A PROTOCOL FOR THE INTERPRETATION OF FOUR COMMONLY ORDERED LABORATORY VALUES IN OLDER ADULTS

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ABSTRACT

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Diagnostic testing enables the Advanced Practice Nurse to identify pathological conditions and alterations in health status in elderly patients and, then, plan appropriate interventions.

Current standards are based on laboratory results of younger adults and do not take into account factors such as diet, drugs, exercise or normal changes of aging which are significant for the elderly population.

The purpose of this project was to develop a protocol for assessment of four commonly ordered laboratory values: Erythrocyte Sedimentation Rate (ESR), Serum Glucose, Total Cholesterol and Serum Magnesium along with adjusted reference ranges for geriatric patients and a description of the laboratory tests, reasons for ordering the tests, interpretation of the results for each test, adult reference ranges and reference ranges for adults > 65 years old.

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To my husband, George, this goal has been reached because of your love and faith in me. I could not have done it without you. And, to Jacki Ann and Christopher, your support and cooperation have made this project an accomplishment for all of us. Thank you.

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Introduction

It is known that the United States is becoming an aging society. Elderly are increasing in numbers and census figures indicate that there were nearly 34 million Americans over the age of 65 in 1995. Additionally, those over the age of 85 are the fastest growing age group at present and this trend will continue into the next century (Older Women's League, 1995). Office visits to primary health care practitioners by aged persons are increasing correspondingly. Over 208 million office visits took place in 1989. The number of visits to general surgeons in the same year was estimated at 23.8 million, with 7.2 million in the 65-75 and older age-range (U.S.D.H.H.S., 1993).

Factors such as multi-drug regimens, nutrition and exercise need to be acknowledged in order to meet the needs of geriatric patients. Accuracy of test results leads to more accurate diagnoses, increased patient satisfaction, a

potential decrease in the number of office visits and, in the long run, a decrease in overall healthcare costs.

The use of laboratory testing in primary care is a part of the practitioner's professional responsibility to the patient. Diagnostic testing enables the practitioner to identify pathological conditions or altered health states as part of the assessment process and is routinely ordered as part of a total health screening. Duthie (1991) states, "Efficient use of laboratory testing is essential in the care of the elderly, both for making accurate diagnoses and keeping costs in line." Standards have been established for laboratory tests in order to interpret findings and make comparisons with the general population, however, it is important to note that in the elderly, many values change with age and an abnormal value might not be indicative of disease (Wolf-Klein, 1989).

The role of the Advanced Practice Nurse (APN) is clear. Within the primary care setting the APN must correctly identify abnormal laboratory values in elderly patients in order to accurately diagnose problems and then identify and initiate appropriate interventions. Too often patients' signs and symptoms are perceived as expected changes of aging and the same holds

true for abnormal laboratory findings. Lack of knowledge in this area leads to under- or over-diagnosing of major health problems (Melillo, 1993).

Purpose of the Study

The purpose of this study is to formulate a protocol for healthcare providers to enhance accurate interpretation of laboratory test results for elderly patients. This protocol may be utilized in private practices, clinics, nursing homes and other primary care settings by all healthcare providers with specific focus on the APN.

The proposed protocol will outline appropriate reference ranges for geriatric patients for the following laboratory values: Erythrocyte Sedimentation Rate (ESR), Serum Glucose, Total Cholesterol, and Serum Magnesium. These are four frequently ordered laboratory tests which could easily be misinterpreted by practitioners in primary care and which could have significant implications to the treatment of elderly patients. Reference ranges refer to 95% distribution of values of a laboratory test with (+) or (-) two standard deviations.

Four laboratory tests which were previously identified by the author as potentially falling outside of the commonly accepted norms for elderly patients include Erythrocyte Sedimentation Rate, Serum Glucose, Total

Cholesterol, and Serum Magnesium. These four tests are routinely ordered for elderly patients by advanced practice nurses and are used to determine potential health problems such as, diabetes, hyperlipidemia, gout, and hypo- or hypermagnesemia (Mosby, 1995). Studies have shown, however, that these particular tests are sometimes misinterpreted and may vary in what is "normal" for elderly patients, especially those over the age of 75.

Literature Review

Reference ranges for most lab tests do not take into consideration age-related factors that might affect results for the elderly, therefore, published standards may be inappropriate. Studies to determine normal laboratory values for elderly patients have been hindered by lack of healthy, aging patients and the fact that many of these studies have taken place in institutions where chronic disease is prevalent (Coodley, 1989). A case in point is a decrease in glucose tolerance experienced by elderly persons that is associated with a declining impairment in sensitivity and responsiveness to insulin (Blair, 1990).

Diagnostic or laboratory manuals are employed in most primary care settings in order to facilitate interpretation of the results, and most laboratory

results indicate the average (normal) reference range along with the actual reading and an "H" or "L" to quickly identify "High" or "Low" readings. Reference ranges are based on 95% averages with (+) or (-) two standard deviations. Averages are based on findings of laboratory tests performed on, for the most part, student subjects or younger adults (Melillo, 1993). These may not be reflective of the findings that might be anticipated in a geriatric population. It has been shown that many established reference ranges for diagnostic tests are, indeed, appropriate for elderly patients. Other blood tests, however, are affected by normal changes in aging, multi-drug regimens and other factors such as exercise and nutrition.

