

The observation period should include testing at the shift start time, followed by a test every four hours and at two hours after "on-duty" meals. For example, if a 10-hour shift starts at 7AM and ends at 5PM with a meal at noon, testing would be conducted at 7AM, 11AM, and 2PM (two hours after the meal started). For a 12-hour shift ending at 7PM, an additional test would be done at 6PM. No testing at the end of the shift is needed.

GROUP II: CANDIDATES WHO USE INSULIN

The observation period should include testing at the shift start time, and then every two hours. No testing at the end of the shift is needed.

Repeat SMBG within 15 minutes whenever a reading is <100 mg/dL. To avoid dropping below 70 mg/dl, the candidate must take appropriate action such as ingesting 15 grams of fast-acting carbohydrate and retest in 15 minutes.

Before starting the observation period, the occupational medicine physician should inform the candidate that the goal is to maintain all pre-shift and on-duty blood sugars between 70 mg/dL and 300 mg/dL. To accomplish this, candidates should be encouraged to practice on their own and to make any necessary adjustments prior to starting the observation period. Additionally, the screening physician should stress the need for compliance with the timing of the testing regimen, as late or missed tests will be considered to be equivalent to those out of range.

During the observation period, candidates should provide their BG meter to the screening physician at 4-6 week intervals for downloading. Submission of BG meter printouts from candidates is not acceptable, since the BG meter software allows the user to alter the data prior to printing.

After reviewing the BG meter data, the physician should discuss out-of-range and missed dates with the candidates. There may be occasions with the candidate questions the results of a test and immediately repeats it. An inaccurate result could be the result of technical errors, such as failure to cleanse and dry fingers appropriately. If a second test is completed with 2-3 minutes, the physician may consider it. However, frequent retests (> 1-2/month) should be discussed with the candidate. If recurrent missed tests result from scheduling conflicts with other activities, the physician may consider changing the test days and start times for future testing.

At the end of the three-month observation period, the physician should be able to estimate the number of times per year that the candidate will be on restricted duty (count any missed values as out-of-range). For example, if there was one excursion out of the required range during the three month observation period, the physician can advise the employer that the candidate will likely experience four episodes of short-term restricted duty perform year. For those with zero excursions or missed

values, no advisement is necessary.

In certain cases, an extension of the observation period beyond three months may be advantageous to a candidate. For example if the candidate experienced one or two excursions/misses during the three month observation period, an additional three months of monitoring with zero excursions or misses would allow the physician to reduce the estimate for the frequency of restricted duty periods in half. This option should be discussed and offered to the candidate.

5.1.7 Required Conditions for Employment

To ensure that neither acute nor chronic complications of diabetes create a direct threat or harm to the candidate or others, it is critically important for candidates to agree to the following conditions:

Acute Complications. Candidates should sign an agreement that obligates him/her to perform SMBG while on duty (except for Group 1, Level 1 Candidates; see below) and to take appropriate action for values that are out of range. Since type 2 diabetes is usually a progressive disease with the eventual need for more intensive therapy, these candidates must agree in writing to notify the employer's designated occupational medicine physician if their medication regimen is significantly altered. Since an episode of severe hypoglycemia (even while off duty or asleep) creates a period of particularly high risk for a recurrent episode, the candidate must also agree to immediate notification of such an event. Verification of these conditions also requires that the candidate agrees to periodically provide their diabetic records for review by the occupational medicine physician.

Chronic Complications. The potential for development of chronic complications warrants that the special examination procedures recommended above (i.e., color vision, monofilament, orthostatic blood pressure, and stress testing) be repeated periodically. As a balance between the cost of these examinations and the probability of detecting a condition that would warrant restriction, it is recommended that these procedures be repeated every five years for candidates who have had diabetes for less than ten years, or who have demonstrated good glycemic control (HbA1c levels predominately $<7\%$). Retesting in other candidates should be performed every two years. Also, per the recommendations of the ADA, a dilated retinal examination by a vision specialist should be performed at least every year. (ADA, 2009) The occupational medicine physician should confirm with the primary treating physician that these recurrent examinations will occur in a

timely manner.

Sample Pre-Placement Agreements (Forms 1 though 5) are provided for each evaluative group and level described. Note that all of the agreements for Group I candidates included an admonishment that more intensive on-duty monitoring may be required after hire if the condition worsens.

Once the agreement is signed and returned to the screening physician, the evaluation process may be completed by informing the employer of any restrictions identified. Additionally, except for Group I, Level 1 candidates, the screening physician should advise the employer that the following accommodations are necessary for the candidate to perform safety-sensitive duties without posing a direct threat of harm to himself or others:

1. The candidate must be allowed several minutes for blood glucose testing while on duty. This will be necessary at least ___ [insert frequency excluding pre-shift test] per ____ [insert number of hours] hour shift. Testing could be deferred if the candidate is responding to an emergency situation.

2. The candidate must be allowed to carry glucose tablets or oral gel.

3. The candidate is medically authorized to self-identify brief periods of time (usually lasting 30-60 minutes) during which he/she is not fit to perform safety duties. It is anticipated that these periods will occur approximately, ___ times per year [the frequency of restricted duty periods was estimated above). Note: this advisement can be omitted for candidates who had no out-of-range excursions or missed testing during the observation period.

It is up to the employer to decide whether the candidate can be hired with reasonable accommodation.

5.1.8 Monitoring on the Job Compliance

As discussed above, the mitigation of the risks posed by a diabetic officer requires that the candidate agree to number conditions. However, the effectiveness of the pre-placement agreement depends, in large part, on enforcement of these provisions by the employer. This requires the services of a health care professional (HCP) to monitor

compliance with the agreement.

The duties of the HCP include the following:

1. Designate the times at which the law enforcement officer must perform on-duty SMBG.

2. Critically review documentation provided by the law enforcement officer regarding any failure to perform SMBG at the designated times.

3. Download the law enforcement officer's BG meter at intervals of 1-2 months.

4. Assess the need for changes in on-duty SMBG protocols based on changes in therapy or A1C levels per these guidelines.

5. Place the officer on restricted duty if indicated by the guidelines.

6. Review medical records to determine of the officer has failed to report initiation of insulin-infusion testing, an episode of impairment, or has failed to obtain proper eye examinations.

7. Report compliance violations to the employer for possible disciplinary action.

8. Conduct a periodic medical work fitness evaluation to determine if any chronic complications have developed that may pose a direct threat of harm in the performance of law enforcement tasks.

The HCP selected should be a physician who has a thorough knowledge of the diabetes guidelines. However, this physician could delegate many of the duties listed above to an ancillary HCP under his/her direct supervision, such as a RN, or other health care professional having certification in diabetes education (C.D.E.). Moreover, since the responsibilities of the HCP may necessitate placing work restrictions on the officer and/or reporting violations that could lead to disciplinary action, including discharge, it is critically important that the HCP selected by the employer be free of any conflict of interest that could inhibit the performance of these duties.

All forms should be first reviewed and cleared by the employer's legal advisor prior to use.

Table 4: Pre-placement Agreement Forms

FORM 1 Pre-placement Agreement Form for Group 1, Level 1

Diabetes controlled with Diet and/or a Biguanide (Glucophage), Alpha-Glucosidase Inhibitor (Precose, Glyset), or Thiazolidinedione (Actos, Avandia), or equivalent oral medication (except for a sulfonylurea) and HbA1c <7%, and Historical Glycemic Levels between 70 mg/dL and 300 mg/dL.

FORM 2 Pre-placement Agreement Form for Group 1, Level 2

Diabetes controlled with Diet and/or Biguanide (Glucophage), Alpha-Glucosidase Inhibitor (Precose, Glyset), Thiazolidinedione (Actos, Avandia), Meglitinide (Prandin, Starlix) or an equivalent oral medication (except for a sulfonylurea) and HbA1c $\geq$7%, or Historical Glycemic Levels Occasionally >300 mg/dl.

FORM 3 Pre-placement Agreement Form for Group 1, Level 3

Diabetes controlled with a Sulfonylurea, with HbA1c <7%, and Historical Glycemic Levels between 70 mg/dL and 300 mg/dL.

FORM 4 Pre-placement Agreement Form for Group 1, Level 4

Diabetes controlled with Sulfonylurea, with HbA1c $\geq$7%, or Historical Glycemic Levels >300 mg/dl.

FORM 5 Pre-placement Agreement Form for Group 2

Diabetes controlled with insulin.

FORM 1 Pre-placement Agreement Form: Group 1, Level 1

I _____, agree to the following as conditions of employment as a commissioned law enforcement officer for the _____. I understand that these conditions are offered to me as an accommodation for my medical condition of diabetes.

1) I will obtain HbA1c testing every six months from my private physician, and will inform the employer's designated health care professional (HCP) before my next shift if any HbA1c level is greater than or equal to 7 percent. I understand that this will obligate me to begin self-monitoring my blood sugars while on duty, and to maintain my blood sugars in a range between 70 mg/dL and 300 mg/dl.

2) I will obtain a dilated retinal examination from a vision specialist at a minimum of every year from the date of this Agreement, and will inform the HCP before the start of my next shift if laser photocoagulation is recommended or performed.

3) If I begin using insulin or a new oral medication even on an intermittent or regular basis to control my diabetes, I will notify the HCP before my next shift. I understand that the use of these medication swill result in the need for me to begin self-monitoring my blood sugars while performing law enforcement duties, and to maintain my blood sugar in a range of between 70 mg/dL and 300 mg/dl.

4) I will report any episodes of impaired mental abilities or altered consciousness to the HCP either on the day of occurrence, or before beginning my next shift, regardless of whether the episode occurred on or off duty.

5) To verify compliance with items 1-4 of this Agreement, I agree to provide the HCP with full access to the medical and pharmacy records related to my diabetes upon request. I understand that these will be requested on a routine basis every 1-2 years.

6) I consent to medical work fitness examinations by the HCP every 2-5 years to ensure that I have not developed any chronic complications that may pose a direct threat of harm to myself or others while on duty.

7) I understand that failure to comply with this agreement could result in work restrictions and/or disciplinary action, including discharge.

By signing below, I acknowledge that I have read and accept the conditions of this Notice of Conditional Employment.

_____ _____

Signature of Employee Date

In my opinion the foregoing medical restrictions and conditions of employment are necessary for the safe performance of the essential job functions of the position.

_____ _____

Occupational Medicine Physician Date

FORM 2 Pre-placement Agreement Form Group 1, Level 2

I _____, agree to the following as conditions of employment as a commissioned law enforcement officer for the _____. I understand that these conditions are offered to me as an accommodation for my medical condition of diabetes.

1) While performing duties as a law enforcement officer, I agree to test my blood sugar using a blood glucose meter designated the employer's Health Care Professional (HCP) at the start of my work shift and two hours following each on-duty meal. The specific times at which testing must be performed will be designated by the employer's HCP.

2) I understand that the test must be conducted within a time frame that commences five minutes before the specified testing time and ends five minutes there after. If on occasion, I am not able to perform the testing within this designated time frame, I must record and/or obtain sufficient documentation indicate that my failure to test was due to circumstances beyond my control. I must maintain this documentation and agree to provide it to the HCP upon request.

3) If my blood glucose meter reading is 71-100 mg/dl during any of these tests, I agree to raise my blood sugar by consuming a fast-acting carbohydrate. Furthermore, I agree to retest my blood sugar within 15 minutes. If, upon this repeat testing, my blood sugar is not 100 mg/dl or higher, I agree to repeat ingestion of additional fast-acting carbohydrates and blood sugar testing as necessary to raise my blood sugar to 100 mg/dl or higher.

4) If my blood glucose meter reading is less than 70 mg/dl during any of these tests, I agree to inform my supervisor that I am not fit to perform safety-related duties. I will then attempt to raise my blood sugar by consuming a fast-acting carbohydrate. I may return to full duty if retesting of my blood sugar after 15 minutes indicates a glycemic level of 100 mg/dl or higher.

5) If my blood glucose meter reading is greater than 300 mg/dl during any of these tests, I agree to inform my supervisor that I am not fit to perform safety-related duties. I will test my blood sugar a minimum of at least every 30-60 minutes and will return to full duty when my blood sugar indicates a glycemic level of 300 mg/dl or lower.

6) I agree to provide the blood glucose meter that I use for testing pursuant to this agreement to the HCP for downloading upon request. I understand that I may be required to do this as frequently as once per month.

7) If I begin using insulin or a new oral medication even on an intermittent basis to control my diabetes, I will notify the HCP before my next shift. I understand that the use of these medications will result in the need for me to increase the frequency of on-duty blood sugar testing.

8) I will report any episodes of impaired mental abilities or altered consciousness to the HCP either on the day of occurrence, or before beginning my next shift, regardless of whether the episode occurred on or off duty.

9) I will obtain a dilated retinal examination from a vision specialist at a minimum of every year from the date of this Agreement, and will inform the HCP before the start of my next shift if laser photocoagulation is recommended or performed.

10) To verify compliance with items 7-9 of this Agreement, I agree to provide the HCP with full access to the medical and pharmacy records related to my diabetes upon request. I understand that these will be requested on a routine basis every 1-2 years.

11) I consent to medical work fitness examinations by the HCP every 2-5 years to ensure that I have not developed any chronic complications that may pose a direct threat of harm to myself or others while on duty.

12) I understand that failure to comply with this Agreement could result in work restrictions and/or disciplinary action, including discharge.

By signing below, I acknowledge that I have read and accept the conditions of this Notice of Conditional Employment.

_____ _____

Signature of Employee Date

In my opinion the foregoing medical restrictions and conditions of employment are necessary for the safe performance of the essential job functions of the position.

_____ _____

Occupational Medicine Physician Date

FORM 3 Pre-placement Agreement Form Group 1, Level 3

I _____, agree to the following as conditions of employment as a commissioned law enforcement officer for the _____. I understand that these conditions are offered to me as an accommodation for my medical condition of diabetes.

1) While performing duties as a law enforcement officer, I agree to test my blood sugar using a blood glucose meter designated the employer's Health Care Professional (HCP) at the start of my work shift and every four hours there after. The specific times at which testing must be performed will be designated by the employer's HCP.

2) I understand that the test must be conducted within a time frame that commences 5 minutes before the specified testing time and ends five minutes thereafter. If on occasion, I am not able to perform the testing within this designated time frame, I must record and/or obtain sufficient documentation indicating that my failure to test was due to circumstances beyond my control. I must maintain this documentation and agree to provide it to the HCP upon request.

3) If my blood glucose meter reading is between 70 mg/dL and 300 mg/dl during any of these tests, I agree to raise my blood sugar by consuming a fast-acting carbohydrate. Furthermore, I agree to retest my blood sugar within 15 minutes. If, upon this repeat testing, my blood sugar is not 100 mg/dl or higher, I agree to repeat ingestion of additional fast-acting carbohydrates and blood sugar testing as necessary to raise my blood sugar to 100 mg/dl or higher.

4) If my blood glucose meter reading is less than 70 mg/dL during any of these tests, I agree to inform my supervisor that I am not fit to perform safety-related duties. I will then attempt to raise my blood sugar by consuming a fast-acting carbohydrate. I may return to full duty if retesting of my blood sugar after 15 minutes indicates a glycemic level of 90 mg/dl or higher.

5) If my blood glucose meter reading is greater than 300 mg/dl during any of these tests, I agree to inform my supervisor that I am not fit to perform safety-related duties. I will test my blood sugar a minimum of at least every 30-60 minutes and will return to full duty when my blood sugar indicates a glycemic level of 300 mg/dl or lower.

6) I agree to provide the blood glucose meter that I use for testing pursuant to this agreement to the HCP for downloading upon request. I understand that I may be required to do this as frequently as once per month.

7) If I begin using insulin on an intermittent or regular basis to control my diabetes, I will notify the HCP before my next shift. I understand that the use of this medication will result in the need for me to increase the frequency of on-duty blood sugar testing.

8) I will report any episodes of impaired mental abilities or altered consciousness to the HCP either on the day of occurrence, or before beginning my next shift, regardless of whether the episode occurred on or off duty.

9) I will obtain a dilated retinal examination from a vision specialist at a minimum of every year from the date of this Agreement, and will inform the HCP before the start of my next shift if laser photocoagulation is recommended or performed.

10) I will obtain HbA1c testing every six months from my doctor, and will inform the employer's HCP before my next shift if any HbA1c level is greater than or equal to 7%. I understand that this will result in the need to increase the frequency of on-duty blood sugar testing.

11) To verify compliance with items 7-10 of this Agreement, I agree to provide the HCP with full access to the medical and pharmacy records related to my diabetes upon request. I understand that these will be requested on a routine basis every 1-2 years.

12) I consent to medical work fitness evaluations by the HCP every 2-5 years to ensure that I have not developed any chronic complications that may pose a direct threat of harm to myself or others while on duty.

13) I understand that failure to comply with this Agreement could result in work restrictions and/or disciplinary action, including discharge.

By signing below, I acknowledge that I have read and accept the conditions of this Notice of Conditional Employment.

_____ _____

Signature of Employee Date

In my opinion the foregoing medical restrictions and conditions of employment are necessary for the safe performance of the essential job functions of the position.

_____ _____

Occupational Medicine Physician Date

FORM 4 Pre-placement Agreement Form Group 1, Level 4

I _____, agree to the following as conditions of employment as a commissioned law enforcement officer for the _____. I understand that these conditions are offered to me as an accommodation for my medical condition of diabetes.

1) While performing duties as a law enforcement officer, I agree to test my blood sugar using a blood glucose meter designated the employer's Health Care Professional (HCP) at the start of my work shift and every four hours thereafter. The specific times at which testing must be performed will be designated by the employer's HCP.

2) I understand that the test must be conducted within a time frame that commences 5 minutes before the specified testing time and ends five minutes thereafter. If on occasion, I am not able to perform the testing within this designated time frame, I must record and/or obtain sufficient documentation indicating that my failure to test was due to circumstances beyond my control. I must maintain this documentation and agree to provide it to the HCP upon request.

3) If my blood glucose meter reading is 71-99 mg/dl during any of these tests, I agree to raise my blood sugar by consuming a fast-acting carbohydrate. Furthermore, I agree to retest my blood sugar within 15 minutes. If, upon this repeat testing, my blood sugar is not 100 mg/dl or higher, I agree to repeat ingestion of additional fast-acting carbohydrates and blood sugar testing as necessary to raise my blood sugar to 100mg/dl or higher.

4) If my blood glucose meter reading is less than 70 mg/dl during any of these tests, I agree to inform my supervisor that I am not fit to perform safety-related duties. I will then attempt to raise my blood sugar by consuming a fast-acting carbohydrate. I may return to full duty if retesting of my blood sugar after 15 minutes indicates a glycemic level of 100 mg/dl or higher.

5) If my blood glucose meter reading is greater than 300 mg/dl during any of these tests, I agree to inform my supervisor that I am not fit to perform safety-related duties. I will test my blood sugar a minimum of at least every 30-60 minutes and will return to full duty when my blood sugar indicates a glycemic level of 300 mg/dl or lower.

6) I agree to provide the blood glucose meter that I use for testing pursuant to this agreement to the HCP for downloading upon request. I understand that I may be required to do this as frequently as once per month.

7) If I begin using insulin on an intermittent or regular basis to control my diabetes, I will notify the HCP before my next shift. I understand that the use of this medication will result in the need for me to increase the frequency of on-duty blood sugar testing.

8) I will report any episodes of impaired mental abilities or altered consciousness to the HCP either on the day of occurrence, or before beginning my next shift, regardless of whether the episode occurred on or off duty.

9) I will obtain a dilated retinal examination from a vision specialist at a minimum of every year from the date of this Agreement, and will inform the HCP before the start of my next shift if laser photocoagulation is recommended or performed.

10) To verify compliance with items 7-9 of this Agreement, I agree to provide the HCP with full access to the medical and pharmacy records related to my diabetes upon request. I understand that these will be requested on a routine basis every 1-2 years.

11) I consent to medical work fitness examinations by the HCP every 2-5 years to ensure that I have not developed any chronic complications that may pose a direct threat of harm to myself or others while on duty.

12) I understand that failure to comply with this Agreement could result in work restrictions and/or disciplinary action, including discharge.

By signing below, I acknowledge that I have read and accept the conditions of this Notice of Conditional Employment.

_____ _____

Signature of Employee Date

In my opinion the foregoing medical restrictions and conditions of employment are necessary for the safe performance of the essential job functions of the position.

_____ _____

Occupational Medicine Physician Date

FORM 5 Pre-placement Agreement Form Group 2

I _____, agree to the following as conditions of employment as a commissioned law enforcement officer for the _____. I understand that these conditions are offered to me as an accommodation for my medical condition of diabetes.

1) While performing duties as a law enforcement officer, I agree to test my blood sugar using a blood glucose meter designated the employer's Health Care Professional (HCP) at the start of my work shift and every four hours thereafter. The specific times at which testing must be performed will be designated by the employer's HCP.

2) I understand that the test must be conducted within a time frame that commences 5 minutes before the specified testing time and ends five minutes thereafter. If on occasion, I am not able to perform the testing within this designated time frame, I must record and/or obtain sufficient documentation indicating that my failure to test was due to circumstances beyond my control. I must maintain this documentation and agree to provide it to the HCP upon request.

3) If my blood glucose meter reading is between 70 mg/dl and 100 mg/dl during any of these tests, I agree to raise my blood sugar by consuming a fast-acting carbohydrate. Furthermore, I agree to retest my blood sugar within 15 minutes. If, upon this repeat testing, my blood sugar is not 100 mg/dl or higher, I agree to repeat ingestion of additional fast-acting carbohydrates and blood sugar testing as necessary to raise my blood sugar to 100 mg/dl or higher.

4) If my blood glucose meter reading is less than 70 mg/dl during any of these tests, I agree to inform my supervisor that I am not fit to perform safety-related duties. I will then attempt to raise my blood sugar by consuming a fast-acting carbohydrate. I may return to full duty if retesting of my blood sugar after 15 minutes indicates a glycemic level of 100 mg/dl or higher.

5) If my blood glucose meter reading is greater than 300 mg/dl during any of these tests, I agree to inform my supervisor that I am not fit to perform safety-related duties. I will test my blood sugar a minimum of at least every 30-60 minutes and will return to full duty when my blood sugar indicates a glycemic level of 300 mg/dl or lower.

6) I agree to provide the blood glucose meter that I use for testing pursuant to this agreement to the HCP for downloading upon request. I understand that I may be required to do this as frequently as once per month.

7) I will report any episodes of impaired mental abilities or altered consciousness to the HCP either on the day of occurrence, or before beginning my next shift, regardless of whether the episode occurred on or off duty.

8) I will obtain a dilated retinal examination from a vision specialist at a minimum of every year from the date of this Agreement, and will inform the HCP before the start of my next shift if laser photocoagulation is recommended or performed.

9) To verify compliance with items 7-8 of this Agreement, I agree to provide the HCP with full access to the medical and pharmacy records related to my diabetes upon request. I understand that these will be requested on a routine basis every 1-2 years.

10) I consent to medical work fitness examinations by the HCP every 2-5 years to ensure that I have not developed any chronic complications that may pose a direct threat of harm to myself or others while on duty.

11) I understand that failure to comply with this Agreement could result in work restrictions and/or disciplinary action, including discharge.

By signing below, I acknowledge that I have read and accept the conditions of this Notice of Conditional Employment.

_____ _____

Signature of Employee Date

In my opinion the foregoing medical restrictions and conditions of employment are necessary for the safe performance of the essential job functions of the position.

_____ _____

Occupational Medicine Physician Date

5.2 Parathyroid Disorders

Primary hyperparathyroidism results from the excess production of parathyroid hormone (PTH). Secondary hyperparathyroidism is caused by other metabolic problems such as end stage renal failure, vitamin D deficiency, and calcium absorption problems. Asymptomatic hypercalcemia is usually caused by primary hyperparathyroidism. Depending on the degree of elevation, excess calcium may cause fatigue, depression, mental confusion, anorexia, nausea, vomiting, constipation, polydipsia, polyuria or cardiac arrhythmias. Kidney stones may be associated with hypercalcemia, and the possibility of an underlying malignancy causing hypercalcemia should be considered. The most common cause of primary hyperparathyroidism is a benign adenoma, and the condition is improved upon excision. Patients with hyperparathyroidism may also have accompanying peptic ulcer disease and hypertension from a pheochromocytoma. This condition is referred to Multiple Endocrine Neoplasia 2 (MEN 2).

5.2.1 Recommended Evaluation Guidelines Undiagnosed Abnormalities

Undiagnosed abnormalities in calcium levels require evaluation, diagnosis, and treatment before medical clearance. Calcium and phosphate levels should be in an acceptable range based on two lab tests conducted at least one month apart as provided by the primary care physician or treating specialist. The candidate should be asymptomatic.

5.3 Thyroid Disorders

Thyroid disorders result an excess or insufficient amount of circulating thyroid hormone. Hyperthyroidism commonly causes nervousness, emotional lability, inability to sleep, tremors, frequent bowel movements, excessive sweating and heat intolerance. Muscle weakness and weight loss may progress to the point where stair climbing is difficult. Cardiovascular disorders, such as atrial fibrillation or congestive heart failure, may occur. Hypothyroidism often has an insidious onset and includes symptoms such as lethargy, constipation, stiffness or cramping of muscles, or carpal tunnel syndrome. Intellectual activity slows, hair loss may occur, and the voice may become hoarse.

5.3.1 Recommended Evaluation Guidelines for Thyroid Abnormalities

Thyroid abnormalities require evaluation, diagnosis, and treatment prior to medical clearance. Stable thyroid levels (Free T4 & TSH) in the normal range should be obtained from two lab tests conducted at least one month apart as provided by the primary care physician or treating specialist. Candidates on thyroid replacement should be asymptomatic and have normal or low TSH levels.

5.4 Adrenal Disorders

The adrenal glands produce corticosteroids that affect metabolism and sodium-potassium balance in the body, catecholamines that regulate heart rate, blood pressure and sweating, and other body responses.

Corticosteroid insufficiency is characterized by agitation, weakness, anorexia, nausea, vomiting, hypotension, or hypoglycemia. Excess corticosteroids may cause hypertension, glucose intolerance, psychological conditions and gastrointestinal problems.

5.4.1 Recommended Evaluation Guidelines Adrenal Abnormalities

Adrenal abnormalities require evaluation, diagnosis, and treatment before medical clearance. No cardiac arrhythmia or hypertension should be present. Sodium and potassium should be in normal range. Candidates with adrenal insufficiency should provide documentation of their ability to perform vigorous physical activity under stress and adverse environmental conditions without weakness or compromised function. Acceptable documentation may include review of current job duties, work attendance records, medical records and recreational activities.

5.5 Obesity

Obesity is an excess of body fat frequently resulting in a significant impairment of health. Patients with obesity have higher risks for heart disease, diabetes, cancer and other health problems. Excess fat weight makes movement inefficient and difficult. On the other hand, a high lean body weight allows the body to accomplish work efficiently and expend more calories even at rest.

5.5.1 Recommended Evaluation Guidelines for Obesity

There is no absolute level of weight, weight for height, BMI or percent body fat that can be used as a cutoff for safe performance of job functions. With regard to the American Disability Act, the Equal Employment Opportunity Commission (EEOC) states, "except in rare circumstances, obesity is not considered a disabling impairment (29 CFR 1630.2[j]). A person who was so morbidly obese that he or she was presently and substantially disabled in performing major life activities is unlikely to be able to perform the essential functions of any law enforcement occupation.

When a candidate presents with obesity, the occupational medicine physician should consider any relevant safety factors such as the ability of the candidate to safely drive. If the candidate is so obese that he or she cannot freely turn the wheel of a patrol car, the candidate should be disqualified. The candidate should also be able to see objects that are dropped near him/her. For example, if a candidate is so obese, he or she cannot see a gun on the floor near his or her feet, rejecting this candidate due to safety concerns would be reasonable.

The simplest way to examine body weight status is to calculate the body mass index (BMI). The formula to calculate the BMI is kg/m^2 or body weight in kilograms divided by height in meters squared (Nieman, 1990, p. 115). As BMI increases, mortality from heart disease, cancer and diabetes also increases (Bray & Gray, 1988). Federal guidelines state that a BMI of less than 25 represents the normal healthy individual (NIH, 2000, p. 1). The following grading system for BMI has been established for both males and females:

Table 4: **Standard Values for Body Mass Index**

Rating
• Underweight — BMI <18.5 kg/m^2
• Normal weight — BMI $=18.5$ to 24.9 kg/m^2
• Overweight — BMI $=25.0$ to 29.9 kg/m^2
• Class I obesity — BMI of 30.0 to 34.9 kg/m^2
• Class II obesity — BMI of 35.0 to 39.9 kg/m^2
• Class III obesity — BMI $=40$ kg/m^2

Data from National Heart Lung and Blood Institute, US Department of Health and Human Services, National Institutes for Health (1998).

Another measurement that should be conducted is waistline circumference, which is a measure of central adiposity. Candidates in the overweight range (BMI = 25-29.9 kg/m^2) and a waist circumference greater than 102 cm (40 in) for men and 88 cm (35 in) for women are at a higher risk for hypertension, type 2 diabetes, dyslipidemia, and heart disease. Cardiac stress testing is recommended in these individuals to detect silent ischemia.

In the absence of any universal body fat requirement, departments are free to negotiate body fat percentage job standards with law enforcement unions.

6.0 REFERENCES

29 Code of Federal Regulations Pt. 1630 (1992).

49 Code of Federal Regulations Pt. 391.41 (b) [3] (1995).

American Diabetes Association (ADA). (2009). Executive Summary: Standards of Medical Care in Diabetes. *Diabetes Care*, 32, (S6-S12).

American Diabetes Association (ADA). (2006). Physical Activity/Exercise and Type 2 Diabetes: A consensus statement from the American Diabetes Association. *Diabetes Care*, 29, 6, (1443-38).

American Diabetes Association (ADA). (2004a). Clinical practice recommendations: physical activity/exercise and diabetes. *Diabetes Care*, (Suppl. 1) 27, s58-62.

American Diabetes Association. (2004b). Clinical practice recommendations: The standards of care in diabetes. *Diabetes Care*, (Suppl. 1) 27, s15-35.

American Diabetes Association (ADA). (2003). Blood glucose monitors and data management. *Diabetes Forecast*, 77-103).

Amatuzio, D.S., et al., (1953). Interpretation of the rapid intravenous glucose tolerance test in normal individuals and in mild diabetes mellitus. *J Clin Invest*, 32, 428-35.

Banford, D., et al. (1994). Longitudinal study of visual functions in young insulin dependent diabetics. *Ophthalmic Physiol Opt*, 14, 339-46.

Benbassat, C.A., et al., (2001). Pulmonary function in patients with diabetes mellitus. *Am J Med Sci*. 3, 127-32.

Bray, G.A. & Gray, D.S. (1988). Obesity: Part I - Pathogenesis. *W J Medicine.* 149, 429

Burge, M.R. et al., (1998), A prospective trial of risk factors for sulfonylurea-induced hypoglycemia in type 2 diabetes mellitus. *J Am Med Assoc.* 14, 137-43.

Carlson, J.E. (1999). Assessment of orthostatic blood pressure: Measurement technique and clinical applications. *South Med J.* 92, 167-73.

Centers for Disease Control (CDC). (2009). *National Diabetes Fact Sheet*. http://www.cdc.gov/diabetes/pubs/estimates.htm

Colberg, S. (2001). *The Diabetic Athlete: Prescriptions for Exercise and Sports*. Champaign, IL:Human Kinetics Press.

Cox, D.J. et al., (1999). Biopsychological model of severe hypoglycemia II. *Diabetes Care*. 22, 2018-25.

Cox, D.J., et al., (2000). Progressive hypoglycemia's impacting on driving simulation performance. *Diabetes Care*, 23, 163-170.

Cox, D.J., et al., (2002a). The effects of glucose fluctuation on cognitive function and QOL. *Int J Clin Pract Suppl*, 129, 20-26.

Cox, D.J., Gonder-Frederick, L.A., Kovatchev, B.P., & Clarke W.L. (2002b). The metabolic demands of driving for drivers with type 1 diabetes mellitus. *Diabetes Metab Res Rev*, 18, 5, 381-385.

Cox, D.J., et al., (2003). Diabetes and driving mishaps, *Diabetes Care* ,26, 2329-34.

Cox, D.J, et al., (2005). Relationships between hyperglycemia and cognitive performance among adults type 1 and type 2 Diabetes, *Diabetes Care*, 28, 71 – 77.

Damsbo, P. et al., (1999). A double-blind randomized comparison of meal-related glycemic control by repaglinide and glyburide in well-controlled type 2 diabetic patients. *Diabetes Care*, 22, 789-94.

DCCT Research Group. (1991). Epidemiology of severe hypoglycemia in the diabetes control and complications trial. *Am J Med*, 90, 450-459.

DCCT Research Group. (1993). The effects of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *NEJM,* 329, 977-86.

DCCT Research Group. (1997). Hypoglycemia in the diabetes control and complications trial, *Diabetes,* 46, 271-86.

Deary, I.J. (1999). Symptoms of hypoglycemia and effects on mental performance and emotions. In: *Hypoglycaemia in Clinical Diabetes*. Frier, B.M. & Fisher, B.M. (eds.). Chrickerester, UK: Wiley and Sons.

Draelos, M.T., et al., (1995). Cognitive function in patients with insulin-dependent diabetes during hyperglycemia and hypoglycemia. *Am J Med,* 98, 135-44.

Erlinger, T.P. & Brancati, F.L. (2001). Post challenge hyperglycemia in a national sample of U.S. adults with type 2 diabetes. *Diabetes Care*, 24, 1734-38.

Fanelli, C.G., et al., (1998). Impact of nocturnal hypoglycemia on hypoglycemic cognitive dysfunction in type 1 diabetes. *Diabetes Care*, 47, 1920-27.

Fong, D.S., et al., (2004). Retinopathy in diabetes. *Diabetes Care*. 27, S84-S87.

Furushima, M., et al., (1999). Changes in refraction caused by induction of acute hyperglycemia in healthy volunteers. *Jpn Ophthalmol,* 43, 398-403.

Gold, A.E., et al., (1997). A structural equation model for the prediction of severe hypoglycaemia in patients with insulin-dependent diabetes mellitus. *Diabet Med,* 14, 309-315.

Gonder-Frederick, L.A., et al., (1994). Individual differences in neurobehavioral disruption during mild and moderate hypoglycemia in adults with IDDM. *Diabetes*, 43, 1407-1412.

Gwinup, G. & Villarreal, A. (1976). Relationship of serum glucose concentration to changes in refraction. *Diabetes*, 25, 29-31.

Hardy, K.J., et al., (1992). Detection of colour vision abnormalities in uncomplicated type 1 diabetic patients with angiographically normal retinas. *Br J Ophthalmol*, 76, 461-64.

Hepburn, D.A., et al., (1993). Frequency and symptoms of hypoglyce mia and hyperglycemia in type 1 diabetes. *Diabet Med*, 10, 231-237.

Hoffman, R.G., et al., (1989). Changes in cortical functioning with acute hypoglycemia and hyperglycemia in type 1 diabetes. *Diabetes Care*, 12, 193-7.

Hollander, P.A., et al., (2001). Importance of early insulin secretion: comparison of nateglinide and glyburide in previously diet-treated patients with type 2 diabetes. *Diabetes Care*, 24, 983-88.

Holmes, C.S. (et al., (1986). Simple vs. complex performance impairments at three blood glucose levels. *Psychoneuroendocrinolgy*, 11, 353-7.

Holstein, A., et al., (2001). Lower incidence of severe hypoglycaemia in patients with type 2 diabetes treated with glimepiride. *Diabetes Metab Res Rev*, 17, 467-73.

Holstein, A. & Egberts, E.H. (2003). Risk of hypoglycaemia with oral antidiabetic agents in patients with type 2 diabetes. *Exp Clin Endocrinol Diabetes*, 111, 405-14.

Jennings, A.M., et al., (1989). Symptomatic hypoglycemia in NIDDM patients treated with oral hypoglycemic agents. *Diabetes Care*, 12, 203-8.

Jensen, T., et al., (1998). Impaired aerobic work capacity in insulin dependent diabetics with increased urinary albumin excretion. *Brit Med J*, 296, 1352-4.

Kjaer, M., Hollenbeck, C.B., Frey-Hewitt, B., Galbo, H., Haskell, W., Reaven G.M. (1990). Glucoregulation and hormonal responses to maximal exercise in non-insulin-dependent diabetes. *J Appl Physiol*, 68, 2067-74.

Korzon-Buirakowska, A., et al., (1998). Effects of glycemic control on protective responses against hypoglycemia in type 2 diabetes. *Diabetes Care*, 21, 283-290.

Kovatchev, B.P., Cox, D.J., Gonder-Frederick, L.A., Young-Hyman D., Schlundt, D. & Clarke, W.L. (1998). Assessment of risk for severe hypoglycemia among adults with IDDM. *Diabetes Care*, 21, 1870-5.

Kovatchev, B.P., Cox, D.J., Gonder-Frederick, L.A., & Clarke, W.L. (2002). Methods for quantifying self-monitoring blood glucose profiles. *Diabetes Technology & Therapeutics*, 4, 295-303.

Kovatchev, B.P., Cox, D.J., Kumar, A., Gonder-Frederick, L.A., Clarke, W.L. (2003). Algorithmic evaluation of metabolic control and risk of severe hypoglycemia in type 1 and type 2 diabetes using self-monitoring blood glucose data. *Diabetes Technology & Therapeutics*, 5, 817-28.

Kristensen, J.S. et al., (2000). Compared with repaglinide sulfonylurea treatment in type 2 diabetes is associated with a 2.5-fold increase in symptomatic hypoglycemia with blood glucose levels <45 mg/dl [abstract]. *Diabetes*, 49 Suppl. 1, A131.

Kurtenbach, A., et al., (1994). Brightness matching and colour discrimination in young diabetics without retinopathy. *Vis Res*, 34, 115-22.

Lakowski, R. et al., (1972). Association between colour vision losses and diabetes mellitus. *Ophthal Res*, 34, 115-22.

Lawson, M.L., et al., (1999). Effect of intensive therapy on early macrovascular disease in young individuals with type 1 diabetes: A systematic review and meta-analysis. *Diabetes Care*, 22, Suppl, B35-9.

Leese, G.P., et al., (2003). Frequency of severe hypoglycemia requiring emergency treatment in type 1 and type 2 diabetics. *Diabetes Care*, 26, 1176-1180.

Lingren, M., et al., (1996). Restitution of neurophysiological functions, performance, and subjective symptoms after moderate insulin-induced hypoglycaemia in nondiabetic men. *Diabet Med*, 13, 218-25.

MacLeod, K.M., Hepburn, D.A., & Frier, B.M. (1993). Frequency and morbidity of severe hypoglycemia in insulin-treated diabetic patients. *Diabetic Med*, 10, 238-45.

Mafauzy, M., et al., (2002). repaglinide versus glibenclamide treatment of type 2 diabetes during Ramadan fasting. *Diabetes Res Clin Pract*, 58, 45-53.

Mangouritsas, G., et al., (1995). Effect of induced hyperglycemia on contrast sensitivity function in insulin-dependent diabetic patients. *Opthalmologe*, 92, 142-7.

Maryland Motor Vehicle Administration (MVA). (2008). *CDL Medical Waiver Information Packet*. http://mva.maryland.gov/Resources/CDLWaiver.pdf

Mitchel, T.H. et al., (1988). Hyperglycemia after intense exercise in IDDM subjects during subcutaneous insulin infusion. *Diabetes Care*, 11, 311-17.

National Heart Lung and Blood Institute, US Department of Health and Human Services, National Institutes for Health. (1998). *Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults*. http://www.nhlbi.nih.gov/guidelines/obesity/ob_home.htm

National Institutes of Health (NIH). (1998). Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. NIH Publication No. 98-4083.

National Institutes of Health (NIH). (2007). *Estimated Diabetes Costs in the United States in 2007*. http://diabetes.niddk.nih.gov/dm/pubs/statistics/index.htm#costs

Nieman, D. C. (1990). *Fitness and Sports Medicine: An Introduction*. Palo Alto:Bull Publishing Company.

Novo Nordisk. (2004). Prandin package insert: available from http://www.novonordiskus.com.

Okamoto, F. et al., (2000). Refractive changes in diabetic patients during intensive glycaemic control. *Br J Ophthalmol*, 84, 1097-1102.

Orchard, T.J., et al., (1990). Prevalence of Complications of IDDM by sex and duration. *Diabetes*, 39, 1116-24.

Pearson, A.R., Tanner, V., Keightley, S.G. & Casswell, A.G. (1998). What effect does laser photocoagulation have on driving visual fields in diabetics? *Eye*, 12, 64-68.

Rosenstock, J., et al., (2001). Basal insulin therapy in type 2 diabetes. *Diabetes Care*, 24, 631-36.

Saito, Y., et al., (1993). Transient hyperopia with lens swelling at initial therapy in diabetes. *Br J Opthalmol*, 77, 145-148.

Salorant, C. et al., (2002). Efficacy and safety of nateglinide in type 2 diabetic patents with modest fasting hyperglycemia. *J Clin Endocrinol Metab*, 87, 4171-6.

Schatz, H. (1999). Preclinical and clinical studies on safety and tolerability of repaglinide. *Exp Clin Endocrinol Diabetes*, 107, Suppl 4, 144-8.

Seltzer, H.S. (1989). Drug-induced hypoglycemia: A review of 1418 cases. *Endocrinol Metab Clin N Am*, 18, 163-83.

Sigal, R.J. et al., (1994). Hyperinsulinemia prevents prolonged hyperglycemia after intense exercise in insulin-dependent diabetic subjects. *J Clin Endocrinol Metab*, 79, 1049-57.

Stahl, M. & Berger, W. (1999). Higher incidence of severe hypoglycemia leading to hospital admission in type 2 diabetic patients treated with long-acting vs. short-acting sulfonylureas. *Diabet Med*, 16, 586-90.

Stratton, I.M., et al., (2000). Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): Prospective observational study. *Brit J Med*, 321, 405-12.

Sugarman, J.R. (1991). Hypoglycemia associated with hospitalization in a population with a high prevalence of non-insulin-dependent diabetes mellitus. *Diabet Res Clin Pract*, 14, 139-47.

UK Prospective Diabetes Study Group. (1998). Intensive blood-glucose control with sulfonylureas or insulin compared with conventional treatment. *Lancet*, 352, 837-53.

U.S. Department of Transportation (DOT), Federal Motor Carrier Safety Administration. (September 3, 2003). *Qualifications of Drivers; Exemption Applications; Diabetes*. FR 68 (170):52441-52.

Utku, D. & Atmaca, L.S. (1992). Farnsworth-Munsell 100-hue test for patients with diabetes mellitus. *Ann Ophthalmol (Turkey)*, 24, 205-8.

Wanke, T. et al., (1992). Pulmonary gas exchange and oxygen uptake during exercise with type 1 diabetes mellitus. *Diabet Med*, 9, 252-7.

Weinger, K. et al., (1995). Blood glucose estimation and symptoms during hyperglycemia and hypoglycemia in patients with insulin-dependent diabetes mellitus. *Am J Med*, 98, 22-31.