Polypharmacy is a significant problem for geriatric patients. It is not uncommon to find elderly patients taking a multitude of prescription and non-prescription drugs. Haaksma (1995), in his Scholarly Project, reports that multi-drug regimens affect elderly patients in many ways and that health care workers must be aware of these effects on their elderly patients. Keeping this in mind, accurate interpretation of laboratory values of elderly patients who are taking a multitude of drugs is an important issue of concern for the APN.

APN's are often faced with a lack of standards when looking at values

for elderly patients and new reference ranges for geriatric patients should be developed. Reference range refers to 95% distribution of the test results in the reference population. This population is clearly defined in terms of age, sex, race and health status (Duthie, 1991).

Cavalieri, Chopra and Bryman (1992) state that some lab values change with age, while others do not. It has been reported in several studies that ESR is altered with age and may increase as much as 0.22 mm/hr/yr. Cavalieri, et al (1992) also have identified a decrease in glucose tolerance as persons get older and report a post-prandial blood sugar increase of 70 mg/dl from age 20 to age 75. In her studies on the interpretation of laboratory values Melillo (1993) finds that gradual increases in cholesterol takes place. Although they level off at approximately age 65, they remain higher than those of younger adults even at age 85. Regarding magnesium, she states that decreases in levels of as much as 15% have been found in patients between the 3rd and 8th decades of life.

Changes of aging often influence laboratory test findings because of specific physiological impacts upon the elderly person and other changes which take place, such as the changes in nutritional status, decline in kidney function, etc. Physiological changes that occur in this age range indicates a

decrease in cardiac and renal function, endocrine variations and alterations in metabolism. An example is a decrease in glucose tolerance that is caused by insulin being less biologically active. There is also an increased insulin resistance with advanced age (Cavalieri, Chopra and Bryman, 1992).

Erythrocyte Sedimentation Rate (ESR)

ESR is frequently ordered in order to screen, diagnose and monitor disease. It is a fairly simple test that measures the time that it takes for red blood cells to settle at the bottom of a calibrated tube. It is reported in millimeters/hour. Changes in plasma components cause the Erythrocyte Sedimentation Rate (ESR) to become elevated. This elevation may or may not be associated with disease, and changes in the amounts of albumin and fibrinogen within the plasma may be the cause of the alteration. Other factors that influence the speed with which the blood cells settle to the bottom are concentrations of other plasma proteins (globulins), the size of the cells, their shape and the actual number of erythrocytes.

This test is especially useful in diagnosing temporal arteritis and polymyalgia rheumatica and is also useful in monitoring the course of rheumatoid arthritis and Hodgkin's disease (Ontario Association of Medical

Laboratories, 1995). McFarland and Grant (1994) found this test useful in following the progress of inflammatory diseases such as rheumatoid arthritis, rheumatic fever, respiratory infections and acute myocardial infarction.

Very high results of ESR are caused by multiple myeloma, macroglobulinemias and hyperfibrogenemias. Other moderate increases are neoplasms, chronic infections, collagen diseases and pregnancy (McFarland and Grant, 1994).

Factors that tend to decrease ESR are sickle cell disease, polycythemia and abnormal red blood cell structure (Helfgott and Kieval, 1995). Low results also occur with errors in the testing procedure, i.e., allowing the specimen to stand longer than three hours prior to testing.

In a test of men ages 20-81, it was noted that ESR did, in fact, increase significantly with age (Cavalieri, et al, 1992) and that certain drugs are responsible for increases in ESR values. Examples are: Procainamide, Theophylline, Methyldopa, which are prescribed regularly for elderly patients with cardiac irregularities, Chronic Obstructive Pulmonary Disease (COPD), and hypertension (Semia, Buzer and Higbee, 1995-96). Drugs that tend to lower ESR levels are aspirin, cortisone and quinine (Mosby, 1995).

Serum Glucose

Endocrine changes may cause laboratory findings to be misinterpreted due to a decrease in cellular sensitivity to insulin. (Blair, 1990). Peterson (1994) states that diabetes mellitus is a classic misdiagnosis in the elderly patient. Aging causes hyperglycemia that manifests as increased glucose levels and may be caused by environmental or other factors and not, necessarily, by disease. Malarkey and McMorrow (1996) report that glucose levels should be adjusted by 1 mg/dl per year of life after sixty years of age. This impaired glucose tolerance does not mean, however, that elders will not experience health effects from elevated glucose levels and elderly patients should be monitored for potential side effects related to these elevations. Funnell and Merritt (1993) note that diabetes may develop in about 20 percent of patients with IGT (impaired glucose tolerance).

Blood glucose is a measure of carbohydrate metabolism and identifies the amount of sugar circulating in the bloodstream and whether or not insulin, a hormone produced by the beta cells of the pancreas, is enabling glucose molecules to move out of the bloodstream and into the liver and other body cells (McFarland and Grant, 1994).

Capillary blood glucose testing has replaced urine glucose measurement as a way for practitioners and patients to monitor glucose levels and adjust dietary, insulin and exercise needs. It is convenient and easy and, therefore, very useful to patients for monitoring their own therapy. It requires collection of a drop of blood with a sterile lancet and placement of the drop onto a specially prepared paper. It is then inserted into the glucose monitor and the results are read within one minute.

Other forms of glucose testing are venous blood samples and the glucose tolerance test which measures glucose levels at intervals of 30 minutes and 1 hour, 2 hours and 3 hours after ingesting an oral glucose mixture. This is a more specific test that is usually performed to diagnose potential diabetic conditions. With the exception of the glucose tolerance test with specific testing intervals, serum glucose testing is done either in a 12-hour fasting state (fasting blood sugar) or a 2-hour postprandial state (random blood sugar). Researchers (Henry 1984; Byrne, Saxton, Pelekan and Nugent, 1986) state that plasma specimens collected twelve to fourteen hours after eating show a decrease in variation among patients than those collected at other times. The fasting blood sugar, then, is a more reliable indicator of true blood sugars than those done on a random basis.

There are various reasons for elevated serum glucose. Many disease states cause an elevation in blood glucose levels such as diseases of the pancreas, tumors, acromegaly, Cushing's syndrome, hyperaldosterism, etc. Other causes are drugs (steroids, thiazide diuretics, propranolol, phenytoin, diazoxide, oral contraceptives and alloxan and streptozotocin), chronic renal states, chronic liver disease, infection, and abnormal insulin (Henry, 1984).

Regarding the elderly, Davidson (1979) states that the disposal of glucose load is progressively impaired with the aging process and that five possibilities exist which account for this change in insulin activity. They are: (1) poor diet, (2) physical inactivity, (3) decreased lean body mass in which to store the carbohydrate load, (4) decreased insulin secretion, and (5) insulin antagonism.

Stress also plays a role in increased serum glucose results. Mosby (1975) identifies these stressors as trauma, general anesthesia, Cerebrovascular Accident (CVA) and Myocardial Infarction (MI). Caffeine and drugs such as antidepressants, beta blockers, dextrose intravenous infusion, dextrothyroxine, epinephrine, estrogens, glucagon isoniazid, lithium, phenothiazines, phenytoin and triamterene , according to Mosby, also increase serum glucose levels. Drugs that might decrease these levels

include acetaminophen, alcohol clofibrate, disopyramide, mao inhibitors, propranolol, tolazamide, tolbutamide and insulin.

It is important for the APN to distinguish between hyperglycemia which is a result of normal aging changes and diabetes mellitus. It goes without saying that consistent, highly elevated glucose levels indicate disease, however, there are many other factors to consider, especially in the elderly population where aging changes and medications often alter test results.

Total Cholesterol

Cholesterol is a fat-like substance that is formed in the liver and derived from ingested fats. It is found in brain tissue, blood and bile and is synthesized in the liver and flows with the bile and eventually mixes with dietary cholesterol. Free cholesterol is taken into the bloodstream and 70% is combined with fatty acids to form cholesterol esters (Byrne, Saxton, Pelekan, and Nugent, 1986).

Although cholesterol is not the cause of atherosclerosis by itself, it is the lipoproteins with which it binds that form the plaque and cause occlusion of the arteries. Two-thirds of this blood cholesterol is transported as low-density lipoproteins (LDL) and a small amount is bound to high-density lipoproteins (HDL). LDL is the "bad" cholesterol and increases in LDL are

related to development of CAD. Conversely, HDL is the "good" cholesterol and high levels decrease the risk for coronary artery disease. These values, along with triglycerides, are monitored in patients to determine risk factors for coronary heart disease.

Ochs (1991) states that diagnostic testing for a baseline evaluation of elderly patients should include a lipid profile. He further states that patients with high cholesterol levels should be monitored at 3 to 6 month intervals in order to monitor their response to therapy. Research findings indicate that cholesterol levels rise significantly with age and that levels continue to rise between the third and eighth decades (Cavalieri, et al, 1992). Leaf (1994) states that hypercholesteremia contributes to Coronary Artery Disease (CAD) that is the cause of death in more than 70% of those 75 years old and above.

The American College of Physicians recommends that total cholesterol measurement take place once in early adulthood and every five years up to age 70. The U.S. Preventive Services Task Force indicates that regular measurement of total serum cholesterol is especially important for middle-age men and that it is also significant for young men, women and elderly persons (U.S. Public Health Service, 1995). In addition, the Second Report of the Expert Panel on Detection, Evaluation and Treatment of High Blood

Cholesterol in Adults presented the National Cholesterol Education Program's updated recommendations for cholesterol management. This report indicates that the addition of age to the list of major CHD risk factors defined > 45 years in men and > 55 years in women. It further stated that high-risk postmenopausal women and high-risk elderly patients, who are otherwise in relatively good healthy, should be considered for cholesterol-lowering therapy (National Cholesterol Education Program, 1996).

Cholesterol tests require collecting blood from patients after a twelve hour fasting requirement. A venipuncture is then performed and two 7-ml capacity tubes are filled. If the testing is a screening test only, a fingerstick is done using a sterile lancet (Malarkey and McMorrow, 1996).