GASTROINTESTINAL SYSTEM

1.0 INTRODUCTION

The gastrointestinal system is important as a source of materials that provide energy and needed nutrients to build cellular and tissue elements. The gastrointestinal tract is also a route of exposure for materials from the external environment.

There are a number of mechanisms by which the gastrointestinal tract can be compromised in its functioning and produce symptomatology. These include traumatic, inflammatory, infectious, vascular and neoplastic processes. Peptic ulcer disease and functional bowel disease may be related to stress. The liver is susceptible to a variety of types of injuries by virtue of its role as a major route of metabolism for a variety of inhaled and ingested materials. Alcoholic beverages rank as a very important consideration in diseases of the gastrointestinal tract, especially the esophagus, stomach, small intestine and liver.

Accordingly, programs designed to deal with alcoholism are important for their impact on the gastrointestinal tract as well as on many other parts of the body, in the overall functioning of the employee. Early identification and intervention of these types of problems is crucial.

2.0 OUTLINE OF HIGHLIGHTED CONDITIONS

- Hernias
- Hemorrhoids
- Ulcerative Colitis
- Gallbladder Disease
- Irritable Bowel Syndrome
- Peptic Ulcers
- Hepatitis
- Pancreatitis
- Other Conditions

3.0 IMPLICATIONS FOR JOB PERFORMANCE

Gastrointestinal disease is now well understood and effective treatments are available for most conditions. There are few, if any, conditions that are likely to cause sudden loss of consciousness or inability to work, provided they are well managed and under regular review by the treating physician.

Untreated peptic ulceration and oesophageus may manifest as anemia, pain or frank bleeding. While the symptoms may render a person unfit for duty in the short term, these conditions respond well to treatment and the risk of a sudden disabling illness is insignificant.

Inflammatory bowel conditions such as ulcerative colitis and Crohn's disease may cause considerable pain and disability if not well controlled. This may take the form of lethargy, diarrhoea, urgency of defecation and, in extreme cases, fecal incontinence. A person with such symptoms would have difficulty performing a number of tasks.

Some gastrointestinal conditions can impair a law enforcement officer's performance for diverse reasons. Hernias can result in sudden incapacitation. Hemorrhoids can interfere with prolonged sitting. Other conditions can cause chronic fatigue, frequent diarrhea, and require extensive sick leave.

4.0 EVALUATION OF COMMON CLINICAL CONDITIONS

4.1 Hernias

Hernia is the protrusion of a pouch through a defect in the wall of the peritoneal cavity that can occur in a variety of sites including the inguinal and femoral canals, the umbilicus, and old surgical scars. The most important complications are intestinal obstruction and strangulation caused by a loop of bowel with its blood supply becoming trapped in the hernial sac. Among predisposing causes are obesity and the lifting of heavy weights. The treatment is usually surgical.

4.1.1 General Considerations

During high static exertion, increased pressure can cause herniation of the bowel through inguinal and ventral abdominal wall defects with resulting pain and potential strangulation. This could occur during a variety of typical law enforcement officer activities that involve static, explosive, dynamic, and trunk strength. The resulting pain could be sufficient to cause sudden incapacitation, resulting in a direct threat to

self and others.

Surgical repair, including laparoscopic techniques, is very successful for inguinal and ventral hernias unless the latter is secondary to medium-to-large incisional defects.

4.1.2 Recommended Evaluation Protocol

When a hernia is suspected, a surgical consultation is necessary to confirm the diagnosis and to correct the condition. Employment decisions should be deferred until the surgeon clears the candidate for very heavy lifting and participation in contact sports. This typically involves four week for open repair or 2-3 weeks for a laparoscopic repair of an inguinal hernia (Millikan & Deziel, 1996).

4.2 Hemorrhoids

Although there is no risk of sudden incapacitation, symptomatic hemorrhoids can make prolonged sitting quite uncomfortable. Current treatment of hemorrhoids is usually non-invasive and very successful within a short period of time.

The employment of candidates with symptomatic, prolapsed, or significantly bleeding hemorrhoids should be deferred until successfully treated. Attention to precipitating factors, such as chronic constipation, should be addressed.

4.3 Ulcerative Colitis

4.3.1 General Considerations

Ulcerative colitis (UC) is a chronic disorder of generally unpredictable course characterized by remissions and recurrences. This condition has relevance to the law enforcement officer occupation for several reasons:

- Manifestations, such as frequent diarrhea and urgency, can interfere with an officer's ability to conduct surveillances.
- Secondary anemia, weakness, arthritis, or fatigue can limit an officer's functional capacity during a critical incident.
- Use of sick leave may be in excess of the amount which can be reasonably accommodated by the hiring agency.

It is a common misperception among both patients and physicians that stress can exacerbate UC. The preponderance of evidence and the consensus opinion among gastroenterologists is that stressful life events or depressed mood do not precipitate exacerbations (North, et al., 1991; Helzer, et al., 1984).

Although the severity of symptoms is generally proportional to the amount of bowel involved, this can vary greatly, as can the response to medication. Fortunately, the typical candidate has had only a single episode of "colitis," (which may have been infectious in origin), or has an established disease that is now in remission or well-controlled on medication.

Ulcerative proctitis is the mildest form of UC. Approximately 40% will have a permanent remission after the first attack. Only 10-15% will develop more extensive disease, and the majority will do so within the first year or two after the initial attack (Powell-Tuck, et al., 1977). The risk of progression is somewhat higher if the onset is before age 21.

When UC extends beyond the rectum, 60% will develop relapsing disease, and 20% will suffer chronic unremitting symptoms (Bayless, 1988). One study found that half of all patients were symptomatic at any one time (Henriksen, et al., 1985). The extent of colonic involvement is associated with the severity of the disease, but does not affect the probability of recurrence. A minority of patients will develop extraintestinal manifestations such as arthritis, uveitis, or skin disease (Bayless, 1988). Those with pancolitis are at an increased risk of colon cancer (0.5-1% per year) if they have had the disease for 10 years or more (Sugita, et al., 1991).

Therapy can substantially alter the course of the disease. Treatment with 5-aminosalicylic acid drugs (sulfasalazine, mesalamine, olsalazine, or balsalazide) can be used to reduce symptoms and prevent recurrences.

Severe to Active UC

- Prednisolone
- Methyl Prednisolone
- Hydrocortisone
- Cyclosporin
- Infliximals
- IV Steroid and Antibiotics for Toxic Mega Colon

Chronic Active Disease

- Ginercaptopure
- Azathioprine
- Infliximals

Mild to Moderate UC

- Mesalame
- Cortisone Foam
- 5 – Asa Enema
- Sulfasalazine
- Mesalamine (Asacol, Lialda, Pentura)
- Olsalazine
- Bulsalazide
- Sulfasalatine/Oral 5 ASA plus 5 ASA enema, steroid enema

Also, specific diets formentable dietary fiber MVI.

Maintenance therapy in asymptomatic patients with negative sigmoidoscopic findings will keep recurrence rates below 20% (Misiewicz, et al., 1965; Dissanayake & Truelove, 1973; Azad Kahn, et al., 1980). Approximately, 5-15% of patients with mild-moderate disease will still require surgery within ten years (Sinclair & Brunt, 1983); 30-50% of those who present with pancolitis will have surgery within 2-3 years (Bayless, 1988; Podolsky, 1991). Surgery is considered curative, but is associated with a mortality rate of up to 2% (Bayless, 1988).

4.3.2 Recommended Evaluation Protocol

The physician must obtain a detailed history of the course, complications, and treatment. Candidates must be questioned regarding the number of bowel movements per day, the presence of blood or mucus, urgency, fever, joint or abdominal pain and the use of sick leave over the past two years. Review of medical records is strongly recommended. Documentation of sick leave use for the past two years is also helpful. If a candidate has had colonic disease for more than ten years, it is prudent to require a colonoscopy (or review the results of one performed within the last two years) to evaluate premalignant changes and the need for surgery (Glickman, 1987). Testing of CBC, sed rate, stool occult blood, and C-reactive protein is helpful.

GROUP I: ***HISTORY OF ONE EPISODE ONLY AND CURRENTLY ASYMPTOMATIC***

In general, restrictions cannot be justified unless the episode was recent. In this case, a deferral period of one year to observe the course of the disease may be justified since most of those who suffer relapses will do so within this time period (Glickman, 1987).

GROUP II: ***HISTORY OF RELAPSING DISEASE***

Assessing the risk of recurrences and associated morbidity is best done by consideration of the candidate's past history. There are no effective laboratory tests to serve as markers for severity or recurrence risk. However, if the applicant claims to be in remission currently, this can be confirmed by testing of acute phase reactants such as serum sedimentation rate and C-reactive protein (Cronin & Shannon, 1998).

Level 1: Asymptomatic, sick leave use has not been excessive, sed rate, C-reative protein, stool occult blood, and CBC are normal:

In general, no restrictions are warranted since these candidates are in remission. However, if the candidate is on corticosteroids, emotional lability is a potential side-effect of concern. This should be evaluated trough review of medical records and psychological screening.

Level 2: In remission, but use of sick leave over last two years exceeds that normally available:

Advise the hiring agency to consider whether the applicants use of sick time can be reasonably accommodated.

Level 3: Currently symptomatic or anemic

Work limitations regarding surveillance or exercise-related activities may be justified on an individual basis. Advise the department if excessive use of sick leave is probable.

4.4 Gallbladder Disease

Gallbladder disease is usually caused by the presence of gallstones. These are of two varieties, cholesterol and pigment. Cholesterol gallstone formation is very common in certain ethnic groups, notably Native Americans, and also is associated with a number of other diseases. Female gender, obesity, and diabetes are also risk factors. Although the natural history is unpredictable, there is a cumulative chance (about 2% per year) that symptoms will develop. Candidates are placed into two groups:

GROUP I: ASYMPTOMATIC GALLSTONES

Stone formation in the gallbladder is exceedingly variable and most people are asymptomatic for long periods of time. However, the potential complications represent serious disease. Symptoms usually manifest after a stone of sufficient size (usually > 8mm) lodges in the gallbladder or common bile duct. Individuals who have been asymptomatic for 10 years are likely to remain asymptomatic. If gallstones are discovered as an incidental finding on another study, the candidate should be deferred until evaluated by a gastroenterologist as to the probability and severity of symptoms and whether treatment is indicated.

GROUP II: SYMPTOMATIC GALLSTONES

Symptoms are irregular and often do not progress in severity or frequency, but neither do they cease. Symptoms include abdominal pain that may be made worse by fatty foods, pain occurring after meals, jaundice, and fever. Candidates who are symptomatic are at increased risk of developing complications and surgery (laparoscopic cholecystectomy) or other treatment indicated. Typically there is no recurrence of symptoms in over 99% of individuals following treatment. Candidates are deferred until treated and fully recovered.

4.5 Irritable Bowel Syndrome

4.5.1 General Considerations

Irritable bowel syndrome may present as chronic recurring periods of diarrhea or constipation which may be associated with pain. Although this condition is characterized by an absence of detectable organic pathology, it may have a negative impact on performance as a law enforcement officer due to following considerations:

- Urgent diarrhea may disrupt surveillances;
- Most patients will have abnormal scores on general psychological testing due to hysteria, anxiety, or depression;
- It is sometimes treated with drugs that have sedative side-effects, such as Lomotil, codeine or dicyclomine;
- 75% of those seeking medical treatment will not have permanent remissions;
- Psychological stress may trigger an exacerbation of symptoms in some patients (Dancey, et al., 1995; Schuster, 1982; LaMont, & Isselbacher, 1987).

The last consideration is particularly relevant, given the high degree of emotional stress associated with the law enforcement officer occupation. Research has shown that the job of policing is an extremely stressful occupation (Cooper, 1982; Hurrell, 1977; Kroes, 1976; Rubinstein, 1973; Davidson & Veno, 1977; Farmer, 1990).

4.5.2 Recommended Evaluation Protocol

The physician must assess the manifestations of the syndrome (diarrhea vs. constipation), course, severity, treatment, and relation to stress from thorough questioning of the candidate and a review of all relevant medical records. If diarrhea is present, determine whether it is present only in the morning or throughout the entire day. The physician should also confirm that a diagnostic evaluation was performed to rule out any underlying organic disease. Documentation of sick leave use for the past two years is also helpful.

Given the prevalence of abnormal psychological profiles in this population, it may be efficient to defer any extensive medical evaluation until the candidate has successfully completed psychological screening.

GROUP I: ***HISTORY OF CONSTIPATION OR HISTORY OF DIARRHEA OCCURRING IN EARLY MORNING ONLY, AND NO USE OF SEDATING MEDICATIONS; SICK LEAVE USE IS NOT EXCESSIVE***

It is difficult to justify restrictions for these candidates since their condition is unlikely to impair job performance, even if aggravated by stress. Use of loperamide or hyoscyamine should not cause significant sedation.

GROUP II: ***HISTORY OF REFRACTORY NON-A.M. DIARRHEA, USE OF SEDATING MEDICATION TO CONTROL SYMPTOMS, OR EXCESSIVE USE OF SICK LEAVE***

Disease of this severity will significantly interfere with law enforcement duties; therefore, appropriate work restrictions are in order. If the candidate is currently asymptomatic, restrictions against exposure to job-related stress may be warranted if the medical records clearly show that stress causes recurrences of severe disease in this applicant.

4.6 Peptic Ulcers

It has been established that H. Pylori causes 95% of duodenal ulcers and 75% of gastric ulcers. Most of the remaining ulcers are caused by use of NSAIDS. After successful treatment of H. Pylori, ulcer recurrences are rare. Current antibiotic regimens have lowered the morbidity associated with peptic ulcers to the extent that, in general, consideration of this condition is not necessary for law enforcement officer candidates. The one possible exception may be a candidate who has frequent severe recurrences and has not been properly evaluated. In this case, a short deferral to allow for evaluation and treatment may be justifiable.

4.7 Hepatitis

4.7.1 General Considerations

The evaluating physician will have little difficulty in evaluating the rare candidate with severe symptomatic hepatitis or chronic hepatic failure. The more typical candidate is a chronic carrier of the HBV or HBC virus who claims to be asymptomatic. There are several issues of concern

which are relevant to performing essential law enforcement duties:

1. The risk of infecting others (see Infectious Diseases chapter),

2. The applicant's current physical state, and

3. The probability of significant deterioration in the immediate future.

Regarding the applicant's current physical state, the most common problems are malaise and easy fatigability. However, anorexia, nausea, right upper quadrant pain, and weight loss can occur. Review of medical records and possibly sick leave records is very important to determine the severity of symptoms, and whether they would interfere with the performance of law enforcement duties.

If the candidate is presently asymptomatic or the symptoms are not severe, an assessment is necessary as to whether he or she will be able to perform law enforcement officer duties in the immediate future (i.e., 2-3 years). Unfortunately, the absence of symptoms is an unreliable indicator of the underlying clinical state and future prognosis. Deterioration of functional ability could be due to progression of the disease or the initiation of interferon therapy. Interferon is usually administered for 4 months for hepatitis B and for 12 months for hepatitis C. Side effects which could significantly impact the performance of law enforcement duties are common as shown in Table 1:

Table 1: Side Effects of Interferon Alpha

Systemic Effects
Fatigue, fever, headache, myalgia, arthralgia, backache, anorexia, weight loss, nausea, vomiting, abdominal cramps, hair loss, and hypersensitivity reactions
Neurologic effects
Difficulty concentrating, lack of motivations, sleep disturbance, delirium, disorientation, coma, seizures, electroencephalographic changes, decrease in hearing, tinnitus, dizziness, vertigo, decrease in vision, retinal hemorrhages, and cotton-wool spots.

Table 1: Side Effects of Interferon Alpha, Continued

Psychological effects
Anxiety, irritability, depression, social withdrawal, decreased libido, paranoid or suicidal ideation, and return of craving for alcohol or drugs.
Hematologic effects
Decease in platelet count, white-cell count, and hematocrit
Immunologic effects
Increased susceptibility to bacterial infections, especially bronchitis, sinusitis, furuncles, and urinary tract infections; in rare instances: pneumonia, lung abscess, brain abscess, septicemia, and bacterial peritonitis.
Autoimmune effects
Development of autoantibodies and anti-interferon antibodies, hyperthyroidism, hypothyroidism, lichen planus, diabetes, hemolytic anemia, thrombocytopenic purpura, and lupis-like symptoms.
Other effects
In rare instances: pneumonitis, proteinuria, interstitial nephritis, nephrotic syndrome, cardiac arrhythmia, congestive heart failure, and acute exacerbation of liver disease.

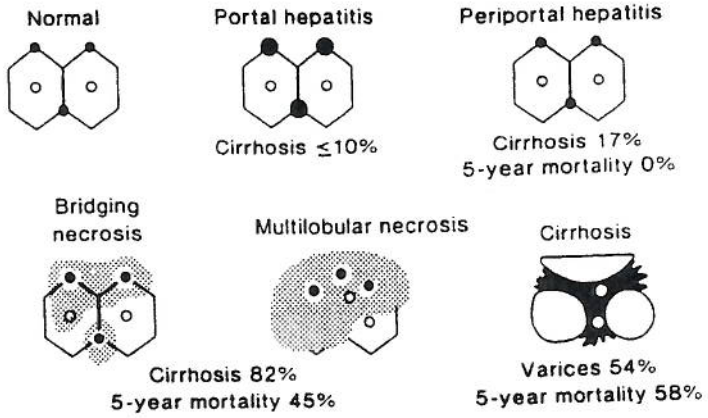
Due to side effects, the dose of interferon has to be reduced in 10-40% of patients, and discontinued early in 5-10% (Hoofnagle, 1997).

Hepatitis B: In patients who have chronically elevated liver enzymes and +HBeAg, 50% will develop cirrhosis within 5 years (Lee,1997). Biopsy has prognostic value. Chronic persistent hepatitis characterized by inflammation limited to the portal area is generally not progressive (Bianchi, 1977) unless the patient has +HBeAg (Aldershvile, et al., 1982). Chronic active hepatitis may have a very poor prognosis, depending on the appearance of the biopsy (Figure 1). Interferon is recommended for patients with persistent elevations of liver enzymes, detectable levels of HbsAg, HbeAg, and HBV DNA in serum, and chronic hepatitis on liver biopsy (Hoofnagle 1997).

Hepatitis C: 20-50% will progress to cirrhosis, but this progression is not predictable. It can develop in 1-2 years after infection or take 20-30

years. Liver biopsy is not helpful in predicting the development of cirrhosis, since even chronic active hepatitis may not be progressive (Hoofnagle, 9/97). Similarly, the finding of chronic persistent hepatitis does not imply a benign course unlike in hepatitis B (Gerber, 1992). Treatment with interferon and ribavirin is recommended for patients with elevated liver enzymes, anti-HCV in serum, and chronic hepatitis on biopsy. Side-effects of interferon therapy are similar to those in hepatitis B (See Table 1), but less severe due to lower dosing (Hoofnagle, 1997).

Figure 1: **Histologic Patterns of Liver Inflammation**



Reproduced with permission from Hoofnagle, J. & Di Bisceglie A.M. (1997). The treatment of chronic viral hepatitis. *NEJM*, 336, 347-356.

4.7.2 Recommended Evaluation Protocol

Candidates with a history of chronic HBV or HCV viral infection need to be questioned regarding symptoms such as jaundice, nausea, vomiting, arthralgias, myalgias, fever, and easy fatigability. Details regarding prior evaluations and treatment are important. The physical examination should include palpation of the liver, and spleen, and inspection of the skin (spider angiomas). Laboratory analysis should include liver enzymes. Medical record review is strongly recommended if enzymes are elevated

GROUP I: ***UNEXPLAINED ELEVATED ENZYMES (1.5 times the upper limit of normal) IN AN ASYMPTOMATIC CANDIDATE***

Elevated enzymes including ALT, AST, GGTP are indicators of liver or hepatic dysfunction. There are many causes for the elevation including alcohol

ingestion, viral hepatitis, medication use, a fatty liver (which can be observed in the obese), and other factors. Rare conditions such as Wilson's disease, a congenital disorder of copper metabolism, can also increase liver enzymes. The physician needs to ascertain the cause of the elevation since the underlying condition can affect placement. In general, persons can have mild elevations of transaminases (less than 1.50 upper limit of normal) without having significant problems.

If the history suggests alcohol, vitamin, or steroid abuse, advise the candidate to cease this behavior and repeat enzymes serially until they are normal and it is apparent that the candidate is not suffering from addiction. Otherwise, require and evaluation by the candidates's physician to establish a diagnosis. If liver enzymes remain elevated (especially at a level of 2x normal) for a period of more than six months, this evaluation should include serum titers for infectious agents. A liver biopsy may also be necessary.

Elevations of two or more enzymes in excess of twice the upper limit of normal is highly suggestive of a significant underlying problem and requires further clinical assessment including consultation with a hepatologist or gastroenterologist. Generally work restrictions will not be necessary.

GROUP II: ***ASYMPTOMATIC CHRONIC HBV/HCV INFECTION WITH NORMAL LIVER ENZYMES***

Risk of significant progression in the immediate future is not very high.

GROUP III: ***ASYMPTOMATIC CHRONIC HBV/HCV INFECTION WITH ELEVATED LIVER ENZYMES***

Request previous records and require an evaluation from the candidate's private physician regarding whether interferon is recommended. Temporary deferrals to assess the impact of potential side-effects would be warranted if interferon is recommended. If treatment is not recommended, assess the 2-3 year prognosis for significant morbidity based on the following:

1. **Recent liver biopsy (if available)** -- For HBV, bridging necrosis, multilobar necrosis, or cirrhosis indicate poor prognosis, especially if associated with significant inflammation. Those with a diagnosis of CPH from a previous biopsy do not need to be rebiopsied, unless there is significant inflammation present or the candidate is HbeAg+. For HCV, only the presence of cirrhosis indicates poor prognosis in the near future.