The purpose of the serum cholesterol test is to identify patients who might be at risk not only for CAD and MI, but also to determine the effectiveness of interventions that have been initiated in order to promote a healthier lifestyle for those who might be at risk. Cholesterol levels are also indicators of jaundice and other liver disorders. Elevated cholesterol levels are seen with patients who have obstructive jaundice whereas low cholesterol levels are found with infectious hepatitis and cirrhosis (Byrne, Saxton, Pellekan and Nugent, 1986).

Medications have an effect on the results of cholesterol tests, and this is especially significant with elderly patients. Clinicians should be aware of this when looking at test results. Those which increase cholesterol levels are: anabolic steroids, progestins, bile salts and chlorpromazine (U.S. Public Health Service, 1995).

Conditions that affect cholesterol findings according to Malarkey and McMorrow (1996) are: alcoholism, arteriosclerosis, diabetes, hepatitis, high fat diet, myxedema, obstructed bile duct and pancreatitis. These all increase cholesterol readings. Decreases are noted with patients experiencing hyperalimentation, hyperthyroidism, liver disease, malabsorption and malnutrition.

It is important to mention, however, that studies on cholesterol do not only focus on high levels. In fact, recent studies have been done which have looked at the relationship between low cholesterol levels in elderly patients and impending death. Goichot, Schlienger, Grunenberger, Pradignac and Aby (1995) have found that an increase in mortality rate is this age group has been found in patients with low cholesterol concentrations.

According to Grant, Zdzislaw, Piotrowski and Miles (1996), low serum cholesterol levels have been consistently related with increased short-

term mortality among elderly in institutions. They further state that declining levels have also been found with inflammatory illnesses such as infections or neoplasms and that the decline in cholesterol levels of elderly, prior to death, might be the result of many factors including catabolism, anabolism, malnutrition or inflammatory processes. It is necessary for the practitioner to be familiar with all factors that might be affecting a patient's cholesterol level, especially elderly patients, and to be able to interpret the findings accordingly.

Serum Magnesium

Magnesium is an abundant intracellular cation that plays an important role in the body's metabolism. It is necessary to enhance cardiac contractility and conductivity in the transmission of neurochemicals, in skeletal muscle activity and in the maintenance of appropriate levels of intracellular calcium, potassium and, potentially, sodium (American Diabetes Association, 1996). To test magnesium levels, a 5-ml sample of venous blood is drawn in a plain collecting tube and hemolysis is avoided when taking the collection. There is no special fasting or diet required of the patient.

A reduction in magnesium creates a comparable reduction in other

enzymes affecting the entire system. Wood, Suster and Russell (1995) indicate that low magnesium levels are linked with the pathogenesis of many diseases including ischemic heart disease, hypertension, osteoporosis, glucose intolerance and diabetes. They further report that older women and men consume less than RDA requirements of magnesium - approximately 2/3 of the recommended amounts.

Magnesium imbalances are often found in geriatric practice especially with patients having a decrease in nutritional intake and compromised renal function (McFarland and Grant, 1994). Significant decreases have been reported in patients and decreases of 15% between the 3rd and 8th decade of life have been noted (Mellilo).

The American Diabetes Association sponsored a consensus conference on magnesium supplementation in the treatment of diabetes May 15-16, 1992 and reported three main causes of magnesium deficiency: 1) excessive urinary loss from diuretics or diabetic ketoacidosis; 2) a decrease in intestinal absorption from severe diarrhea and small bowel resection; and 3) a decrease in dietary intake.

The group also found that disease plays an important role in decreased magnesium levels. Some of the diseases mentioned by this group,

specifically, were hypertension, diabetes, perinatel morbidity in diabetic pregnancies, arrhythmias and congestive heart failure. Mosby (1995) reported that magnesium deficiency occurred in patients who were malnourished and that excessive alcohol use increases the loss of magnesium in the urine. Chronic renal diseases, hypoparathyroidism, hyperthyroidism and hyperaldosteronism all play a role in lowered magnesium levels.

It is especially important to note with elderly patients that some drugs also decrease magnesium levels: diuretics, antibiotics and insulin: all are drugs commonly prescribed for older persons (Mosby, 1995). Additionally, Byrne, Saxton, Pelekan and Nugent (1986) report an alteration of results with dialysis therapy, digitalis intoxication, ethacrynic acid administration and hypercalcemia.

Wood, Suter and Russell (1995) state that the amount of published experimental data that identifies the magnesium needs of elderly people is very limited and practically does not exist in those over the age of 85. It becomes necessary, then, for the primary care practitioner to look at the magnesium intakes of his/her elderly patients and identify whether the values are appropriate and/or whether intervention needs to take place.

Conceptual Framework

In 1966 Virginia Henderson outlined her theory of nursing and emphasized the unique function of nurses. She stated that a nurse must seek to help the patient, in both sickness and health, in performance of activities that will move him/her along a continuum to wellness or to a peaceful death. Maintenance of independence is also identified as a major goal of nursing care. Henderson also states that the nurse may need to assume many other roles in order to meet patient needs (George, 1985). One of these roles is that of assessor. Identification of laboratory results is part of the assessment process and because the patient lacks the ability, for the most part, to understand his/her test results, the practitioner must intercede.