2. **The severity and time course of past symptomatic episodes.** These are likely to recur unless the candidate has taken interferon, and is in the minority of patients (<40%) who have a sustained positive response to treatment. Due to the frequency of relapses after an initial response, "success" cannot be reliably determined until six months after treatment has finished. At that time, liver enzymes should still be normal with no detectable HBV DNA, HbeAg, or HCV RNA (Hoofnagle 1997).

GROUP IV: SYMPTOMATIC

Restrictions are warranted if the symptoms will interfere with the safe or effective performance of essential duties. If this is not the case, evaluate the risk of significant deterioration as per GROUP III.

4.8 Pancreatitis

4.8.1 General Considerations

Pancreatitis may be acute or chronic. Alcohol and biliary disease are the two main causes of acute pancreatitis. Acute pancreatitis causes abdominal pain and sometimes pancreatic pseudocysts that may require surgical treatment. Diagnosis of acute pancreatitis can nearly always be made easily because of elevation of serum amylase. Pancreatic pseudocysts can easily be diagnosed by abdominal ultrasound.

Chronic pancreatitis has two manifestations that usually coexist in the same patient. First, it may cause recurrent attacks of abdominal pain. The severity of this pain frequently leads to narcotic dependence. The second manifestation is deficiency of the exocrine and endocrine

pancreas leading to intestinal malabsorption and diabetes mellitus. Diagnosis of chronic pancreatitis may require a variety of special tests including endoscopic retrograde cannulation of the pancreas.

4.8.2 Recommended Evaluation Protocol

Episodes of acute inflammation and chronic pain should be evaluated with regard to the candidate's ability to work extended shifts. This condition is subject to remission and relapses and surgery may be necessary to relieve pain. Diabetes mellitus is a common complication of pancreatitis, and a fasting blood sugar should be checked. It is important to determine the underlying cause of the pancreatitis, since it is often related to overconsumption of alcohol. Deferral is recommended in a candidate who has not had a diagnostic evaluation.

4.9 Other Conditions

Gastrointestinal Cancers

Improved prognosis from gastrointestinal cancers will present a number of challenges to the evaluating physician particularly in areas of altered bowel function, malabsorption syndromes and excisional hernias.

Diverticulitis

Consideration needs to include sudden incapacitation from symptomatic diarrhea

Post Bariatric Surgery

The examining physician needs to consider issues of stamina, malabsorption, symptoms of bloating, dumping syndrome, nausea and possibility of recurrence of weight gain.

5.0 REFERENCES

Aldershvile, J. Dietrichson, O., Skinhoj, P., Kryger, P., Mathiesen, L.R., & Christofferson, P. (1982). Chronic persistent hepatitis: Serological classification and meaning of the hepatitis B e system. *Hepatology*, 2, 243-246.

Anderson, K.E., Sun, S.C., Berg, H.S., & Chang, N.K. (1974). Liver function and histology in asymptomatic Chinese military personnel with hepatitis B antigenemia. *Am J Dig Dis*, 19, 693-703.

Azad Khan, A.K., Howes, D.T., Piris, T., & Truelove, S.C. (1980). Optimum dose of sulfasalazine for maintenance treatment of ulcerative colitis. *Gut*, 21, 232-240.

Bayless, T.M. (1988). Prognosis of idiopathic inflammatory bowel disease. Chap. 32 in *Inflammatory Bowel Disease*, Eds. J.B. Kirsner and R.G. Shorter. Philadelphia: Lea & Febiger.

Bianchi L. (1977). Acute and chronic hepatitis revisited: A review by an international group. *Lancet*, 2, 914-919.

Cooper, C.L. (1982). Stress in the police service. *JOM*, 24, 30-36.

Cronin, C.C. & Shanahan F. (1998). Immunological tests to monitor inflammatory bowel disease- Have they delivered yet? *Am J Gastroenterol*, 93, 295-297.

Dancey C.P., Backhouse, S., Painter J., & Whitehouse A., (1995). The relationship between hassles, uplifts, and irritable bowel syndrome: a preliminary study. *Journal of Psychosomatic Research*, 39, 827-832.

Davidson, M.J. & Veno, A. (1977). *Multifaceted Aspects of Stress in the Police Service*. Woden Act, Aust: Australian Institute of Criminology Press.

Dissanayake, A.S. & Truelove, S.C. (1973). A controlled therapeutic trial of long-term maintenance treatment of ulcerative colitis with sulfasalazine. *Gut*, 14, 923.

Farmer, R.E. (1990). Clinical and managerial implications of stress research on the police. *J Pol Sci Adm*, 17, 205-218.

Feinman, S., Berris, B., Sinclair, J.C., Wrobel, D.M., Murphy, B.L., & Maynard, J.E. (1975). E antigen and anti-e in HBsAg carriers. *Lancet*, 2, 1173-1174.

Fleming, L.E. (1992). Unusual occupational gastrointestinal and hepatic disorders. *Occupational Medicine: State of the Art Reviews*. 7, 433-448.

Gerber M. (1992). Chronic hepatitis C: The beginning of the end of a time-honored nomenclature? *Hepatology*, 15, 733-734.

Glickman, R.M. (1987). Inflammatory bowel disease. Chap. 238 in *Principles of Internal Medicine*, Eds. Harrison, et al., New York: McGraw-Hill, 1227-90.

Helzer, J.E., Chammas, S., Norland, C.C., Stillings, W.A., & Alpers, D.H. (1984). A study of the association between Crohn's disease and psychiatric illness. *Gastroenterol*, 86, 324-330.

Henriksen, C., Kreiner, S., & Binder, V. (1985). Long term prognosis in ulcerative colitis. *Gut*, 26, 158-163.

Hoofnagle, J.H. & Di Bisceglie A.M. (1997). The treatment of chronic viral hepatitis. *NEJM*, 336, 347-356.

Hoofnagle, J.H. (1997). Hepatitis C: The clinical spectrum of disease. *Hepatology*, 26 (3, Suppl 1), 15s-20s.

Hurrell, J.J. (1977). *Job Stress among Police Officers - A Preliminary Analysis*. U.S. Dept of Health, Education, and Welfare. Pub No. (NIOSH) 7604228. Cincinnati: U.S. Govt Printing Office.

Ko, C.W. & Lee, S.P., (2002). Epidemiology and natural history of common bile duct stones and prediction of disease. *Gastrointest Endosc*. 56, (6 Suppl), S165-9.

Kroes, W.H. (1976). *Society's Victim - The Policeman - An Analysis of Job Stress in Policing*. Springfield: C.C. Thomas.

Lapane, K.L., Jakiche, A.F., & Sugano, D. (1998). Hepatitus C infection risk analysis: who should be screened? *Am J Gastroenterol*, 93, 591-596.

LaMont, J.T. & Isselbacher, K.J. (1987). Diseases of the small and large intestine. Chap. 239 in *Principles of Internal Medicine*, Eds. Harrison, et al., New York: McGraw-Hill, 1290-1302.

Lee W.M. (1997). Hepatitis B virus infection. *NEJM*, 337, 1733-1745.

Millikan, K.W. & Deziel D.J. (1996). The management of hernia. *Surg Clin North Am*, 76, 105-116.

Misiewicz, J.J., et al. (1965). Controlled trial of sulfasalazine in maintenance therapy for ulcerative colitis. *Lancet*, 2, 185.

North, C.S., Alpers, D.H., Helzer, J.E., Spitznagel, E.L., & Clouse, R.E. (1991). Do life events or depression exacerbate inflammatory bowel disease? *Ann Int Med*, 114, 381-386.

Podnos, Y.D., Jimenez, J.C., Wilson, S.E., Stevens, C.M., & Ngyuen N.T. (2004). Complications after laparoscopic gastric bypass: A review of 3,464 cases. *Arch Surg*, 3, 138, 957-961.

Podolsky, D.K. (1991). Inflammatory bowel disease. *NEJM*, 325, 930-937.

Powell-Tuck, J., Ritchie, J.T., & Lennard-Jones, J.E. (1977). The prognosis of idiopathic proctitis. *Scand J Gastroenterol*, 12, 727-732.

Rubinstein, J. (1973). *City Police*. New York: Farrar, Straus & Giroux.

Schuster, M.M. (1982). The irritable bowel syndrome. Chap. 36 in *Principles of Ambulatory Medicine,* Eds. L.R. Barker, et al,. Baltimore: Williams and Wilkins.

Shaffer, E.A. (2005). Epidemiology and risk factors for gallstone disease: has the paradigm changed in the 21st century?. *Curr Gastroenterol Rep*. 7, 2, 132-40.

Sinclair, T.S., Brunt, P.W., & Mowat, N.W. (1983). *Gastroenterol*, 85, 1-11.

Sten A. (1985). Chronic hepatitis B. Chap. 7 in *Hepatitis B*, Ed. Gerety, R.J., Orlando, FL: Academic Press, 124.

Sugita, A., Sochar, D.B., Bodian, C., Robeiro, M.D., Aufses, A.H., & Greenstein, A.J. (1991). Colorectal cancer in ulcerative colitis. *Gut*, 32, 167-169.

Ukleja, A. & Stone, R.L. (2004). Medical and gastroenterologic management of the post-bariatric surgery patient. *J Clin Gastroenterol*, 38, 312-321.

Velasco, M., Gonzalez-Ceron, M., De la Fuente, C., Ruiz, A., Donoso, S., & Katz, R. (1978). Clinical and pathological study of asymptomatic HBsAg carriers in Chile. *Gut*, 19, 569-571.

Vittal, S.B., Dourdourekas, D., Jhobassy, N., Gerber, M., Telischi, M., Szanto, P.B., Steigmann, F., & Clowdus, B.F. (1974). Asymptomatic hepatic disease in blood donors with hepatitis B antigenemia. *Am J Clin Pathol*, 62, 649-654.

Woolf, I.L. (1974). Symposium on the carrier state. *Br Soc Gastroenterol.*

Yusoff, I.F., Barkun, J.S., & Barkun, A.N. (2003). Diagnosis and management of cholecystitis and cholangitis. *Gastroenterol Clin North Am*, 32, 4, 1145-68.

GENITOURINARY SYSTEM

1.0 INTRODUCTION

The kidney has the vital function of excretion, and controls acid-base, fluid,, and electrolyte balance. It also acts as an endocrine organ. Renal failure, with severe impairment of these functions, results from a number of different disease processes, most of which are acquired although some may be inherited. Chronic renal failure implies permanent renal damage which is likely to be progressive. Occupational and environmental toxins known to cause chronic renal disease include the heavy metals (Pb, Cd, Hg, As, Cr, U), organic solvents, silica, and beryllium (Weeden, 1997, p. 46; de Broe, D'Haese, Nuyts, & Elseviers, 1996, p. 114).

Glomerular involvement gives rise to glomerulonephritis, which presents with proteinuria, haematuria, or both, and may be accompanied by hypertension and impaired renal function. If proteinuria is severe, it can lead to nephrotic syndrome. Pyelonephritis and renal scaring is the end result of infective disorders with or without anatomical abnormalities of the urinary tract. System disease such as diabetes mellitus, hypertension, and collagen disorders, can affect the kidney while polycystic kidney disease is the commonest inherited disorder leading to renal failure. The renal tract can also be affected by problems of an anatomical nature, such as stones, strictures, obstruction, and tumor.

The genital organs share reproductive and endocrine functions. They produce a variety of hormones, produce and deliver germ cells (spermatozoa and ova) and provide an appropriate environment for the embryo and fetus. Since the gonads are very sensitive to a host of chemicals, their effect on the reproductive system and the reproductive potential of workers is receiving increasing attention.

2.0 OUTLINE OF HIGHLIGHTED CONDITIONS

Urinary System

- Glomerular disorders
- Haementeria or Proteinuria
- Renal Calculi

- Polycystic kidney disease
- Chronic renal disease
- Solitary Kidney

Reproductive System

- Hydrocele
- Varicocele
- Premenstrual syndrome (PMS)
- Pregnancy

3.0 IMPLICATIONS FOR JOB PERFORMANCE

The genitourinary system is important in the occupational setting because the kidney is a target organ for many toxins. A number of governmental regulations mandate monitoring and evaluation of the status of the genitourinary system for individuals occupationally exposed to a variety of agents. Historically, females who were fertile were excluded from certain exposures, most notably inorganic lead, in attempts to protect the fetus. However, in 1991 the U.S. Supreme Court ruled that baring fertile females from jobs in order to protect unborn children was sex discrimination under Title VII.

Immune mechanisms are involved in a variety of inflammatory processes of glomeruli and tubules in both infectious and drug-induced diseases. Vascular disorders, metabolic impairments, obstruction, and neoplasms also have important impact on the function of the urinary tract.

Abnormalities in the ovulatory process may induce serious hormonal imbalances causing various somatic and emotional problems. Similarly, abnormalities in androgen production by the testis results in serious somatic and emotional dysfunctions.

4.0 EVALUATION OF URINARY CONDITIONS

History, physical examination and laboratory tests including urinalysis, urinary electrolytes, serum electrolytes, BUN and creatinine are very

important in the evaluation of renal status. Proteinuria can be an important manifestation of renal disease as can the presence of casts in the urinary sediment. Renal biopsy is often a diagnostic aid in assessing the status of the kidney. Other studies of importance to the evaluation of renal disease include IVP, nephrotomography, renal ultrasound, renal scan and cystoscopy.

In a thorough examination of the patient with renal disease, the physician must determine not only the nature and severity of the disease but the extent and severity of organ system complications caused by other conditions such as diabetes mellitus. The history and physical examination must cover all organ systems. Interpretation and weighing of the findings must take into account the interacting effects of impairment of several organ systems.

The history must focus on documentation of renal abnormalities. Information should be elicited pertaining to systematic disease such as diabetes mellitus or lupus erythematosus, that might have renal involvement.

4.1 Glomerular Disorders

There are a variety of conditions that affect primarily the glomerulus. With progressive disease, other parts of the nephron and kidney can be affected. The nephrotic syndrome, which can be due to many causes, is characterized by massive proteinuria which results in hypoalbuminemia, red cell casts in the urine, and impaired glomerular function. Renal insufficiency is frequently progressive in nature.

4.2 Haementeria or Proteinuria

Any candidate who has haementeria or proteinuria on urinalysis should be carefully assessed by a urologist to exclude any condition which may suddenly worsen and require urgent medical attention.

4.3 Renal Calculi

A variety of metabolic disorders predisposes the individual to the development of calculi. Stones may be present without causing disease or symptoms. At times, the treatment for the underlying metabolic problem can help to control the calculi formation. Candidates should be evaluated for pain, urinary obstruction and infection. For persons with stones under 5 mm, the risk of sudden incapacitation due to pain is remote since the onset of acute colic can take an hour or more. Individuals with larger stones should be evaluated by a urologist do assess the probability of sudden incapacitation. Candidates should

be advised of the condition and symptoms and be counseled as to the need for adequate fluid replacement when performing job duties where dehydration is possible.

4.4 Polycystic Kidney Disease (PDK)

This is a hereditary condition that occurs in about one-half of 1% of all autopsies. Patients may experience pain in the flanks or hematuria. About 75% of these patients develop high blood pressure. About 10% develop a Berry aneurysm of the circle of Willis with a high incidence of subarachnoid hemorrhages. Renal failure in these patients tends to progress very slowly. Diagnosis of polycystic kidney disease is made with Ultra-Sound, CT or MRI.

Aside from the end stage problems caused by the kidney's inability to filter wastes from the blood stream, several symptoms can occur including hypertension, fatigue, frequent urination, headache, hiatal hernia, cerebral aneurysms, urinary tract infections, low back pain during physical work, diverticulosis of the colon and mitral valve prolapse. Complications include the rupture of cysts causing bleeding and possible infection, recurrent kidney stones, intense pain in upper abdomen and renal infections. When advanced, the numerous cysts that are growing throughout the kidney have grown to a point where they are crowding out much of the functioning normal kidney tissue. When this occurs, the normal waste filtering functions of the kidney become impaired resulting in end-stage renal failure.

4.5 Renal Disease

4.5.1 Chronic Renal Disease

A slow, progressive renal disorder culminating in end-stage renal disease (ESRD). The decline in kidney function correlated with the degree of nephron loss. During CRD, regardless of etiology, injury occurs to the nephrons in a progressive manner. Significant damage to groups of nephrons will eliminate them from their contributing role in maintaining renal function. The remaining intact nephrons will compensate by experiencing cellular hypertrophy. This growth process will enable them to accept larger blood volumes for clearances resulting in the exertion of greater solute levels, thus compensation results.

4.5.2 Chronic Renal Failure

With chronic renal failure, problems develop in fluid regulation, acid-base and electrolyte balance, excretion of wastes and in endocrine functions.

Specific clinical and laboratory findings aid in the diagnosis of chronic renal failure. Chronic renal insufficiency often progresses to end-stage renal disease. Dialysis and renal transplantation are the only treatment of end-stage renal disease.

Individuals with chronic renal failure are significantly uremic, having serum creatinine levels of greater than 2.5 mg/dl. Such levels are associated with significantly high risks of electrolyte abnormalities, such as hypo-and hyperkalemia, hypo- and hypercalcemia and hypo- and hypernatremia, all of which can cause changes in awareness and neuromuscular function and increase the risk of sudden, incapacitating cardiac or neurologic events.

Individuals with no other systemic involvement may require three four-hour dialysis sessions a week. Several factors need to be considered including the extent and severity of the loss of renal function, the extent of organ system impairment and damage, the composite effects of impairment of multiple organ systems, and the impact of those impairments on job duties.

4.5.3 Recommended Evaluation Protocol

The history should address voiding problems and the appearance of urine, the amount and location of peripheral edema and hypertension. The examination should cover general appearance, nutritional status, blood pressure, and the skin for excoriations and ecchymosis. The lungs should be auscultated for rales, pleural friction rubs or pleural effusions. The heart should be examined for the presence of pericardial friction rubs, effusions, or gallops. The candidate should be evaluated for mental status impairment muscle weakness, blunted or absent sensations and diminished reflexes, joint swelling and limited range of motion.

Necessary laboratory tests include BUN, serum creatine, phosphorus, uric acid, potassium, glucose, and parathyroid hormone. Chest x-rays may reveal a large heart, pleural effusion, or uremic pneumonitis,

Disease of this severity will significantly interfere with job duties. Dialysis patients are chronically tired and easily fatigued. Therefore, appropriate work restrictions are in order. If the candidate is currently asymptomatic, restrictions against exposure to work-related stress may be warranted if the medical records clearly show that stress causes recurrences of severe disease in this applicant.

Uremia is a systemic disorder cause impairment in all body organ systems. while either renal disease causing renal failure may be

irreversible, conservative management and renal replacement therapy may ameliorate or even reverse the impairments. However, some impairments persist or even progress. This is particularly true of diabetics who make up one third of the dialysis population and who become disabled due to vision loss, neuropathy and cardiovascular complications. These include hypertension, accelerated atherosclerosis congestive heart failure or uremic pericarditis (with or without effusion). Accelerated atherosclerosis may present as coronary artery disease (CAD) , with manifestations of angina pectoris, myocardial infarction, stroke, or peripheral vascular occlusive disease. Congestive heart failure may be due to hypertension, fluid overload, CD, uremia (reversible) or ischemia (not reversible) and cardiomyopathy. Neuropsychiatric abnormalities can include encephalatrophy, peripheral sensory, and motor neuronopathy, autonomic neuropathy, carpal tunnel syndrome, and depression.

4.6 Solitary Kidney

Congenital loss of one kidney, unilateral kidney disease, loss to trauma, or donation does not have adverse physiological effects nor does it impair longevity if the remaining kidney is healthy. The remaining kidney can generally provide adequate filtration to prevent hypertension, proteinuria, or renal failure. Controversy has existed over participation in contact sports due to the risk of traumatic loss to the remaining kidney. However, rib guards are available, and a survey indicated that 54% of sports medicine physicians do allow full participation in contact sports after discussion the possible risks (Anderson, 1995).

Law enforcement officers with a solitary kidney are not at increased risk of sudden incapacitation. Rather, the potential concern is an increased risk of significant and imminent direct harm to themselves. However, traumatic kidney loss is rare among law enforcement officers. Therefore, while loss of a solitary kidney would constitute a substantial injury, the probability of its occurrence even over a career is not great (i.e. $<50\%$ likelihood). Therefore, denial of a candidate with one healthy kidney would not be medically justifiable.

However, it is appropriate for these applicants to undergo a current evaluation of their kidney function to ensure that the remaining kidney is normal. In surgical patients, loss of more than 75% of overall renal mass is associated with proteinuria, glomerulopathy, and progressive renal failure (Novick, Gepharrdt, Guz, Steinmuller, & Tubbs, 1991).

5.0 EVALUATION OF REPRODUCTIVE CONDITIONS

5.1 Hydrocele

Hydrocele is a cyst formed in the sac which encloses the testes and epididymis. It can occur without an apparent cause or it may be the result of infections, trauma, tumors of surrounding tissues, or generalized edema from any cause.

5.1.1 General Considerations

Small hydroceles (< 1 cm) are not of functional significance. Medium (1-20 cm) and large (>20 cm) require treatment prior to placement.

5.2 Varicocele

Varicosities of the spermatic veins in the area of the plexus pampiniform are called varicocele. The varicosities are thought to be due to: 1) congenital defect or a disease of the valves of the spermatic veins; 2) pressure (e.g., by lymphoma or other tumor in the area) on the spermatic veins as they drain into the vena cava inferior, particularly on the right side or 3) anatomical relationships of the drainage of the left spermatic vein into the left renal vein when varicocele occurs on the left side.