According to Henderson's theory, the nurse is a substitute for what the patient lacks to make him/her complete, whole or independent. Virginia Henderson emphasized that nurses must have a theoretical base for practice and must be knowledgeable. Having the appropriate skills and education, the APNs possesses the knowledge to understand and interpret for the patient the pathological or normal conditions reflected in the patients' laboratory tests. Formulation of a plan then follows.

Fourteen components

The principal concepts of Henderson's theory revolve around the 14 components of nursing that focus on individual care and self-maintenance. They are guidelines for the patient as well as for those providing care, and are essential to health maintenance, recovery or a peaceful death. They are:

1. Breathe normally.
2. Eat and drink adequately.
3. Eliminate body wastes.
4. Move and maintain desirable postures.
5. Sleep and rest.
6. Select suitable clothing -- dress and undress.
7. Maintain body temperature within normal range by adjusting clothing and modifying the environment.
8. Keep the body clean and well-groomed and protect the the integument.
9. Avoid dangers in the environment and avoid injuring others.
10. Communicate with others in expressing emotions, needs, fears, or opinions.
11. Worship according to one's faith.
12. Work in such a way that there is a sense of accomplishment.
13. Play and participate in various forms of recreation.
14. Learn, discover, or satisfy the curiosity that leads to normal development and health and use of the available health facilities. (Henderson, 1955)

In the fourteen components of care, Henderson views the individual as a bio, psycho, socio, and spiritual human being and identifies the unique needs of the patient and the activities required to maintain a state of wellness. Point #14 demonstrates the necessity of utilizing available health facilities. When individuals avail themselves of health facilities, accurate assessment of problems and appropriate interventions are expected. The practitioner is responsible for making sure that this occurs. Henderson also notes that a generalized education will give nurses a better understanding of those under their care and a better identification of factors that might influence their health. She further states that care must be practiced on an individual basis and that nurses must be scientific problem solvers. This is significant in interpretation of laboratory test results, especially within the elderly population. Practitioners must have information available to assist them in the assessment process. A protocol for assessment of laboratory findings of elderly patients with adjusted reference ranges will be the foundation for maintaining standards of practice and assisting the client in maintaining optimal health and control of symptoms.

Nursing process

Henderson's theory states that the application of logic to problem solving is required in giving individualized care. The nurse must also assess the true needs of the individual and must know what is normal or abnormal in health and disease. "The nursing needed by the individual is affected by age, cultural background, emotional balance, and his/her physical and intellectual capacities" (Henderson, 1972). The practitioner must employ logic in interpreting laboratory test results and, as Henderson reports, must take several factors into consideration, i.e., metabolic changes, age, kidney function. Age is specifically mentioned by the theorist as having an effect on what is needed by the individual. It then becomes necessary for the practitioner to identify "normal" from "abnormal" laboratory findings for the aging individual. They must ask themselves if the reference ranges identified in laboratory reports are actually "normal" or "abnormal" for a particular elderly patient with potential kidney dysfunction, slower metabolism, cardiac isabilities, polypharmacy, etc. With appropriate protocols in place regarding

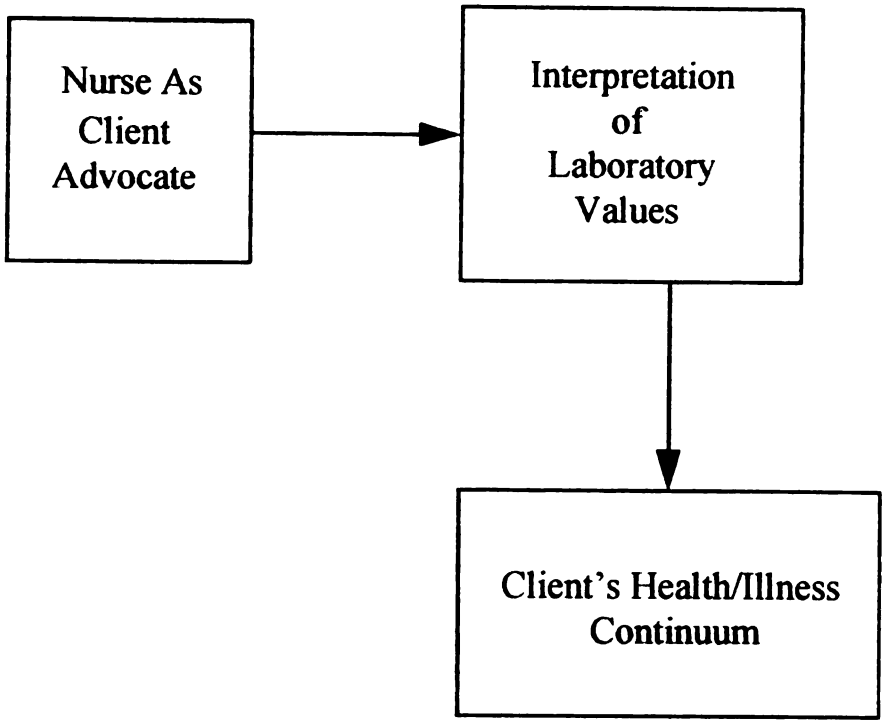

Figure 1. Henderson's Theory of Nursing

accurate identification of values for older patients, a more comprehensive plan of action can be formulated, based on metabolism, cardiac disabilities, polypharmacy, etc. With appropriate protocols in place regarding accurate identification of values for older realistic findings and needs identification.

When the collected data is analyzed, a review of findings and subsequent planning can begin. Henderson states that the nurse must identify actual problems and must give thought to patient needs when doing so. The

planning phase must take into account the unique needs of the elderly patient and the plan must be specific and fit the individuals themselves. When the plan is put into place, then appropriate actions can be taken to improve patient health or maintain the status quo.

Within the planning stages, the APN must have a foundation for the interventions set forth. By correctly identifying the patient's laboratory results, the plan of care will become more appropriate, more reliable and more individualized to patient needs. Nursing process is based on a logical approach to patient care and an understanding of diagnostic values is part of the assessment and planning process.

As part of an interdisciplinary health care team, it is the responsibility of the advanced practice nurse to identify accurate laboratory values for elderly patients. Polypharmacy and over-treatment of these individuals are often a major problem in primary care. By using a holistic approach the APN is able to minimize these problems and plan and implement a plan of care that is based upon recognizing the person as an individual with unique needs. A protocol identifying accurate reference ranges for four frequently used laboratory tests, Erythrocyte Sedimentation Rate (ESR), Serum Magnesium, Total Cholesterol and Serum Glucose, is a step forward in

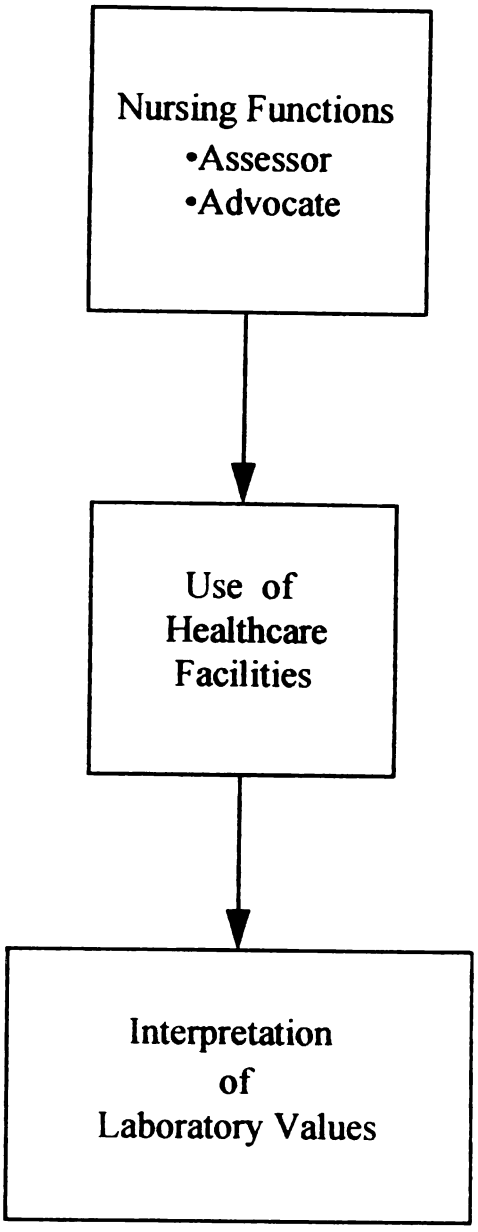

Figure 2. Model For Interpretation of Laboratory Values

maintaining accuracy in assessment and implementation of a plan for geriatric patients as based on Virginia Henderson's theory of nursing.

Development of the Project

Purpose

The purpose of this Scholarly Project is to formulate a protocol for APN's to enhance accurate interpretation of laboratory test results for elderly patients. This protocol may be utilized in private practices, clinics, nursing homes and other primary care settings. It will outline the appropriate reference ranges for geriatric patients for Erythrocyte Sedimentation Rate (ESR), Serum Glucose, Total Cholesterol, and Serum Magnesium.

Based on the current literature, guidelines will be formulated with revised reference ranges for elderly patients. The guidelines will present more appropriate reference ranges for the laboratory tests in this study, based on current research and investigation.

The protocol will include the reference ranges for adults for each specific test and adjusted ranges for adults above the age of 65. It will also present a brief explanation of the test, including reasons for ordering, and factors that might affect the results, such as disease or drugs.

An understanding of the effects of aging on laboratory values will increase the APN's ability to correctly diagnose the patient in primary care and begin appropriate interventions. Without accuracy in interpretation of these laboratory tests, the advanced practice nurse is not able to fulfill his/her commitment to holistic care.

The laboratory tests included in this study are frequently ordered in primary care practice and, too often, age-related factors are not taken into account when analyzing the results of the data. This leads to errors in diagnosing and treatment of elders.

As traditional thinking about aging changes, so does the distinction between normal aging and disease process. It is important for the APN to distinguish between disease and/or age changes in his/her patients who are reporting symptoms (Peterson, 1994). The protocol will be developed in order to better identify appropriate reference ranges for Erythrocyte Sedimentation Rate (ESR), Serum Glucose, Total Cholesterol and Serum Magnesium for elderly patients and, accordingly, initiate appropriate interventions.