The presence of varicocele can be easily detected on physical examination of the scrotum where it feels like a "bag of worms." Its presence is frequently associated with defective sperm production and diminished fertility potential (Goldstein, 1997 & Belloli, Pesce, Fantuz, 1993). When large, the varicocele may be associated with scrotal pain, a symptom aggravated by lifting or straining.

Candidates should be questioned about any pain, heaviness, or swelling. Referral to a urologist in these cases is recommended. Repair can be accomplished by surgical ligation and division of testicular veins or intravenous embolization of testicular veins.

5.3 Premenstrual Syndrome (PMS)

This condition comprises a protean gamut of physical and psychologic symptoms frequently associated with episodes of abnormal vaginal bleeding and dysmenorrhea (menstrual cramping). It may be present premenstrually or throughout the menstrual cycle. The symptoms may

include pelvic and abdominal pain, fluid retention, bloating, diarrhea and constipation, visual symptoms (photophobia, difficulty focusing, retro-orbital pain), sensation of excessive warmth, anxiety, hostile and aggressive behavior, depression, inability to concentrate, and inability to perform tasks normally completed without difficulty. The condition may vary in severity from mild, causing only minimal discomfort, to severe, causing the patient to become incapacitated for days, weeks, or even months. The pathophysiology and etiology of this syndrome are not clear. Therapy is difficult and frequently unrewarding, ranging from psychologic intervention to attempts to correct the abnormal hormonal patterns. Trottier and Brown (1994) cite instances in which this condition has affected appropriate judgement in law enforcement officers. Severe PMS may require a review of medical records and an individual evaluation by a urologist.

5.4 Pregnancy

5.4.1

The state of pregnancy in law enforcement officer candidates raises issues of inability to perform, injury to self (the mother), and injury to others (the fetus). However, the U.S. Supreme Court, in its landmark United Auto Workers v. Johnson Controls decision, ruled that employer fetal protection policies are not legal. Therefore, the examining physician cannot consider risks to the fetus.

Inability to perform and risks of injury to self generally arise in the third trimester. However, women who are better conditioned to performing tasks such as heavy lifting and running prior to pregnancy are likely to be able to safely continue to do these activities longer than someone who was not athletic prior to pregnancy.

The occupational physician should first assess the pregnant candidate's baseline level of fitness. Next, the physician needs to assess the obstetrical risk profile of the woman. Since intensive job physical demands have been clearly associated with intrauterine growth retardation and preterm birth, an estimate of obstetrical risk is necessary. A high risk woman (older, smoker, history of previous preterm birth, twins or multiple gestation currently, history of fetal death, multiple miscarriages or significant intrauterine growth retardation, recent vaginal spotting, etc.) would need more work restrictions than a low risk woman who was very fit at baseline.

Generally, for healthy, well-nourished women, exercise during pregnancy is safe and subject to few restrictions. This conclusion is reflected in the 2002 recommendations of the American College of Obstetricians and Gynecologists Guidelines for sports participation

during pregnancy. These guidelines, however, must be used with caution since they consider the health of the fetus as well as the mother.

Given the legal limitations referred to above, the best course of action is to discuss the demands of training with the candidate's obstetrician, and to rely on this physician for appropriate work limitations. While the employer cannot restrict a woman to protect the fetus, the private treating physician does not have such prohibitions.

The obstetrician should be made aware of not only the physical requirements, but also the unavoidable exposure to high levels of impulse noise from firing ranges (See Ears and Hearing). According to the ACGIH (1998), "There is evidence to suggest that noise exposure in excess of a C-weighted, 8 hour TWA of 115 dBC or a peak exposure of 155 dBC to the abdomen of pregnant workers, beyond the fifth month of pregnancy, may cause hearing loss in the fetus."

Note that the C scale is used and not the dBA scale. This is because the C scale gives a better measure of sound energy transferred to the cochlea, which is the force which actually damages hearing (the A scale is weighted to emphasize human hearing frequencies, rather than the sound energy across the spectrum).

Work site noise levels measured with dBA reading will be lower than the dBC reading. Therefore, if a workplace is below 115 dBA it will not be below 115 dBC. Of concern is the fact that 155 dBC is about the noise level of a gunshot from greater than 0.22 caliber weapon. Given these noise levels, the obstetrician may have concerns of damage to the fetal hearing system. A recommendation in writing should be required as to when critical components of training such as firearms training, running, wrestling, jumping, and lifting should cease. Additionally, a statement regarding how many weeks the obstetrician will keep the candidate at home postpartum should also required. A six-week period is common.

With this information, the examining physician can approximate the dates during which the candidate will need work restrictions and/or be off-duty. The department can assess whether reasonable accommodation is possible.

6.0 REFERENCES

ACOG Committee Obstetric Practice. (2002). Exercise during pregnancy and the postpartum period. (Opinion Number 267), *Obstet Gynecol*, 1, 171-173.

American Conference of Government and Industrial Hygienists (ACGIH) (1998). *Today*, 6, 8.

American Medical Association, Council on Scientific Affairs (1984). Effects of pregnancy on work performance. *JAMA*, 251, 1995-97.

American Medical Association, Council of Scientific Affairs. (1985). Effects of toxic chemicals on the reproductive system. *JAMA*, 253, 3431-38.

Anderson, C.R. (1995). Solitary kidney and sports participation. *Arch Fam Med*, 4, 885-8.

Axelsson, G., Lutz, C., & Rylander, R. (1984). Exposure to solvents and outcome of pregnancy in university laboratory employees. *Brit J Ind Med*, 41, 305-312.

Belloli G.S., Pesce, C., Fantuz, E. (1993). Varicocele in childhood and adolescence and other testicular anomalies: an epidemiological study. *Pediatr Med Chir*, 15, 159.

Cordes, D. H. (1982). *Reproductive Hazards in the Workplace (Project Module)*. Hyattsville, MD: Bureau of Health Professions (NTIS No. 0906086).

de Broe, M.E., D'Haese, P.C., Nuyts, G.D., & Elseviers, M.M. (1996). Occupational renal diseases. *Curr Opin Nephrol Hypertens*, 5, 114-21.

Goldstein M. (1997). New insights into the etiology and treatment of male infertility [editorial; comment]. *J Urol*, 158, 1808.

United Auto Workers v. Johnson Controls, Inc. 499 USC 187 (1991).

McDonald, A.D. (1986). Spontaneous abortion and occupation. *JOM*, 28, 1232-38.

McDonald, A.D. (1988). Prematurity and work in pregnancy. *Brit J Ind M*, 45, 56-62.

Niedzielski J., Paduch, D., & Raczynski, P. (1997). Assessment of adolescent varicocele. *Pediatr Surg Int,* 12, 410.

Novick, A.C., Gepharrdt, G., Guz, B., Steinmuller, D., & Tubbs, R.R. (1991). Long-term follow-up after partial removal of a solitary kidney. *NEJM,* 325, 1058-62.

Rosenberg, M.J., Feldblum, P.J., & Marshall, E.G. (1987). Occupational influences on reproduction: A review of the recent literature. *JOM*, 29, 584-91.

Sternfeld, B. (1997). Physical activity and pregnancy outcome. Review and recommendations. *Sports Med,* 23, 33-47.

Trottier, A. & Brown, M.D. (1994). *A Physician's Guide for the Assessment of Police Officers*. Ottawa: Canada Communications Corporation.

Wedeen, R.P. (1997). Occupational and environmental renal disease. *Semin Nephrol*, 17, 46-53.

Wilcox, A.J. (1988). Incidence of early loss of pregnancy. *NEJM*, 319, 189-94.

Windham, G.C. & Osorio, A.M. Female Reproductive Toxicology In: Ladou, J. (2007). *Occupational and Environmental Medicine, 4th Edition*, New York: McGra-Hill.

HEMATOPOIETIC SYSTEM

1.0 INTRODUCTION

While history and physical examination are most important in the evaluation of the hematologic system, the performance of laboratory tests is almost always necessary for determination of anatomic and functional states. The individual evaluation of functional ability should proceed carefully with a view to factors discovered in the history, physical examination and laboratory testing.

It is important to recognize that hematologic abnormalities may, in and of themselves, not cause significant impairment since body compensatory mechanisms may be adequate to overcome any deficiency. For example, mild iron deficiency anemia may be well-controlled in a person with an adequate cardiovascular system. However, it is important to recognize that the underlying cause of the hematologic abnormality may have significant implications for a person's ability to perform a given job. For example, mild iron deficiency related to poor iron ingestion in a female may be well-compensated and not pose any significant impairment. In distinction, a mild iron deficiency anemia, which also may be compensated in an adult male may be secondary to chronic rectal bleeding from an undiagnosed rectal carcinoma. In this instance, it may be difficult to make any decisions regarding a person's ability to perform a given job, since their medical condition is unstable, and likely to change within the near future. Decisions regarding placement of such individuals cannot be made prior to the condition being fully identified and treatment outcome better defined.

Exposures to toxins are of potentially great concern to individuals with hematologic or lymphatic system diseases because of the fragile conditions of existing or remaining cell lines. Chemicals that interfere with the reproduction of or efficacy of blood components or blood cells may significantly compromise the functioning of the hematologic system and the worker. Affected individuals should not be exposed to such chemicals.

Much concern has existed regarding the toxicity of benzene on formed elements of the blood. Reflecting this concern, government regulations require careful monitoring of the blood count in persons occupationally exposed to benzene or chemically related compounds. Benzene has been found to be responsible for hematologic malignancies (AML, CML) in studies of occupationally exposed workers.

Other exposed workers manifested changes in hematologic function leading to aplastic anemia, thrombocytopenia, pancytopenia, myelofibrosis and others. Organic solvents are often a mixture of multiple chemically-related compounds and should be considered potentially hepatotoxic. For persons on cancer chemotherapy, exposures to alkylating agents may be potentially toxic.

In the presence of inadequate combustion, especially with automobile exhausts and some furnaces, carbon monoxide exposure occurs. Carbon monoxide affects both the ability of the blood to transport oxygen and oxygen utilization at the cellular level. Some studies have indicated a potential for carbon monoxide to accelerate atherosclerosis in some occupationally exposed groups of workers. Therefore, the interaction of carbon monoxide exposure takes on great significance in individuals in whom hematologic disease already affects oxygen transport to the tissues. It is of interest that methylene chloride is metabolized to carbon monoxide in the body.

A number of nitrogen containing compounds and amines used extensively in industry can cause methemoglobinemia. Methemoglobinemia will affect the survival of red cells as well as their ability to transport oxygen to the tissues. Therefore, patients with hematologic diseases (including and especially the anemias) should be evaluated carefully with respect to potential exposure to this family of compounds; exposure is inadvisable.

For persons with chronic hematologic disorders whose conditions have well been defined, their capability to perform a job may be best assessed by complete medical history, physical examination, targeted laboratory tests and a review of previous medical records. Any evaluation should include:

- Presence of symptoms
- Frequency of therapy and any associated side effects
- Ability to carry out all job tasks
- Evidence of immune depression and presence of frequency of infections

Decisions regarding work limitations or placement should be based on sound clinical judgement, recognizing that individuals may vary in response to several environmental factors, even though they may have the same diagnosis.

2.0 OUTLINE OF HIGHLIGHTED CONDITIONS

- Iron-deficiency Anemia
- Thalassemia
- Bleeding Disorders/Anticoagulants
- Sickle Cell Disease

3.0 IMPLICATIONS FOR JOB PERFORMANCE

Anemia can limit exercise capacity and therefore a worker's ability to perform activities requiring endurance. Law enforcement activities may require an exercise capacity of up to or more than 12 METS (Jette, et al., 1990). Anemia can limit a law enforcement officer's ability to safely perform in a wide variety of physically demanding situations (See Table 1 in the section in section on the Musculoskeletal System).

Bleeding disorders and anticoagulants increase the risk of serious complications from even minor episodes of blunt or penetrating trauma.

4.0 EVALUATION OF COMMON CLINICAL SYNDROMES

4.1 Iron-deficiency Anemia (IDA)

IDA is common, especially among females who are avid runners. Research has shown that running can contribute to iron loss through hematuria, subclinical GI bleeding, sweating, decreased absorption, and mechanical trauma to the foot (Eichner, 1986; Newhouse & Clement, 1988). Relatively severe IDA (hemoglobin < 10 gm%) will clearly impair athletic performance (Newhouse & Clement, 1988; Celsing, et al., 1986). Impairment due to mild IDA remains controversial, but several studies provide enough evidence to warrant concern. A survey of female agricultural workers in Sri Lanka found that those with hemoglobin levels of 11.0-11.9 gm% were 20% less productive than those with levels > 13 gm% (Gardner, et al., (1975). Rowland, et al., (1988) found that treatment improved treadmill performance in seven women who had mild IDA with hemoglobin levels above 12 gm%. An additional study of Guatemalan manual laborers found that short duration near-maximal exercise capacity was impaired even with the mildest degrees of anemia (Viteri & Torun, 1974). Treatment with iron substantially improved performance within one month. Given this

potential for IDA to impair performance, the physician should require law enforcement candidates with IDA to undergo evaluation with possible iron studies, colonoscopy, and esophagogastroduodenoscopy (EGD) to determine the cause of anemia. Treatment should be aimed at correcting the cause of iron deficiency (such as control of bleeding) and may require dietary iron supplementation. The candidate may be required to bring documentation from their treating physician to show that their post-treatment hemoglobin levels have normalized. Exercise testing should demonstrate a capacity of at least 12 METS.

4.2 Thalassemia

Thalassemia is a genetic disorder characterized by absent or diminished synthesis of either the alpha or beta chains in the hemoglobin molecule. The prevalence of heterozygotic Thalassemia "minor" is reported to be common in African, Mediterranean, and Oriental populations. Clinically, there is usually mild microcytic anemia with hematocrits greater than 32%. Since these anemias are chronic, these patients usually have normal cardiovascular capacity. However, any question regarding a particular candidate should be assessed with an exercise test. Homozygous thalassemia ("intermedia" and "major") is a very grave condition resulting in premature death, poor growth, absent secondary sexual characteristics, and multiple endocrine deficiencies.

4.3 Bleeding Disorders

Having a bleeding diathesis secondary to clotting disorders, or the use of warfarin increases the risk of serious injury as a result of physical trauma associated with subduing combative subjects and other essential job functions. Bleeding into joints, the retroperitoneal area, and intra cranial bleeding are of concern. However, these complications will not cause incapacitation nor impair the performance of essential functions within the 5-15 minute duration that is typical for most critical law enforcement incidents. Therefore, these candidates do not generally pose a risk of harm to others while performing duties. One exception would be a candidate with severe thrombocytopenia (platelet counts < 50,000) or a major platelet dysfunction disorder (Lieberman, et al., 2001). Severe spontaneous life threatening bleeding may occur if platelet evaluations fall below 6000.

Regarding the risks "to self" posed by law enforcement duties, intracranial hemorrhage (ICH) from minor head trauma is the greatest concern. In untreated patients, this occurs following about 10% of head injuries (unselected for severity), and has a mortality rate of 20-

50%. However, Andes (1984) found that ICH can be prevented if clotting factors are administered within six hours of the head trauma. This could be done in an E.R. or by self-administered infusions. Some patients with severe factor deficiencies may have a history of spontaneous bleeding into joint spaces with sports activities. However, this can usually be prevented with prophylactic home infusions two to three times per week. Trauma from wrestling and other self-defense training may cause muscle hematomas. However, this can also be prevented with prophylactic treatment. [Note: there is at least one professional hockey player with hemophilia (DeBenedette, 1992)]

One problem with the treatment of hemophilia is the development of inhibitory antibodies to clotting factors. This can be very dangerous. In the Andes (1984) study, 2/5 patients with inhibitors died vs. 1/32 patients without inhibitors. Inhibitors may be transient or persistent. Some are characterized by an anamnestic response following exposure to factor VIII (Type I inhibitors). This renders the use of factor VIII useless. In an emergency, these patients may require intensive plasmapheresis or infusion of prothrombin complex concentrates to bypassing the "block" in the clotting cascade. Other patients may have "Type II" inhibitors which have a low titer that does not respond to stimulation. These patients can be treated acutely by simply increasing the dose of administered factors. Chronic treatment is possible using immune tolerance therapy, immunosuppression, or plasmapheresis.

An acceptable candidate for law enforcement officer should have the following:

- No history of severe thrombocytopenia (platelet counts $<50,000$) or a major platelet dysfunction disorder.
- Demonstrated history of successful sports participation without recurrent bleeding complications,
- The ability to self-administer clotting factors,
- A current evaluation for the presence of inhibitors,
- A written management plan from a hematologist for the administration of medication for various bleeding contingencies and blunt trauma to various parts of the body;
- Documentation via medical records that the candidate possesses adequate knowledge of their disease and has acted responsibly in the past to obtain therapy in a timely manner,

- Written acknowledgment from the candidate that he/she is aware of the following facts and associated personal risks:
  - The mortality from ICH is 20-50%; those who survive often have permanent neurological impairment.
  - Field work creates an imminent and substantial risk of head trauma.
  - To reduce the risk of ICH, it is imperative that the candidate obtain factor replacement or a medical evaluation as soon as possible following any trauma to the head or face.
  - Early therapy of head trauma must not be delayed regardless of the lack of symptoms, fears of developing serum inhibitors to replacement factors, or cost considerations.
  - While effective, early therapy will not eliminate the risk of death from minor head trauma in persons with severe factor deficiencies, or who have serum inhibitors to replacement factors.
- Absence of permanent joint damage which would interfere with the safe performance of duties (see Musculoskeletal Section).

Additionally, the candidate should be thoroughly evaluated for hepatitis B/C, and HIV (see Infectious Disease section).

4.4 Sickle Cell Disease

The degree of clinical severity can be anything from absence of symptoms to severe debilitating multisystem disease. The major source of morbidity in the population is vaso-occlusive pain. All major organ systems should be evaluated on at least a biannual basis. Aplastic crisis may occur under certain conditions. Close attention should be directed toward the avoidance of dehydration in the presence of high temperatures, and low humidity; the effects of high altitude exposure (above 5,000 feet) on oxygen carrying capacity; the use of artificial breathing apparatus (as in deep sea diving or respirators), and exposure to toxins that affect the oxygen carrying capacity of blood. Windy weather and low humidity are associated with increased number of hospital admissions for acute pain and SCD. Effects of high wind and low humidity are likely to be related to skin cooling (Jones, et al., 2005).

5.0 REFERENCES

Andes A., Wulff K., & Smith W.B. (1984). Head trauma in hemophilia. *Arch Int Med*, 144, 1981-83.

Cahill M.R. & Colvin B.T. (1997). Haemophilia. *Postgrad Med J*, 73, 201-06.

Celsing, F., Blomstrand, F., Werner, B., & Pihlstedt, P. (1986). Effects of iron deficiency on endurance and muscle enzyme activity in man. *Med Sci Sports Exerc,* 18, 156-61.

DeBenedette V. (1992). Hemophiliac plays professional hockey. *Phys Sportsmed*, 20, 58.

Eichner, E.R. (1986). The anemias of athletes. *Phys Sportsmed*, 14, 122-30.

Gardner, G.W., Edgerton, V.R., Barnard, R.J., & Bernaur, E.M. (1975). Cardiorespiratory, haematological and physical performance responses of anemic subjects to iron treatment. *Am J Clin Nutr*, 28, 982-88.

Jette, M., Sidney, K., & Blumchen, G. (1990). Metabolic equivalents (METS) in exercise testing, exercise prescription, and evaluation of functional capacity. *Clin Cardiol*, 13, 555-65.

Jones, S., Duncan, E.R., Thomas, N., Walters, J., Dick, M.C,, Height, S.E., Stephens, A.D., Thein, S.L., & Rees, D.C. (2005). Windy weather and low humidity are associated with an increased number of hospital admissions for acute pain and sickle cell disease in an urban environment with a maritime temperate climate. *Brit J Hem,* 131, 4, 530-533.

Kark, J.A. et. al. (1987). Sickle cell trait as a risk factor for sudden death in physical training. *NEJM*, 317, 781-787.

Lieberman, S.A., Oberoi, A.L., Gilkison, C.R., Masel, B.E., & Urban, R.J. (2001). Prevalence of neuroendocrine dysfunction in patients recovering from traumatic brain injury. *J Clin Endocrinol Metab*, 86, 6,2752-2756.

Newhouse, I.J. & Clement, D.B. (1988). Iron status in athletes. *Sports Med*, 5, 337-52.

Rice K.M. & Savidge G.F. (1996). NovoSeven in central nervous system bleeds. *Haemostasis*, 26 (Suppl 1), 131-34.

Risser, W.L. & Risser, J.M.H. (1990). Iron deficiency in adolescents and young adults. *Phys Sportsmed*, 18, 87-101.

Rowland, T.W., Deisroth, M.B., Green, G.M., & Kelleher, J.F. (1988). The effect of iron therapy on the exercise capacity of nonanemic iron-deficient adolescent runners. *Am J Dis Child*, 142, 165-69.

Viteri, F.E. & Torun, B. (1974). Anaemia and physical work capacity. *Clin Haematology*, 3, 609-26.

OPEB Board meeting minutes with discussion on Xavier Capital Management:

December 9, 2011

October 20, 2011

March 23, 2011

September 8, 2010

July 26, 2010

March 11, 2010

March 25, 2009

February 25, 2009

Prince George's County
Board of Trustees
Non-Pension Post Employment Benefit (OPEB)

AGENDA

Friday

December 9, 2011

11:00 A.M.

County Executive's Conference Room

1. **Appointment of Trustees**
2. **Discussion on Investment Manager**
3. **Other Business**

Proposed Meeting Date: January 25, 2012

PRINCE GEORGE'S COUNTY
BOARD OF TRUSTEES

Non-Pension Post Employment Benefits Trust Fund
(OPEB)

December 9, 2011
MINUTES OF OPEN SESSION

Members Present
Bradford L. Seamon, Acting Chief Administrative Officer
Thomas M. Himler, Deputy Chief Administrative Officer
Gail D. Francis, Director, Office of Finance
Stephanye R. Maxwell, Esq., CPM, Director, Office of Human Resources Management
Lawrence E. Cain, Auditor, County Council

Others Present
Cheryl O. Guth, Esquire, McGuire Woods (via conference call)
Kathleen W. Colbert, Manager, Pensions and Investments Division, OHRM
Jessica Portis, Summit Strategies

Revised Acceptance of Appointments: As a result in personnel changes, the revised acceptance of appointments were distributed and signed by those present. The County Executive's new designee is Mr. Thomas M. Himler, Deputy Chief Administrative Officer; the new Chairman of the County Council is Ms. Andrea C. Harrison; the Acting Chief Administrative Officer is Bradford L. Seamon; the new Acting Director of Management and Budget is Ms. Terri Bacote-Charles. The Directors of the Office of Finance and Human Resources Management are no longer acting and signed revised acceptance forms.

Xavier Capital Management Contract: Mr. Seamon moved to close the session in accordance with State Government Article Section 10-508(d)(2). The motion was seconded by Mr. Himler. The Board unanimously approved the motion. Mr. Seamon submitted the written statement attached to these minutes as Exhibit A in accordance with State Government Article Section 10-508(d)(2)(ii).

CLOSED SESSION

The trustees went into Closed Session.

OPEN SESSION

At the conclusion of the Closed Session, the Trustees returned to Open Session. Ms. Portis joined the meeting.

Exhibit B to these minutes sets forth information regarding the Closed Session in accordance with State Government Article Section 10-509(c)(2),

Selection of Fixed Income Investment Manager:

The Board discussed the search process for a replacement of the legacy fixed income manager. A motion was made by Ms. Maxwell and seconded by Mr. Himler to engage Summit Strategies as an adviser for the OPEB trust fund to assist in identifying an interim transition manager for the $44.5 million dollars of assets held in the custodian account and to conduct a due diligence search for a

replacement fixed income manager. Since 2008, Summit Strategies has provided similar investment consulting services for the County's Pension Boards, including the transition of both equity and fixed income portfolios. After discussion, the trustees unanimously approved the motion.

Ms. Jessica Portis explained that the transition process for a fixed income portfolio is more complicated that an equity portfolio. Most new managers would want to liquidate the portfolio and take new positions consistent with their portfolio holdings. As such, it is important to identify an interim transition manager who would passively monitor the holdings until a new manager is selected. Ms. Portis will identify a transition manager by close of business and provide a search booklet of top tier fixed income managers for the Board to review in the near future.

There was discussion on establishing a new investment consulting agreement with Summit Strategies and for contracting with the transition manager. A motion was made by Ms. Maxwell and seconded by Mr. Himler to designate Mr. Seamon as the trustee signatory for all contract documents. The trustees unanimously approved the motion.

Having no further business, the meeting was adjourned.

Exhibit A
Minutes of December 9, 2011

Written Statement Required by State Government Article Section 10-508(d)(2)(ii)

REASON FOR CLOSING THE SESSION/ STATUTORY AUTHORITY TO CLOSE SESSION

State Government Article §10-508(a):

(5) To consider the investment of public funds.

(7) To consult with counsel to obtain legal advice on a legal matter.

TOPICS TO BE DISCUSSED:

1. Termination of Contract with Xavier Capital Management

Exhibit B
Minutes of December 9, 2011

Information Regarding Closed Session Required by State Government Article Section 10-509(c)(2)

Location: County Executive's Conference Room

Date: December 9, 2011
Time: 11:15 a.m.

Motion By: Mr. Seamon Seconded By: Mr. Himler

Vote to Close Session:

	AYE	NAY	ABSTAIN	ABSENT
Bradford L. Seamon	[x]	[ ]	[ ]	[ ]
Thomas M. Himler	[x]	[ ]	[ ]	[ ]
Gail D. Francis	[x]	[ ]	[ ]	[ ]
Stephanye R. Maxwell	[x]	[ ]	[ ]	[ ]
Lawrence E. Cain	[x]	[ ]	[ ]	[ ]
Terri Bacote-Charles	[ ]	[ ]	[ ]	[x]
Andrea C. Harrison	[ ]	[ ]	[ ]	[x]

STATUTORY AUTHORITY TO CLOSE SESSION

State Government Article §10-508(a):

(5) To consider the investment of public funds.

(7) To consult with counsel to obtain legal advice on a legal matter.

TOPICS TO BE DISCUSSED:

1. Termination of Contract with Xavier Capital Management

PERSONS PRESENT:

Bradford L. Seamon, Acting Chief Administrative Officer
Thomas M. Himler, Deputy Chief Administrative Officer
Gail D. Francis, Director, Office of Finance
Stephanye R. Maxwell, Esq., CPM, Director, Office of Human Resources Management
Lawrence E. Cain, Auditor, County Council
Cheryl O. Guth, Esquire, McGuire Woods (via conference call)
Kathleen W. Colbert, Manager, Pensions and Investments Division, OHRM

ACTIONS TAKEN:

1. Terminate the contract with Xavier Capital Management effective December 9, 2011

410-749-2240

Colbert, Kathy C.

From: Maxwell, Stephanye R.
Sent: Wednesday, November 30, 2011 12:57 PM
To: Colbert, Kathy C.
Subject: RE: Xavier

Kathy,

This is very resourceful information. I don't recall seeing Summit's evaluation before? It is very helpful. THANKS

Stephanye R. Maxwell, Esq., CPM
Director
Office of Human Resources Management
Suite 351
1400 McCormick Drive
Largo, MD 20774
(301) 883-6344
srmaxwell@co.pg.md.us

From: Colbert, Kathy C.
Sent: Wednesday, November 30, 2011 12:51 PM
To: Maxwell, Stephanye R.
Subject: Xavier

OPEB Board mtgs:
2/25/09
3/25/09
3/11/10
7/26/10
9/8/10
3/23/11 6/8/11 10/20/11

Stephanye,

Here's a brief history of activity with Xavier and OPEB funding.

6/30/08 – County funded $20M for OPEB and invested in short-term fund (STIF) with custodian bank.
2/25/09 - Initial meeting of OPEB Board . CE asks BOT to consider local firm Xavier as fixed income manager. Recent clients included the Maryland Insurance Fund and Howard County. In July 2008, Summit Strategies was asked to evaluate Xavier as bond manager for pension funds. (See attached summary).
3/25/09 – Xavier made presentation and Board approved $20M for investment in core fixed income.
4/13/09 – Xavier funded with $20M from STIF account.
6/30/09 - County funded $15.3M for OPEB ($15 County/$3 Library) funds sent to STIF account.
9/8/10 – OPEB Board approved Investment Policy Statement and another $20 million to invest with Xavier. Based on available funds, only $15 million was sent on 9/30/10. Initially funds were inadvertently wired to Xavier's M&T bank (management fees paid to this account), but recalled and wired to their custodian account at State Street.
10/20/11 – Xavier reviewed their fund strategy and performance with new trustees.

Let me know if you have any questions. Kathy

Kathleen W. Colbert
Pension Plan Administrator
Prince George's County Pension Funds
Phone: 301-883-6036
Fax: 301-883-6031
E-mail: kccolbert@co.pg.md.us

much I can direct and help, you know help from, if [Candidate A] wins. Um, like uh what gonna be doing um." Then, Johnson discussed how he was arranging to have County funds transferred to the employee for management, "I have a meeting coming up in the, ah, early part of the month, and, ah, you know, there the thing though is that you have to um, there, there two aspects to it, one is that you have to, put the money, um, you know, up front, um, in those accounts, so that we can, um, you know, and then the second one is to make certain that, it's done well, you know, and, um, you have so much work for the next eight, nine, ten years. My God." See CD 1.

On September 8, 2010, Jack Johnson called the employee and advised, "The good news, ah, we got another twenty [million dollars]" in County funds for the employee to manage. Following a lengthy conversation, Jack Johnson stated, "It's amazing, I mean I sat in now, you know, and you realize that, um, ***if you don't have people on the inside fighting for you, you don't have a chance***. I mean, you know, a little measly twenty million dollars, we had to fight to get that today." CD 1 (emphasis added). The employee responded, "***I'm gonna show you how grateful I am and then some.***" Johnson replied that the employee needed to earn money for the County. CD 1 (emphasis added).

On October 4, 2010, the employee called Jack Johnson and stated, "I forgot to tell you I became a millionaire." Johnson responded, "You did. Oh he, you told me that, ah, you. . . $15 million right?" The employee explained that the County's funds were mistakenly transferred to their business check account and that they were in the process of having the transfer reversed. Johnson instructed the employee to have the funds removed from their checking account. See CD 1.

c. *Purchasing County Property*

On June 30, 2010, Jack Johnson called a County official and asked them to assist Johnson

12/4/11 Post

Nichols, the hospital board chairman, has begun notifying board members of plans to place Glover on a paid leave pending the investigation.

Glover said late Saturday via e-mail that he is " confident it will show all existing Dimensions leadership acted appropriately" and that he expects to return to his job after his leave, once the inquiry is completed.

About the same time Johnson was working out arrangements with the hospital, he was trying to get a consulting deal with a company that manages some county funds, prosecutors said. Baker administration officials are trying to determine which firm was involved.

Johnson told an unnamed employee of the firm that he could ensure that the county would give the company more money to invest, prosecutors wrote. In exchange, he said, he wanted a job.

Three months later, Johnson called the employee to say that the county had doubled its investment to $40 million. "If you don't have people on the inside fighting for you, you don't have a chance," Johnson told the employee during an intercepted call.

The employee said: "I'm going to show you how grateful I am and then some."

During an October 2010 phone call between Johnson and a family member whom Johnson helped get a county job, Johnson said he was still solidifying his plans.

"Right now the only thing I got locked down, in terms of commitment, is um [the hospital official]," he said. "But there are two or three other people I'm talking to."

The Johnsons' son Bruce was hired by the county health department just before his father left office, in a process that appeared to flout county rules.

Johnson said he also planned to make some "good money" by developing a senior citizens center. He planned to use federal housing funds, a key part of his bribery scheme, to build the center, and then would bid on a county contract to offer senior services. In a recorded call, a county official agreed to help.

PRINCE GEORGE'S COUNTY GOVERNMENT
OFFICE OF HUMAN RESOURCES MANAGEMENT
PENSIONS AND INVESTMENTS ADMINISTRATION
1400 McCormick Drive, Suite 110, Largo, Maryland 20774
MAIN (301) 883-6390 FAX (301) 883-6031 TTD (301) 883-6329

SENT BY FACSIMILE

September 24, 2010

Nicholas Erickson
State Street Bank & Trust Company
Financial Information Services
801 Pennsylvania Avenue, Tower 1
Kansas City, MO 64105

Dear Mr. Erickson:

Please wire on Thursday, September 30, 2010, $15,000,000.00 to Xavier Capital Management. The funds should come from the OPEB account fund PCP0. The wire instructions are:

Bank Name:	M&T Bank
Bank Address:	Capital Centre Office 1050 Shopper Way Largo, MD 20774-4812
ABA Routing #:	052000113
Account No.:	0006070876
FEIN#:	20-4742786

If you have any questions regarding this matter, please call Mary Sullivan at 301-883-6391 or by email at msullivan@co.pg.md.us.

Sincerely,

Kathleen W. Colbert
Pension Plan Administrator

PRINCE GEORGE'S COUNTY
BOARD OF TRUSTEES

Non-Pension Post Employment Benefit
(OPEB)

February 25, 2009

Members Present
Jack B. Johnson, County Executive
Dr. Jacqueline F. Brown, Chief Administrative Officer
Donald E. Bridgeman, Director, Office of Human Resources Management
Michael J. Dougherty, Director, Office of Finance

Others Present
Kathy Burke, AON Consulting
Kathleen McAuliffe, AON Consulting
Ralph E. Moultrie, Special Assistant to the County Executive
Charles M. Curtis, Jr., Accounting Manager, Office of Finance
Rick Amatucci, The Amatucci Group
Lawrence E. Cain, Jr., Auditor, County Council
Julia D. Sanders, Manager, Benefits Administration Division, OHRM
Kathleen W. Colbert, Manager, Pensions and Investments Administration, OHRM
Cindy L. Thorn, Assistant Manager, Pensions and Investments Administration, OHRM

The meeting of the Prince George's County OPEB Board of Trustees was opened with introductions. Ms. Colbert then provided an overview of OPEB and GASB (Governmental Accounting Standards Board) Statement #45. Effective June 25, 2008 the Council enacted legislation (CR-40) to establish the Prince George's County, Maryland Non-Pension Post Employment Benefits Trust Fund to hold all contributions made by the County together with any income, gains, or profits and taking into account any losses. A seven member Board of Trustees is responsible for managing the assets of the Trust. Currently the fund is invested in short term, cash equivalents through State Street Bank and Trust Company. The components of the GASB Statement #45, is similar to pension plan accounting of normal annual cost and unfunded liabilities. Similar to the methodology used in the pension plan valuations, the County will use a 30-year open amortization of the OPEB unfunded liability. The amortization will be based on level percent of pay.

A presentation made by AON Consulting, illustrated some retiree health care challenges and recommended changes to reduce costs which include setting a subsidy based on lowest cost plan and providing options to medicare eligible retirees. Recommendations and associated costs of alternatives will be provided to the Board by May 2009.

AON explained that the County has a 10 year phase-in of the Annual Required Contribution (ARC) with an expectation to fully fund the ARC by FY2017. While the policy required a 10% contribution ($4.3 million) for FY2008, the County made excess contributions in the first fiscal year of $28.1 million. As a result, additional contributions will not be required for FY09 or FY10.

A motion was made by Dr. Brown, seconded by Mr. Bridgeman to approve the OPEB Trust Fund. The Board unanimously approved.

Clarification was requested regarding the fund's current investment. Ms. Colbert indicated that on June 30, 2008, $20,000,000 was wire transferred to a conservative short term money market mutual fund with State Street Bank and Trust. Eventually the Board will have to decide on an investment strategy and approve an investment policy. Mr. Johnson asked the Board to consider Xavier, a local firm in Prince George's County, as a fixed income manager for the OPEB fund. Recent clients include Maryland Insurance Fund and Howard County Government. After discussion, a motion was made by Mr. Johnson and seconded by Dr. Brown, to hire Xavier as a Fixed Income Manager. The Board unanimously approved the motion.

Final order of the meeting was to elect a Chairman and Vice-Chairman. A motion was made by Mr. Bridgeman and seconded by Dr. Brown to elect Mr. Johnson as Chairman of the OPEB Board of Trustees. The Board unanimously approved the motion. A motion was made by Mr. Johnson and seconded by Mr. Dougherty to elect Dr. Brown as Vice-Chairman of the OPEB Board of Trustees.

Having no further business, the meeting was adjourned.

PRINCE GEORGE'S COUNTY
BOARD OF TRUSTEES

Non-Pension Post Employment Benefit
(OPEB)

March 25, 2009

Members Present
Donald E. Bridgeman, Director, Office of Human Resources Management
Michael J. Dougherty, Director, Office of Finance
Jonathan R. Seeman, Director, Office of Management and Budget

Others Present
Catherine Furr, AON Consulting
Kathleen McAuliffe, AON Consulting
Merson Bartlett, AON Consulting
Ralph E. Moultrie, Special Assistant to the County Executive
Mary Hatfield, Accountant III, Office of Finance
Rick Amatucci, The Amatucci Group
Cheryl Guth, McGuire Woods
Lawrence E. Cain, Jr., Auditor, County Council
Julia D. Sanders, Manager, Benefits Administration Division, OHRM
Kathleen W. Colbert, Manager, Pensions and Investments Administration, OHRM
Cindy L. Thorn, Assistant Manager, Pensions and Investments Administration, OHRM

Xavier Capital Core Fixed Income Presentation: Lorenzo Newsome, President & Chief Investment Officer and Pamela A. Turner, Principal & Senior Analyst to Xavier Capital Management introduced their company to the Board. Founded in 2006, the company is 100% employee owned. Registered as an investment adviser specializing in fixed income portfolios, the primary focus is on core, core-plus and high quality-high yield securities. The overview provided the Board with the company's investment approach, process, philosophy and strategy.

Approval of Minutes from February 25, 2009: The minutes of the February 25, 2009 meeting were approved with the revision to include the dollar amount of $20 million to be invested with Xavier.

Synopsis of Trust Agreement and Fiduciary Obligations: Cheryl Guth, Legal Counsel to the Board, presented a written summary of the Trust Agreement and Fiduciary Responsibilities. Board members may contact Ms. Guth directly if they have any questions.

Results of GASB45 Actuarial Valuation: The results of the July 1, 2008 valuation were presented by Merson Bartlett and Catherine Furr from AON Consulting. For FY09, the present value of projected benefits totaled $969.7M. The actuarial accrued liability (AAL) of $792.2M is funded by the assets of $29.6M, leaving an unfunded actuarial liability of $762.6M. The annual required contributions of $66.2M is comprised of $22.2M as normal cost and amortization of the unfunded AAL at $44M. The report indicates as a result of the additional contributions made in FY08, less additional contributions are needed in FY09 ($3.2 less than what would have been required under 2nd year of funding policy). Additionally, the County has the ability to forego additional contributions in FY10 and FY11 and still be in a similar NOPEBO position at the end of the 10-year phase-in period in FY2017.

OPEB Annual Financial Report as of June 30, 2008: The Board was provided with the Annual Financial Report as of June 30, 2008. No discussion was heard.

Having no further business, the meeting was adjourned.

PRINCE GEORGE'S COUNTY
BOARD OF TRUSTEES

Non-Pension Post Employment Benefit
(OPEB)

September 8, 2010

Members Present
Jack B. Johnson, County Executive and Chairman of OPEB Trust
Ralph E. Moultrie, Acting Chief Administrative Officer
Donald E. Bridgeman, Director, Office of Human Resources Management
J. Michael Dougherty, Director, Office of Finance
Jonathan R. Seeman, Director, Office of Management and Budget

Other Present
Rick Amatucci, The Amatucci Group
Kathleen W. Colbert, Manager, Pension and Investment Administration
Charles M. Curtis, Jr., Accounting Manager, Office of Finance
Mary Hatfield, Accountant, Office of Finance

Approval of Minutes from July 26, 2010:
The minutes were approved.

Fund Overview
As of July 31, 2010, the net asset value of invested funds was $38,465,098. Investments are held in a short term money market fund with the custodian at State Street Bank ($16,074,168) and in a core fixed income account ($22,390,930) with Xavier an Investment Manager designated by the Board of Trustees. Since inception in June 2008, the Money Market Fund has grown from $15,300,000 to $16,074,359 ($15,339,963 County and $734,396 Library). This fund seeks to maximize current income to the extent consistent with the preservation of capital and liquidity, and the maintenance of a stable $1.00 per share net asset value, by investing in dollar denominated securities.

Since inception in May 2009, the fixed income investment with Xavier has grown from $20,000,000 to $22,390,930. Total returns in corporate credits have been positive in the first half of 2010 mainly due to Treasury yield compression and the carry trade. Year to date performance has exceeded the Barclays Aggregate Index by 1.33 since inception.

OPEB Investment Policy Statement:
The Trustees discussed the investment objectives for the OPEB Trust and recognized the need for long-term growth and the periodic payment of benefits. They indicated that safety of principal is the foremost objective and investments should seek to ensure the preservation of capital in the overall portfolio. While the Trustees recognize the importance of diversity of investment as a way to avoid unreasonable risk, they agreed that until there are sufficient funds for investments (over $100,000,000) funds will be conservatively invested in core fixed income instruments.

The Board unanimously approved the Statement of Investment Objective, Policy and Guidelines.

Asset Allocation Review and Portfolio Implementation

Summit Strategies provided an asset class risk/return profile for the various asset classes and indicated that a global equity allocation was used in the modeling analysis for the equity portfolio. Ms. Portis reviewed four potential asset allocations with varying equity exposures from 10% to 25%. She indicated that the current portfolio expected to earn 3.2% with a standard deviation of 2.4% over a 10 year period. A portfolio with 25% equity is expected to earn 4.5% with a standard deviation of 5.3% over a 10 year period.

In response to the Board's request, Summit Strategies provided a manager search comparison of passive global equity and fixed income managers. The following candidates were reviewed detail for this mandate: Mellon Capital Management, Northern Trust and State Street Global Advisors. Ms. Portis review in detail the firm, product and characteristics of each manager, including annualized returns compared to the designated benchmarks. She also indicated that there is not much alpha with a fixed income portfolio and one of the benefits of investing in an index fund was lower fees and fund liquidity. Management fees average 6 basis points compared to active management fees of 30 basis points.

After discussion, the Mr. Bridgeman made a motion to fund and additional $20,000,000 with Xavier Capital Management stating the firm produced returns in excess of the Barclays Capital Aggregate Index. This motion was seconded by Mr. Moultrie and unanimously approved.

Other Business

Having no further business, the meeting was adjourned.

INVESTMENT MANAGEMENT AGREEMENT

This INVESTMENT MANAGEMENT AGREEMENT, dated March 31st, 2009, (this "Investment Agreement" or "Agreement") by the Board of Trustees (herein-after referred to as the "Board") of the Prince George's County, Maryland Non-Pension Post Employment Benefits Trust Fund (the "Fund") and Xavier Capital Management LLC (the "Investment Manager").