Procedure

The APN in primary care is responsible for the assessment of patient symptoms and utilizes laboratory tests to increase diagnostic accuracy and maximize the appropriateness of interventions. The protocol will assist the APN to better interpret the results of laboratory testing and will serve as a guideline for him/her to refer to when working with elderly patients.

The protocol may be used by other health care providers and when accessible, will serve as an important reference point for all who utilize laboratory test results. The protocol is intended to be used in many settings and is appropriate in private practice, acute care facilities, ambulatory clinics, long term care facilities and various other health care settings.

The protocol will be specific to patients over the age of 65 and will be formated as follows; the name of each test will be listed in Column 1. The next column will identify reasons for ordering the test, such as ruling out certain diseases, identifying the efficacy of health promoting activities or confirming suspected diagnoses. The third column will present the current, normal, reference ranges for adults and the last column will identify the

revised reference ranges for adults above the age of 65.

In addition, each test will have an accompanying interpretation of results with explanations of values falling outside of the reference ranges. Explanations for both high and low values will be presented in sequential fashion and organized by physiological factors, drugs which might affect the results and disease processes. Signs and symptoms of low or high values for each particular test will also be included, if appropriate.

The protocol may be placed in examination rooms, charts, procedure manuals, at nurse's stations, medical carts or lab rooms. It should be easily accessible for all who are responsible for the patient's care and will serve as a guide to a more accurate interpretation of lab values. As Cavalieri, et al (1992) state, "To ensure proper assessment of the geriatric patient, the clinician needs to be aware of age-related changes and their effect on laboratory values." The protocol will maximize geriatric assessment and enhance patient care.

Evaluation of the protocol

The protocol could be evaluated, first, by a review of 100 charts of elderly patients in a primary care setting. The instances in which the tests

were ordered could be identified and test results of ESR, Serum Glucose, Total Cholesterol or Serum Magnesium examined. Next, signs and symptoms presented by patients and their treatments could be compared for those with similar lab results.

Comparisons could then be made between patients prior to and after the protocol. An analysis of the number and types of treatments ordered and the results of the interventions could be looked at and a determination made as to the validity of the revised reference ranges for elderly patients and whether or not the protocol was being utilized.

In addition, a panel of practicing APN's could review the protocol for its effectiveness and usefulness in practice. A determination could also be made regarding the appropriate format for the guidelines, i.e., the most useful presentation and placement of the document.

Implications for the future

Interpretation of laboratory values for elderly persons is complicated by a number of factors including underlying disease, anatomic changes in the elderly, drug use and the effects of diet and nutrition on laboratory tests (Coodley, 1989). As trends indicate, the number of elderly within the population is increasing at a significant rate and increasing numbers are

being seen in primary care facilities. The correct interpretation of laboratory tests in this population will continue to be of increasing importance to the APN in the future when diagnosing problems and planning interventions.

Melillo (1993) has reported that health professionals must not treat abnormal laboratory values that may only represent altered physiological states and not true disease or pathological disorders. As a result, the APN must be aware of the physiological changes that take place with elderly patients and adjust treatment for these patients accordingly.

Education

Nursing school curriculums could include a teaching module regarding adjusted laboratory values in geriatric programs. In this way, the students would be better prepared and alert to changes which might affect test results for their patients. Similarly, inservices and training sessions in current practices, in all levels of care, would be a step in the right direction in assisting staff to use critical thinking in the assessment of laboratory values. Cavalieri, et al (1992) state that clinically significant changes may be incorrectly attributed to age alone by health care professionals and changes that are normal with aging may be misinterpreted as signs of disease by this same group. This information becomes critical, then, for education of health

care providers in providing optimal care to their patients.

Research

There is a lack of research on laboratory values for elderly patients. Melillo (1993) reports scant literature on the subject and Kelso (1990) reiterates the paucity of data on reference values for healthy, elderly persons.

At present, there is limited reference to normal ranges for persons over the age of 65 for ESR, Serum Glucose, Total Cholesterol and Serum Magnesium. Further studies need to be undertaken to refine appropriate reference ranges for other laboratory values as well. There have been indications regarding the need for new guidelines for Uric Acid, Creatinine Clearance and Hemoglobin, Hematocrit and Red Blood Cells. Melillo (1993) reports wider ranges and lower values than those for younger adults in the geriatric population.

There is also a lack of data regarding the value of routine laboratory tests in older adults. Kim and Berlowitz (1994) state that routine comprehensive laboratory panels may not be warranted in severely impaired elderly patients in long-term care facilities. They have found that laboratory assessments limited to assessing acute changes in clinical status might be more appropriate for these patients as well as being more cost effective.

There is a need for more research in the area of normal laboratory values in geriatric populations.

Summary

The APN has a responsibility to the patient to provide optimal care while making appropriate use of health care resources. He/she will be able to improve the quality of care for his/her patients by correct interpretation of ordered lab tests. This will allow for more accurate diagnoses, decreased number of office visits, and increased patient satisfaction. Costs for needless interventions are also contained, which is a significant issue in health care at the present time.

Advanced practice nurses treating the elderly in primary care, have access to many non-invasive and invasive procedures as well as high technology devices in order to accurately diagnose and treat their patients. An understanding of the effects of age on laboratory values has been lacking in the literature. This is especially true for the population of elderly over the age of 75 which, at present, includes the fastest growing segment of the aging population. Ochs (1991) indicates that, with elderly patients, the selection of the proper test is essential in meeting patient needs and that the decision must take into account not only the suspected condition, but the diagnostic value of

the test, the skill required to perform it and the cost of the test itself.

A research-based protocol delineating the adjusted "normal" laboratory values for geriatric patients is a positive step in promoting accurate diagnosing and appropriate treatment interventions for the elderly. As Melillo (1993) states, "Health care providers who work with the elderly are faced with a lack of aggregated standards with which to compare patient values." It is the intent of the author to provide an acceptable standard of values for elderly patients which will be useful to all primary care providers.

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APPENDIX

LABORATORY VALUES FOR ESR, SERUM MAGNESIUM, TOTAL CHOLESTEROL AND SERUM GLUCOSE

Laboratory Test	Reason for Ordering Test	Adult Reference Range	>Age 65 Reference Range
ESR (Erythrocyte Sedimentation Rate)	To identify and monitor disease activity in infectious, inflammatory and neoplastic conditions. Especially useful in detecting rheumatic and collagen disease.	0-15 mm/hr for males 0-20 mm/hr for females	0-20 mm/hr for males 0-30 mm/hr for females
Serum Magnesium	To evaluate electrolyte disorders, hypocalcemia, and acid-base imbalance. To monitor cardiac disorders.	1.2-2.5 mEq/L	0.5-.78 mEq/L
Total Cholesterol	To identify persons at risk for CAD and to determine the effectiveness of health promoting lifestyle changes.	< 200 mg/dl	<212-214 mg/dl for males <202-233 mg/dl for females
Serum Glucose (Two-Hour Post Prandial)	To evaluate insulin response to glucose intake and to evaluate the management of diabetes mellitus.	70-145 mg/dl	100 mg/dl & patient's age

LABORATORY TEST	CAUSES OF HIGH VALUES	CAUSES OF LOW VALUES
ESR (Erythrocyte Sedimentation Rate)	*Disease:* multiple myeloma neoplasms chronic infections collagen disease	*Disease:* sickle cell disease polycythemia abnormal red blood cells
	Drugs: dextran methyldopa contraceptives penicillamine procainamide theophylline vitamin A	*Drugs:* aspirin cortisone quinine ACTH
	Other: pregnancy menstruation changes in albumin & fibrinogen in plasma elevated glucose levels high cholesterol	*Other:* specimen allowed to stand longer than three hours
	Signs & Symptoms: disease related	*Signs & Symptoms:* disease related

Serum Magnesium	*Disease:* chronic renal failure Addison's disease	*Disease:* renal disease diabetes hypoparathyroidism hyperaldosteronism pancreatitis ischemic heart disease osteoporosis diarrhea congestive heart failure
	Drugs: magnesium sulfate sedatives antacids enemas milk of magnesia	*Drugs:* diuretics antibiotics insulin
		Other: decrease in calcium and potassium decreased nutritional intake malabsorption maldigestion alcohol abuse
	Signs & Symptoms: decreased nerve and muscle activity lethargy decreased perspiration coma cardiac arrest	*Signs & Symptoms:* tremors parasthesias weakness tetany increased blood pressure increased heart rate convulsions disorientation

Cholesterol	*Disease:* arteriosclerosis CAD alcoholism diabetes mellitus myxedema obstructive bile duct pancreatitis obstructive jaundice	*Disease:* hyperthyroidism liver disease hepatitis cirrhosis sepsis pernicious anemia
	Drugs: anabolic steroids progestins bile salts chlorpromazine beta adrenergic blockers corticosteroids epinephrine phenytoin sulfanomides thiazide diuretics vitamin D	*Drugs:* fluvastatin lovastatin niacin probucol mao inhibitors allopurinol androgens captopril colchicine erythromycin isoniazid
	Other: high fat diet	*Other:* hyperalimentation oophorectomy malabsorption malnutrition *An increase in short-term mortality has been found with elderly patients and decreases in cholesterol levels.
	Signs & Symptoms: disease related	*Signs & Symptoms:* disease related

Blood Glucose (Two-Hour Post Prandial)	*Disease:* diabetes mellitus CVA MI Cushing's disease hyperparathyroidism adenoma of pancreas pancreatitis	*Disease:* insulinoma hypothyroidism hypopituitarism liver disease
	Drugs: antidepressants beta adrenergic blockers corticosteroids dextrose IV solutions dextrothyroxine diazoxide diuretics epinephrine estrogens glucagon isoniazid lithium phenothiazines phenytoin salicylates triamterene	*Drugs:* acetaminophen alcohol anabolic steroids clofibrate desopyramide insulin mao inhibitors pentamidine propranolol tolazamide tolbutamide
	Signs & Symptoms: **polyuria** **polydipsia** **polyphagia** weight loss fatigue hunger	*Signs & Symptoms:* **sweating** **nervousness** increased pulse headache loss of conscience convulsions