WITNESSETH

WHEREAS, the Board is vested with exclusive authority to manage and control the assets held in the Fund,, which was created by Prince George's County, Maryland (the "County") pursuant to a Trust Agreement dated as of July 1, 2008 (the "Trust Agreement"), and is intended to satisfy requirements of Internal Revenue Code Section 115 for tax exempt trusts, for the purpose of investing and administering the County's contributions to the Plan (as defined in the Trust Agreement) and

WHEREAS, the Board is authorized to engage the services of registered investment counsel qualified under the Investment Advisers Act of 1940 (15 U.S.C. Section 80b-1 et. seq.) (the "Advisers Act"), to assist it in managing the assets of the Fund, and desires to retain the services of the Investment Manager in regard to the management of a portion of the assets of the Fund, and

WHEREAS, the Investment Manager is willing to provide services to the Board on the terms and conditions hereinafter set forth, and has represented to the Board that it possesses the highest degree of competence and expertise essential to providing such services.

NOW THEREFORE, in consideration of the covenants and promises herein recited, the parties agree as follows:

ARTICLE I - Scope of Services

1. The Board hereby appoints the Investment Manager to provide the services herein described. The Board shall authorize and direct State Street as Custodian, or such successor Custodian as the Board may appoint to segregate certain assets into a separate account within the Fund to serve as a separate bookkeeping account (the "Investment Account"), and to invest and reinvest the assets in the Investment Account in accordance with instructions received by the Custodian from the Investment Manager. The assets shall, at all times, remain in the custody of the Custodian. The Board, in it sole discretion, from time-to-time may transfer additional assets to, or may withdraw assets from, the Investment Account, with at least twenty-four (24) hours advance notice to the Investment Manager.

2. (a) The Investment Manager hereby accepts the appointment and agrees to provide services as described herein. The Investment Manager shall supervise and manage the investment of the assets of the Investment Account in accordance with the written Investment Policy and Guidelines (the "Guidelines") pertinent to this Investment Account, adopted by the Board, a copy of which is attached as Exhibit One and is incorporated by reference herein. The Board shall provide to the Investment Manager, in a timely manner, copies of any amendments thereto, and copies of any other written statements of investment policies, objectives or restrictions which are adopted by the Board. Subject to the parameters set forth in these documents, the Investment Manager shall have full discretionary authority to invest and reinvest the assets of the Investment Account at such times and in such manner as the Investment Manager believes to be in the best interest of the participants and beneficiaries of the Plan. To this end, the Investment Manager is authorized to do the following:

(i) To purchase, sell, exchange, hold or liquidate securities held in the name of and for the account of the Fund and to have all power in dealing with the Investment Account that the Board would have if it were to hold the Investment Account directly;

(ii) To issue instructions to brokers, dealers, investment bankers, and underwriters to purchase, sell, or otherwise trade or deal with securities in the Investment Account;

7. The Investment Manager shall provide to the Board evidence that the Investment Manager maintains fiduciary insurance against errors and omissions and other potential liabilities which it may incur for breach of any of its fiduciary responsibilities hereunder. Such insurance must be maintained at a level mutually agreed to by the parties hereto, but at least as favorable to the Board as the evidence of initial coverage. Evidence of such fiduciary liability insurance coverage as described in this paragraph shall be provided to the Board upon request or at least annually.

8. The Investment Manager shall give prompt written notification to the Custodian of the issuance by the Investment Manager of an order for the purchase or sale of securities for the Investment Account, and shall instruct the executing broker or dealer to confirm the execution of the transaction to the Custodian. Such notification shall be deemed authorization for the Custodian to pay for securities purchased against receipt thereof and to deliver securities sold against payment therefore, as the case may be. The Investment Manager shall provide such other information requested by the Custodian to enable the Custodian to fulfill its reporting obligations to the Board, and to arrange for the settlement of securities transactions and to ensure the proper safekeeping of the assets in the Investment Account.

9. The Investment Manager shall reconcile all Investment Account transactions on at least a monthly basis with the Custodian. The Investment Manager shall promptly notify the Board of any material inability to reconcile the Investment Account.

10. The Board will furnish or will cause to be furnished to the Investment Manager or to brokers or dealers selected by the Investment Manager such authorizations as may be necessary to effect securities transactions for the Investment Account.

ARTICLE II - Reporting Requirements

1. The Investment Manager shall provide required reports as outlined in the Guidelines, or as the Board from time-to-time may request and shall make representatives available to meet with the Board, at the Board's discretion, to discuss the status of the Investment Account.

2. All reports and documents produced in the performance of this Agreement shall be the sole property of the Board. The Investment Manager shall make no distribution of work specifically produced for the Board under this Agreement to others without the express written consent of the Board. The Investment Manager agrees not to assert any rights at common law or in equity or establish any claim to statutory copyright in such reports.

3. During the term of this Agreement, a representative of the Investment Manager shall be available during regular business hours to furnish advice or report to the Board, including the Staff of the Board, with respect to all matters contemplated by this Agreement.

ARTICLE III - Compensation/Fees

1. The Investment Manager shall receive compensation for its services, in accordance with the Fee Schedule set forth in the attached Exhibit Two, which is attached hereto and incorporated herein by reference, and which may be changed from time-to-time upon the mutual written agreement of the parties, provided that Investment Manager shall give at least ninety (90) days notice of any proposed increase in the Fee Schedule amounts. The fee shall be computed and paid at the end of each calendar quarter of the Board's fiscal year for that quarter. The fair market value of the assets in the Investment Account shall be determined by the Custodian as of the close of business on the last business day of each calendar quarter. The first payment will be prorated to cover the period from the date the Account is opened through the end of the next full calendar quarter. Thereafter, the fee will be based on the Account value calculated on the monthly average of the fair market value of the Investment Account Assets as of the last business day of each month in such quarter ("Average Account Value"). The fee will be paid within thirty (30) days of the invoice date.

Agreement, and that it has not paid or agreed to pay any company or person, other than a bona fide employee working solely for it, any fee, commission, percentage, brokerage fee, gift, or any other compensation contingent upon or resulting from the award or making of this Agreement except where, (i) the Investment Manager has disclosed, in writing to the Board, that it has engaged such company or person other than a bona fide employee to secure the Agreement, and (ii) the cost of such engagement is not charged to the Board under the terms of compensation under this or any subsequent Agreement. For breach or violation of this warranty, the Board shall have the right to void this Agreement without liability, entitling the Board to recover all monies paid hereunder and the Investment Manager shall not make claim for or be entitled to recover, any sum or sums due under this Agreement. This remedy, if effected, shall not constitute the sole remedy afforded the Board for the falsity or breach, nor shall it constitute a waiver of the Board's right(s) to claim damages or refuse payment or take any other action provided for by law or pursuant this Agreement.

6. The Investment Manager hereby agrees to hold harmless the Board, its members, officers, employees, agents and representatives, the Fund, the Plan and the Prince George's County Government, and to indemnify and exonerate same against and in respect of any and all claims, demands, damages, actions, costs, charges, losses, liabilities, and deficiencies, including reasonable legal fees and expenses, resulting from, arising out of or in any way related to (i) any untrue warranty or representation or negligent omission of the Investment Manager in this Agreement; and/or (ii) any liens, claims, encumbrances, or infringement of any patent, trademark, copyrights, or other proprietary right in violation of Section 5(a); and/or (iii) the Investment Manager's willful misfeasance, bad faith, negligence or reckless disregard of its obligations in managing the Investment Account assigned to the Investment Manager under the terms of the Agreement; provided that a court of competent jurisdiction finds that the Investment Manager was in breach of the aforesaid obligations, or such finding is made by a mutually agreed upon arbitration panel. Except as set forth in the foregoing provisions of this Section 6, the Investment Manager shall not be liable for any error of professional judgment or for any loss suffered by the Investment Account in connection with the subject matter of this Agreement. The foregoing provisions of this Section 6 do not constitute a waiver by the Board, the Fund or the Plan of any rights it may have under federal or state securities laws, which under certain circumstances impose liability even on persons who act in good faith.

7. The rights and remedies provided herein are cumulative and are in addition to any remedies otherwise available to the Board in law or in equity and the exercise of any one or more of such remedies shall not be construed as a waiver of any other right or remedy.

8. The Investment Manager agrees to do all acts and execute all other papers, documents, or instruments necessary or desirable to effectuate the purposes of this Agreement.

9. This Agreement shall be governed by and construed in accordance with the laws of the State of Maryland and applicable federal laws.

10. The parties intend that each provision of this Agreement is severable. If any provision or term hereof is determined, for any reason whatsoever, to be illegal or otherwise unenforceable, such determination shall not affect the validity of the remaining provisions and terms hereof.

11. All instructions, notices, demands or other communications to be given by either party to the other party under this Agreement shall be in writing, shall be given by first class, certified or registered mail, by a recognized courier service that maintains written verification of actual delivery, by facsimile, or electronic mail, with a copy thereof sent by first class mail, postage prepaid, or by messenger.

Such communication shall be sufficient and effective when received by the parties as follows:

(a) **to the Board at:**

1400 McCormick Drive, Suite 110
Largo, Maryland 20774
Attention: Kathleen W. Colbert

20. This Agreement represents the complete and exclusive understanding of the parties and may not be modified or amended except by a writing mutually agreed to and duly executed by the parties. Any and all previous communications between the parties whether written or oral with reference to the subject matter of this Agreement is hereby nullified and superseded.

21. The Investment Manager consents to the jurisdiction of the courts of the State of Maryland, including the jurisdiction of the United States District Court for the District of Maryland (to the extent diversity of citizenship or other jurisdictional basis exists) and agrees that venue shall be proper in any county (or Baltimore City) or in the United States District Court for the District of Maryland, if suit is filed to enforce the provisions of this Agreement.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed and delivered as of the day and year first above written.

EXHIBIT ONE
XAVIER CAPITAL MANAGEMENT
CORE FIXED INCOME
INVESTMENT POLICY AND GUIDELINES

I. The purpose of this Investment Policy and Guidelines (the "Guidelines") is to establish a clear understanding between the Board of Trustees (the "Board") and Xavier Capital Management LLC (the "Manager") with respect to the investment policies and objectives of the assets assigned to it for management. These Guidelines will outline an overall philosophy that is specific enough for the Manager to know what is expected, but sufficiently flexible to allow for changing economic conditions and securities markets. This policy will provide risk policies to guide the Manager toward long-term rate of return objectives which will serve as standards for evaluating investment performance. The policy will also establish the investment restrictions to be placed upon the Manager and the procedures for policy and performance review.

II. The Manager will be responsible for a core fixed income style portfolio for the Plan. The Manager will have full discretion for the funds under its management subject to limitations appearing herein.

III. RESPONSIBILITIES OF THE MANAGER

The duties and responsibilities of each of the Managers retained by the Board include:

A. Managing the assets under their discretion in accordance with the policy guidelines and objectives expressed herein.

B. Meeting or exceeding the Manager specific established and agreed upon benchmarks.

C. Exercising investment discretion within the guidelines and objectives stated herein. Such discretion includes decisions to buy, hold or sell securities in amounts and proportions reflective of the Manager's current investment strategy and compatible with the investment objectives.

D. Promptly informing the Board or its agents regarding all significant matters pertaining to the investment of Fund assets, for example:

1. Material changes in investment strategy, portfolio structure and market value of managed assets,
2. The Manager's progress in meeting the investment objectives set forth in this document,
3. Significant changes in the ownership, affiliations, organizational structure, financial condition, professional personnel staffing and clientele of the organization, and
4. Any material changes in the liquidity of the market in which the Manager invests or in the Manager's assessment of the liquidity of the securities it holds in the portfolio.

E. Initiating written communication with the Board, Plan Administrator and Consultant when the Manager believes that this Statement is inhibiting and/or should be altered. No deviation from the guidelines and objectives established in the Policy Statement is permitted until after such communication has occurred and the Board has approved such deviation in writing.

F. Complying with all provisions pertaining to the Manager's duties and responsibilities as a fiduciary. It is expected that the Fund's assets will be invested with the care, skill, prudence and diligence under the circumstances then prevailing that a prudent professional investment manager, acting in a like capacity and familiar with such matters, would use in the investment of Fund assets, all in accordance with applicable law.

E. Up to 30% of the portfolio may be invested in non-U.S. dollar fixed-income securities.

F. Interest rate futures and fixed-income securities options may be used, but not for the purpose of speculation. Futures and short options will be covered with cash, cash equivalents, offsetting derivatives positions, or liquid assets.

G. No security, except issues of the U.S. Government or its agencies or mutual funds, shall comprise more than 5% of the Manager's total portfolio of assets, measured at market. Further, no individual portfolio shall purchase more than 5% or hold more than 8% of its assets in the securities of any single issuer, excepting issues of the U.S. Government or its agencies. (For mortgage-backed securities, an issuer is defined as a separate trust.)

H. Full discretion shall be granted to the Manager regarding its portfolio diversification, by maturity, quality, sector and coupon, the selection of securities, and the timing of transactions, within the parameters of the objectives and guidelines described herein, subject to the following:

1. The average duration (interest rate sensitivity) of an actively managed portfolio shall not exceed seven years.

2. The overall average quality of each high-grade fixed income portfolio shall be AA or better.

I. While the Board is sensitive to excessive turnover, there shall be no specific limitation in this regard, recognizing the importance of providing flexibility to the Managers to adjust their asset mix in changing market conditions.

J. The flexible management of the portfolio is permitted, and while the Board is appropriately sensitive to book losses, there is no justification to hold a particular security, or to manage the collective assets, for the sole purpose of avoiding the recognition of a book loss.

K. Prohibited Investments

The Fund's assets in separately managed accounts may not be used for the following purposes:

1. Transactions prohibited or limited by Maryland Law, as amended.
2. Short Sales
3. Purchases of letter stock, private placements (except for 144A securities)
4. Leveraged transactions other than real estate
5. Puts, calls, straddles, or other option strategies, except where permitted
6. Investment in tax-exempt securities
7. Use of margin, or investments in any derivatives not explicitly permitted in this policy statement
8. Investments by the Managers in their own securities, their affiliates, or subsidiaries (excluding money market or other commingled funds as authorized by the Board)

VI. BENEFIT PAYMENTS

A. Managers should assume that withdrawals may be made from their portfolios from time to time to pay benefits. The Plan Administrator shall provide an estimate of cash needs, updated on an interim basis, and an estimate of the drawdown requirements from the Managers' portfolios. Accordingly, appropriate liquidity should be maintained to fund these withdrawals without impairing the investment process.

C. Any Manager on the watch list or in probationary status will not be eligible to receive additional investment funds.

D. A Manager placed on the watch list will be subject to:

1. A reappraisal of their investment process and philosophy, with particular emphasis on Manager's buy and sell disciplines;

2. A requirement to satisfactorily explain their substandard performance;

3. Two additional quarters to bring their performance up to standard relative to Manager's designated benchmark without modifying their stated investment style.

E. Failure to comply with the conditions of probationary status will be grounds for termination.

IX. REPORTING REQUIREMENTS

A. Managers are expected to promptly inform the Board, Plan Administrator and consultant regarding all significant matters pertaining to, but not limited to

1. Changes to investment strategy, portfolio structure, and market value of assets.

2. Any regulatory action or legal proceedings, including investigations, litigations and disciplinary actions brought about by the Securities and Exchange Commission (SEC), any securities regulatory body, any securities exchange, or any relevant governmental body or agency.

B. Monthly reports provided by each Manager shall contain the following information:

1. The portfolio composition at market value by sector, including, minimally, fixed-income, cash equivalents and uninvested cash balances.

2. Position, by individually named securities, showing both their respective book and market values.

3. All principal and income cash transactions, including sources of all interest and dividends in sufficient descriptive detail.

4. In the case of commingled funds, the information supplied monthly will consist of the cost and market value of fund shares, the number of shares owned and all principal and income cash transactions.

C. Quarterly reports provided by each Manager within 30 days after the end of each calendar quarter shall contain the following information:

1. Review of Organizational Structure

a) Organizational changes (i.e., ownership)

b) Departures of /additions to key investment staff

c) Total assets and accounts for product managed for the Fund

(1) Change in assets/accounts (i.e., Gains $ / Losses $) since last report

Benchmarks:
Barclays Capital Aggregate Bond Index
Cash Parameters: 0% - 10%

All monies invested for the Fund by Xavier Capital Management shall conform to this Statement of Investment Objectives, Policy and Guidelines.

Pamela A Turner
Name (please print or type)

Signature

Principal
Title

Xavier Capital Management, LLC
Firm

3/25/09
Date

Prince George's County
Board of Trustees
Non-Pension Post Employment Benefit (OPEB)

AGENDA

Thursday

October 20, 2011

10-11:30 a.m.

County Executive Conference Room

1. Approval of Minutes June 8, 2011

2. Overview of Fixed Income Investment
   Pam Turner, Xavier Capital Management

3. Review of Investment Policy and Asset Allocation Discussion
   Armand Yambao, Principal, Hewitt EnnisKnupp
   Theresa Long, Vice President, Hewitt EnnisKnupp

4. Other Business

PRINCE GEORGE'S COUNTY
BOARD OF TRUSTEES

Non-Pension Post Employment Benefit (OPEB)

October 20, 2011

Members Present
Bradford L. Seamon, Acting Chief Administrative Officer
Thomas M. Himler, Director, Office of Management and Budget
Gail D. Francis, Director, Office of Finance
Stephanye R. Maxwell, Esq., CPM, Director, Office of Human Resources Management (OHRM)

Others Present
Lorenzo Newsome, Jr., President and Chief Investment Officer, Xavier Capital Management
Pamela A. Turner, Principal and Director of Research, Xavier Capital Management
Armand M. Yambao, FSA, Principal Hewitt EnnisKnupp, Inc.
Kathleen McAuliffe, Vice President AON Consultants
Cheryl O. Guth, Esquire, McGuire Woods
Kathleen W. Colbert, Manager, Pensions and Investments Division, OHRM
Cindy L. Thorn, Assistant Manager, Pensions and Investments Division, OHRM
Julia D. Sanders, Manager, Benefits Administration Division, OHRM
Lawrence E. Cain, Auditor, County Council

Approval of Minutes: The minutes from the meeting on June 8, 2011, were unanimously approved.

Review of Investment Policy and Asset Allocation Discussion: Kathy Colbert and Cheryl Guth provided a brief overview citing that this Board is responsible for the official oversight of the fund and it has a fiduciary obligation to meet periodically. Currently the fund has invested $44.3 million with Xavier Capital Management in core fixed income. The purpose of today's discussion is asset allocation. The Trustees were provided with copies of the approved Investment Policy Statement, and were asked to note and discuss the following asset allocation statement:

"The OPEB Trust recognizes the importance of diversity of investments as an instrument to avoid unreasonable risks and attain the OPEB Trust's objectives. The Board will establish asset allocation policy levels based on analysis of the Fund's liability structure and expected market conditions. Until assets grow to a suitable level ($100,000,000), funds will be conservatively invested in core fixed income instruments. The Trustees will review the allocations at least annually."

Overview of Fixed Income Investment: Ms. Turner and Mr. Newsome began their presentation by introducing their company as a registered investment adviser specializing in fixed income portfolios. Their primary focus is on core, core-plus and high quality yield securities. The firm is headquartered in Largo, Maryland. It was founded in 2006, with the goal of delivering attractive risk-adjusted returns to client portfolios by integrating the highest industry standards on a smaller, more flexible platform. They explained their fixed income philosophy, investment process, portfolio construction and risk management methodology. Mr. Newsome presented the 3rd Quarter Performance report reflecting a return of 3.43% for the quarter and 7.67% since inception. The fund outperformed 67% of fixed income reporting managers in the 3rd quarter of 2011. With the initial investment of $20 million in May 2009 and an additional $15 million, the fund has realized a return of $5 million. In response to a question regarding portfolio construction, Mr. Newsome explained that the portfolio holdings are set by the investment policy statement and Xavier has remained well within the established parameters.

Asset Allocation/Asset Liability Study: Mr. Yambao, Hewitt EnnisKnupp, Inc, and Ms. McAuliffe, AON Consultants, began their presentation by introducing their companies and describing their approach portfolio construction and to the asset-liability modeling. The presentation reviewed the goals of an asset liability study, methodology, mechanics, investment structure, risk/reward analysis and sample asset allocation outcomes. The fee for the study would be $60,000 and take 4 to 6 weeks. The Trustees asked for Mr. Yambao to comment on the risk of not doing an asset-liability study at this time based on the asset size and limited investment options. Mr. Yambao indicated that the study would provide support for the Board's investment policy decisions.

The Board discussed the need to consider whether to fund the study and how much would be available for additional investment strategies. Also, the Board recognizes that it would be limited in the selection of investment firms due to amount of funding and minimum investments requirements for certain strategies. The Board further noted it would have to be cognizant of the manager's fees as well.

A motion was made by Ms. Maxwell and seconded by Ms. Francis to defer moving forward with the asset allocation review at this time and to revisit the issue in one year. The Board unanimously approved the motion.

Having no further business, the meeting was adjourned.

Prince George's County
Board of Trustees
Non-Pension Post Employment Benefit (OPEB)

AGENDA

Wednesday

March 23, 2011

12:30 P.M.
County Executive
Conference Room

1. Overview of OPEB Trust Agreement (CR-40-2008)
   Kathleen W. Colbert/Cheryl O'Donnell-Guth
2. Duties/Powers of Trustees
   Kathleen W. Colbert/Cheryl O'Donnell-Guth
3. Election of Chairman/Vice-Chairman
4. Review Investment Policy
   Kathleen W. Colbert

Next Steps:

Proposed Meeting Dates: May 25, 2011
August 24, 2011
September 28, 2011

PRINCE GEORGE'S COUNTY
BOARD OF TRUSTEES

Non-Pension Post Employment Benefit
(OPEB)

March 23, 2011

Members Present
P. Michael Errico, Acting Chief Administrative Officer
Douglas A. Brown, Deputy Chief Administrative Officer
Thomas M. Himler, Acting Director, Office of Management and Budget
Gail D. Francis, Acting Director, Office of Finance
Stephanye R. Maxwell, Esq., CPM, Acting Director, Office of Human Resources Management
Ingrid M. Turner, Esq., Chair, Prince George's County Council

Others Present
Kathleen W. Colbert, Manager, Pensions and Investments Administration, OHRM
Julia D. Sanders, Manager, Benefits Administration Division, OHRM
Charles M. Curtis, Jr., Accounting Manager, Office of Finance
Mary Hatfield, Accountant, Office of Finance
Cheryl O. Guth, Esq., McGuire Woods

Overview of OPEB Trust Agreement

Ms. Colbert and Ms. Guth provided a synopsis of the OPEB Trust Agreement provision. The following points were reviewed:

- Council Resolution 40-2008 established a Trust Fund as of June 30, 2008.
- Purpose – to fund non-pension benefits payable to retirees (retiree health care).
- Trust Fund is held for the exclusive benefit of participants and beneficiaries.
- Trust is not irrevocable – County may discontinue the benefits and/or Trust at any time.
- Board of Trustees – six (6) ex-officio trustees (or designees) and one (1) appointed by the County Council. (County Executive, Chief Administrative Officer, Directors of Finance, Human Resources, Budget and Chair of County Council)
- Trustees have power to invest Trust Fund.
- Required to adopt an investment policy to set forth how the Trust Fund will be invested.
- Permissible investments include: common and preferred stocks, bonds, notes and debentures, mutual funds, real estate and mortgages.
- May select one or more investment managers to invest the Trust Fund.
- County indemnifies Trustees for any claims that might be made; does not apply to actions taken in bad faith or with gross negligence – fiduciary insurance is in place to cover trustees.

Significant Previous Board Actions

- 6/30/08 – first investment of $20 million made in short-term fund with custodian bank. Trustees informed of requirement to develop an investment strategy and approve an investment policy.

- 2/25/09 – first meeting of the OPEB Board, the County Executive was elected Chair and Chief Administrative Officer was elected Vice-Chair. Aon Consulting presented results of actuarial valuations.
- 2/25/09 – Board approved $20 million for investment in core fixed income with Xavier Capital Management.
- 9/8/10 – Investment Policy Statement approved and another $20 million was approved for Xavier. Due to fund balance, $15 million was transferred for investment on 9/30/10.

OPEB Annual Financial Report as of June 30, 2009: Mr. Charles Curtis, Office of Finance, provided the Board with the Annual Financial Report as of June 30, 2010. He explained this was the second year for an audit opinion and it was favorable.

Meeting Dates

The Trustees agreed to schedule quarterly meetings the same date as the Pension Board meetings with the exception of the May meeting due to a conflict with the County Council meeting adopting the FY2012 budget. An alternative date in May will be selected. The next meetings will be scheduled for August 24, 2011 and September 28, 2011, at 1 p.m. in the County Executive's Conference Room #1.

Having no further business, the meeting was adjourned.

Prince George's County
Board of Trustees
Non-Pension Post Employment Benefit (OPEB)

AGENDA

Wednesday

September 8, 2010

9:00 – 10:30 AM

RMS Building, Room 364

1. Approval of Minutes from July 26, 2010
2. Approve OPEB Investment Policy
3. Discuss Index Funds
4. Other Business

Next Meeting Date: November ?, 2010

PRINCE GEORGE'S COUNTY
BOARD OF TRUSTEES

Non-Pension Post Employment Benefit (OPEB)

September 8, 2010

Members Present
Jack B. Johnson, County Executive and Chairman of OPEB Trust
Ralph E. Moultrie, Acting Chief Administrative Officer
Donald E. Bridgeman, Director, Office of Human Resources Management
J. Michael Dougherty, Director, Office of Finance
Jonathan R. Seeman, Director, Office of Management and Budget

Other Present
Rick Amatucci, The Amatucci Group
Kathleen W. Colbert, Manager, Pension and Investment Administration
Charles M. Curtis, Jr., Accounting Manager, Office of Finance
Mary Hatfield, Accountant, Office of Finance

Approval of Minutes from July 26, 2010:
The minutes were approved.

Fund Overview
As of July 31, 2010, the net asset value of invested funds was $38,465,098. Investments are held in a short term money market fund with the custodian at State Street Bank ($16,074,168) and in a core fixed income account ($22,390,930) with Xavier an Investment Manager designated by the Board of Trustees. Since inception in June 2008, the Money Market Fund has grown from $15,300,000 to $16,074,359 ($15,339,963 County and $734,396 Library). This fund seeks to maximize current income to the extent consistent with the preservation of capital and liquidity, and the maintenance of a stable $1.00 per share net asset value, by investing in dollar denominated securities.

Since inception in May 2009, the fixed income investment with Xavier has grown from $20,000,000 to $22,390,930. Total returns in corporate credits have been positive in the first half of 2010 mainly due to Treasury yield compression and the carry trade. Year to date performance has exceeded the Barclays Aggregate Index by 1.33 since inception.

OPEB Investment Policy Statement:
The Trustees discussed the investment objectives for the OPEB Trust and recognized the need for long-term growth and the periodic payment of benefits. They indicated that safety of principal is the foremost objective and investments should seek to ensure the preservation of capital in the overall portfolio. While the Trustees recognize the importance of diversity of investment as a way to avoid unreasonable risk, they agreed that until there are sufficient funds for investments (over $100,000,000) funds will be conservatively invested in core fixed income instruments.

The Board unanimously approved the Statement of Investment Objective, Policy and Guidelines.

Asset Allocation Review and Portfolio Implementation

Summit Strategies provided an asset class risk/return profile for the various asset classes and indicated that a global equity allocation was used in the modeling analysis for the equity portfolio. Ms. Portis reviewed four potential asset allocations with varying equity exposures from 10% to 25%. She indicated that the current portfolio expected to earn 3.2% with a standard deviation of 2.4% over a 10 year period. A portfolio with 25% equity is expected to earn 4.5% with a standard deviation of 5.3% over a 10 year period.

In response to the Board's request, Summit Strategies provided a manager search comparison of passive global equity and fixed income managers. The following candidates were reviewed detail for this mandate: Mellon Capital Management, Northern Trust and State Street Global Advisors. Ms. Portis review in detail the firm, product and characteristics of each manager, including annualized returns compared to the designated benchmarks. She also indicated that there is not much alpha with a fixed income portfolio and one of the benefits of investing in an index fund was lower fees and fund liquidity. Management fees average 6 basis points compared to active management fees of 30 basis points.

After discussion, the Mr. Bridgeman made a motion to fund and additional $20,000,000 with Xavier Capital Management stating the firm produced returns in excess of the Barclays Capital Aggregate Index. This motion was seconded by Mr. Moultrie and unanimously approved.

Other Business

Having no further business, the meeting was adjourned.

Prince George's County
Board of Trustees
Non-Pension Post Employment Benefit (OPEB)

AGENDA

Monday

July 26, 2010

9:00 - 10:30 AM

RMS Building, Room 364

1. Approval of Minutes from March 25, 2009 and March 11, 2010

2. Discuss OPEB Fund

3. Discuss draft OPEB Investment Policy

4. Other Business

Next Meeting Date: September ?, 2010

PRINCE GEORGE'S COUNTY
BOARD OF TRUSTEES

Non-Pension Post Employment Benefit (OPEB)

July 26, 2010

Members Present
Jack B. Johnson, County Executive and Chairman of OPEB Trust
Donald E. Bridgeman, Director, Office of Human Resources Management
Jonathan R. Seeman, Director, Office of Management and Budget

Other Present
Rick Amatucci, The Amatucci Group
Kathleen W. Colbert, Manager, Pension and Investment Administration
Mary Hatfield, Accountant, Office of Finance

Approval of Minutes from March 25, 2009 and March 11, 2010:
The minutes from both meetings were discussed and approved by the members present. The minutes will be sent to all Trustees for approval by unanimous written consent.

OPEB Fund Review:
As of June 30, 2010, the net asset value of invested funds was $38,192,849. Investments are held in a short term money market fund with the custodian at State Street Bank and in a core fixed income account with Xavier an Investment Manager designated by the Board of Trustees. Since inception in June 2008, the SSgA Money Market Fund has grown from $15,300,000 to $16,074,359 ($15,339,963 County and $734,396 Library). This fund seeks to maximize current income to the extent consistent with the preservation of capital and liquidity, and the maintenance of a stable $1.00 per share net asset value, by investing in dollar denominated securities.

Since inception in May 2009, the fixed income investment with Xavier has grown from $20,000,000 to $22,118,490. Total returns in corporate credits have been positive in the first half of 2010 mainly due to Treasury yield compression and the carry trade. Xavier continues to expect positive excess returns in investment grade debt and continued strong total returns in high yield for 2010. Year to date performance has exceeded the Barclays Aggregate Index by 1.23 and since inception by 0.08. This fund is positioned well for the future.

The Trustees discussed the investment objectives for the OPEB Trust and recognized the need for long-term growth and the periodic payment of benefits. They indicated that safety of principal is the foremost objective and investments should seek to ensure the preservation of capital in the overall portfolio. While the Trustees recognize the importance of diversity of investment as a way to avoid unreasonable risk, they agreed that until there are sufficient funds for investments (over $100,000,000) a conservative asset allocation should be maintained. To further discuss the asset allocation policy and options for achieving a diversity of investments, they requested a report on possible equity and fixed income index funds for discussion at the next meeting.

Draft OPEB Investment Policy:
A draft Statement of Investment Objective, Policy and Guidelines was distributed for review by the Trustees. The purpose of the Statement is to present appropriate goals and objective relating to the investment management of the OPEB Trust, recognize diversification and liquidity requirements, establish a basis for evaluating investment results, ensure OPEB Trust assets are managed prudently and define responsibilities of all parties to the OPEB Trust. The Chairman requested the Trustees to review the Statement and provide comments/questions as soon as possible so a revised draft could be sent for review and approval at the next meeting.

Other Business
The Trustees agreed to schedule the next meeting on Wednesday, September 8, 2010 @ 9:00 a.m. located in Room 364 of the RMS Building. Items for discussion will include the Fund's asset allocation, a review of equity and fixed income index funds and approval of the Investment Policy.

Having no further business, the meeting was adjourned.

Prince George's County
Board of Trustees
Non-Pension Post Employment Benefit (OPEB)

AGENDA

Thursday

March 11, 2010

1:00 PM

RMS Building, Room 364

1. Approval of Minutes from March 25, 2009
   Donald E. Bridgeman

2. Xavier Capital Fixed Income/Fund Performance
   Pam Turner

3. OPEB Annual Financial Report as of June 30, 2009
   Charles Curtis

4. Other Business

Proposed Meeting Dates: June 2010
September 2010
December 2010

PRINCE GEORGE'S COUNTY
BOARD OF TRUSTEES

Non-Pension Post Employment Benefit
(OPEB)

March 11, 2010

Members Present
Donald E. Bridgeman, Director, Office of Human Resources Management
Andrea C. Harrison, Vice Chair, County Council

Others Present
Rick Amatucci, The Amatucci Group
Kathleen W. Colbert, Manager, Pensions and Investments Administration, OHRM
Charles M. Curtis, Jr., Accounting Manager, Office of Finance
Turkessa A. Massiah, County Council
Julia D. Sanders, Manager, Benefits Administration Division, OHRM
Lisa Colmain, Administrative Aide, Pensions and Investments Administration, OHRM

Xavier Capital Core Fixed Income Presentation: Lorenzo Newsome, President & Chief Investment Officer, and Pamela A. Turner, Principal & Senior Analyst to Xavier Capital Management re-introduced their company to the Board. Founded in 2006, the company is 100% employee owned. Registered as an investment adviser specializing in fixed income portfolios, the primary focus is on core, core-plus and high quality-high yield securities. Mr. Newsome provided the Board with a performance summary as of February 2010. Since inception, performance has lagged the Barclays Aggregate Index by -0.18 due to under performance in May while funds were held in Treasuries pending investing in securities. The portfolio has outperformed the Index by 0.72 over the last six months. Mr. Newsome provided a portfolio analysis indicating that short term maturity bonds in industrial and financial sections are doing well. Overall, the portfolio is positioned well for the future.

Approval of Minutes from March 25, 2009: The minutes of the March 25, 2009, meeting were held due to lack of a quorum. Mr. Bridgeman requested that minutes be sent to all trustees for approval by a unanimous written consent.

OPEB Annual Financial Report as of June 30, 2009: Mr. Charles Curtis, Office of Finance, provided the Board with a summary of the Annual Financial Report as of June 30, 2009. He explained this was the first year for an audit opinion and it was favorable. Net assets held in trust are approximately $36M. $20M is invested with Xavier and the remainder held with State Street in short term fixed investments. $8M is held in the County cash operating account for benefit payments. There was a brief discussion about adopting an official investment policy prior to the next annual report.

The trustees agreed to schedule quarterly meetings on the same date as the Pension Board meetings. The next meeting is scheduled for June 23, 2010, at 1 p.m.

Having no further business, the meeting was adjourned.

UNANIMOUS CONSENT

PRINCE GEORGE'S COUNTY NON-PENSION POST EMPLOYMENT BENEFIT

BOARD OF TRUSTEES

The March 25, 2009, minutes require approval by the Board of Trustees. A quorum was unavailable at the March 11, 2010, meeting of the Board and due to the length of time between meetings, it is advisable to approve the minutes prior to the next meeting.

The attached minutes have been prepared and delivered to all Board members for their review and approval.

Once Board members unanimously agree to this Unanimous Consent, the attached minutes will be incorporated into the record of the Board.

BE IT THEREFORE RESOLVED: That the following, being all of the members of the Board of Trustees of the Non-Pension Post Employment Benefit, hereby unanimously agree that the attached minutes of the Board of Trustees meeting are approved as a true record of the March 25, 2009, meeting.

Jack B. Johnson, Trustee
Andrea C. Harrison, Trustee
Ralph E. Moultrie, Trustee
Donald E. Bridgeman, Trustee
J. Michael Dougherty, Trustee
Jonathan R. Seeman, Trustee

Prince George's County
Board of Trustees
Non-Pension Post Employment Benefit (OPEB)

AGENDA

Wednesday

March 25, 2009

11:30 AM

RMS Building, Room 364

1. Xavier Capital Core Fixed Income Presentation
   Lorenzo Newsome/Pamela Turner
   11:30-12:15 P.M.
2. Approval of Minutes from February 25, 2009
   Dr. Jacqueline F. Brown
3. Synopsis of Trust Agreement and Fiduciary Obligations
   Cheryl O'Donnell-Guth
4. Results of GASB45 Actuarial Valuation
   C. Furr
5. OPEB Annual Financial Report as of June 30, 2008
   C. Curtis
6. Other Business

Proposed Meeting Dates: June 24, 2009
September 23, 2009
December 16, 2009

PRINCE GEORGE'S COUNTY
BOARD OF TRUSTEES

Non-Pension Post Employment Benefit
(OPEB)

March 25, 2009

Members Present
Donald E. Bridgeman, Director, Office of Human Resources Management
Michael J. Dougherty, Director, Office of Finance
Jonathan R. Seeman, Director, Office of Management and Budget

Others Present
Catherine Furr, AON Consulting
Kathleen McAuliffe, AON Consulting
Merson Bartlett, AON Consulting
Ralph E. Moultrie, Special Assistant to the County Executive
Mary Hatfield, Accountant III, Office of Finance
Rick Amatucci, The Amatucci Group
Cheryl Guth, McGuire Woods
Lawrence E. Cain, Jr., Auditor, County Council
Julia D. Sanders, Manager, Benefits Administration Division, OHRM
Kathleen W. Colbert, Manager, Pensions and Investments Administration, OHRM
Cindy L. Thorn, Assistant Manager, Pensions and Investments Administration, OHRM

Xavier Capital Core Fixed Income Presentation: Lorenzo Newsome, President & Chief Investment Officer and Pamela A. Turner, Principal & Senior Analyst to Xavier Capital Management introduced their company to the Board. Founded in 2006, the company is 100% employee owned. Registered as an investment adviser specializing in fixed income portfolios, the primary focus is on core, core-plus and high quality-high yield securities. The overview provided the Board with the company's investment approach, process, philosophy and strategy.

Approval of Minutes from February 25, 2009: The minutes of the February 25, 2009 meeting were approved with the revision to include the dollar amount of $20 million to be invested with Xavier.

Synopsis of Trust Agreement and Fiduciary Obligations: Cheryl Guth, Legal Counsel to the Board, presented a written summary of the Trust Agreement and Fiduciary Responsibilities. Board members may contact Ms. Guth directly if they have any questions.

Results of GASB45 Actuarial Valuation: The results of the July 1, 2008 valuation were presented by Merson Bartlett and Catherine Furr from AON Consulting. For FY09, the present value of projected benefits totaled $969.7M. The actuarial accrued liability (AAL) of $792.2M is funded by the assets of $29.6M, leaving an unfunded actuarial liability of $762.6M. The annual required contributions of $66.2M is comprised of $22.2M as normal cost and amortization of the unfunded AAL at $44M. The report indicates as a result of the additional contributions made in FY08, less additional contributions are needed in FY09 ($3.2 less than what would have been required under 2nd year of funding policy). Additionally, the County has the ability to forego additional contributions in FY10 and FY11 and still be in a similar NOPEBO position at the end of the 10-year phase-in period in FY2017.

OPEB Annual Financial Report as of June 30, 2008: The Board was provided with the Annual Financial Report as of June 30, 2008. No discussion was heard.

Having no further business, the meeting was adjourned.

Prince George's County
Board of Trustees
Non-Pension Post Employment Benefit (OPEB)

AGENDA

Wednesday

February 25, 2009

1:00 PM

RMS Building, Room 364

1. Overview of Retiree Health Care Challenges
   AON
2. Overview of OPEB Trust Agreement (CR-40-2008)
   Cheryl O'Donnell-Guth
3. Duties/Powers of Trustees
   Cheryl O'Donnell-Guth
4. Election of Chairman/Vice-Chairman
   Dr. Jacqueline F. Brown
5. Next Steps:
   Review Actuarial Valuation
   Develop Investment Policy Statement
6. Other Business

Proposed Meeting Dates: March 25, 2009
June 24, 2009
September 23, 2009
December 16, 2009

PRINCE GEORGE'S COUNTY
BOARD OF TRUSTEES

Non-Pension Post Employment Benefit
(OPEB)

February 25, 2009

Members Present
Jack B. Johnson, County Executive
Dr. Jacqueline F. Brown, Chief Administrative Officer
Donald E. Bridgeman, Director, Office of Human Resources Management
Michael J. Dougherty, Director, Office of Finance

Others Present
Kathy Burke, AON Consulting
Kathleen McAuliffe, AON Consulting
Ralph E. Moultrie, Special Assistant to the County Executive
Charles M. Curtis, Jr., Accounting Manager, Office of Finance
Rick Amatucci, The Amatucci Group
Lawrence E. Cain, Jr., Auditor, County Council
Julia D. Sanders, Manager, Benefits Administration Division, OHRM
Kathleen W. Colbert, Manager, Pensions and Investments Administration, OHRM
Cindy L. Thorn, Assistant Manager, Pensions and Investments Administration, OHRM

The meeting of the Prince George's County OPEB Board of Trustees was opened with introductions. Ms. Colbert then provided an overview of OPEB and GASB (Governmental Accounting Standards Board) Statement #45. Effective June 25, 2008 the Council enacted legislation (CR-40) to establish the Prince George's County, Maryland Non-Pension Post Employment Benefits Trust Fund to hold all contributions made by the County together with any income, gains, or profits and taking into account any losses. A seven member Board of Trustees is responsible for managing the assets of the Trust. Currently the fund is invested in short term, cash equivalents through State Street Bank and Trust Company. The components of the GASB Statement #45, is similar to pension plan accounting of normal annual cost and unfunded liabilities. Similar to the methodology used in the pension plan valuations, the County will use a 30-year open amortization of the OPEB unfunded liability. The amortization will be based on level percent of pay.

A presentation made by AON Consulting, illustrated some retiree health care challenges and recommended changes to reduce costs which include setting a subsidy based on lowest cost plan and providing options to medicare eligible retirees. Recommendations and associated costs of alternatives will be provided to the Board by May 2009.

AON explained that the County has a 10 year phase-in of the Annual Required Contribution (ARC) with an expectation to fully fund the ARC by FY2017. While the policy required a 10% contribution ($4.3 million) for FY2008, the County made excess contributions in the first fiscal year of $28.1 million. As a result, additional contributions will not be required for FY09 or FY10.

A motion was made by Dr. Brown, seconded by Mr. Bridgeman to approve the OPEB Trust Fund. The Board unanimously approved.

Clarification was requested regarding the fund's current investment. Ms. Colbert indicated that on June 30, 2008, $20,000,000 was wire transferred to a conservative short term money market mutual fund with State Street Bank and Trust. Eventually the Board will have to decide on an investment strategy and approve an investment policy. Mr. Johnson asked the Board to consider Xavier, a local firm in Prince George's County, as a fixed income manager for the OPEB fund. Recent clients include Maryland Insurance Fund and Howard County Government. After discussion, a motion was made by Mr. Johnson and seconded by Dr. Brown, to hire Xavier as a Fixed Income Manager. The Board unanimously approved the motion.

Final order of the meeting was to elect a Chairman and Vice-Chairman. A motion was made by Mr. Bridgeman and seconded by Dr. Brown to elect Mr. Johnson as Chairman of the OPEB Board of Trustees. The Board unanimously approved the motion. A motion was made by Mr. Johnson and seconded by Mr. Dougherty to elect Dr. Brown as Vice-Chairman of the OPEB Board of Trustees.

Having no further business, the meeting was adjourned.