XV. Miscellaneous

Memory Remediation in Older Adults: A Computerized Interactive System

Anderson D. Smith, Ph.D.; Donald D. Wall, Ph.D.; and Clarence M. Rogers, M.D.
VA Medical Center
Research and Development Section
Decatur, GA 30033

Sponsor: VA Rehabilitation Research and Development Service

Purpose — Memory change is associated with the aging process, change not only seen in pathologies associated with aging (e.g., dementia), but also seen in normal aging. Memory failure is recognized by both researchers and by older adults themselves as one of the major psychological factors changing with adult age. Even though older adults report their memories to be worse than younger adults, the actual relationship between memory complaint and actual memory performance is small, typically showing a small correlation. Subjective reports of memory and cognitive ability made by the older adults often fail to reflect the actual capability of the older adult. This makes cognitive remediation difficult, except in extreme cases where cognitive deterioration is both generalized and severe (e.g., closed head injuries, dementia).

One possibility for the discrepancy between subjective report of memory deficits and actual memory performance is the assumption that memory skill is a generalized ability. Instead, it is most likely that changes with age are specific and very different for each individual older adult.

Memory assessment in clinical settings often involves global assessment batteries, tests deriving from the psychometric perspective that often have limited application when remediation is desired. Another serious drawback with most clinical memory assessment batteries is that they are not validated on everyday memory behaviors and problems. Of eight batteries most commonly used in clinical memory testing, none use everyday memory problems as criteria for validation. For remediation to be successful, however, testing and remediation techniques must address specific memory problems as they are identified by either the clinician or by the older adult him/or herself.

Progress — We will develop and test an interactive system (compatible with both microcomputers and the VAMC computer) that allows the patient/subject to practice and deal with specific memory skills rather than to deal with memory as a generalized activity. Specific skills will be identified and then trained or remediated. Furthermore, these skills will be relevant to the specific problems being experienced by older patient/subjects. Using the MUMPS language (currently being used at VAMC), another feature of the system will be the ability to store and use patient-relevant information as a component of the memory-skill training. For each patient/subject, a dataset of the older adult's own experiences will be stored and used in the memory training scheme.

During the pilot phase of this project, several memory skills will be identified for pilot use in two ways. Memory questionnaire data will be examined from normative studies existing in the literature. Second, skills will be identified through interviews and questionnaires with both patient/subjects and VA staff

working with older adults on a day-to-day basis. Computer programs will be developed using the MUMPS language that are designed to train the memory skills through interaction with the computer terminal. The interactive system will then be evaluated for the few skills to be used in the pilot phase of this project, both in terms of its validity of memory improvement and in terms of user compatability (user response).

The project team consists of a cognitive psychologist with extensive research experience in memory performance of older adults, a VA clinician with experience with geriatric medicine and the VA population, and a mathematician with expertise in computer systems design and programming.

A Life-Span Approach to Product Design and Development for the Aging Population

K.G. Engelhardt, A.B., B.A.; Paul Haber, M.D.; Larry Leifer, Ph.D.; Karen Holloway, B.S.; and Roger Awad-Edwards, M.S.
VA Medical Center
Palo Alto, CA 94304

Sponsor: VA Rehabilitation Research and Development Service

Purpose — We hypothesize that technology developed through an interactive process and coupled with an approach to design and development based on a lifetime continuum will be appropriate to and accepted by the end-user population. This interactive process requires user involvement at all stages of the development cycle. It is believed that user-focused research will insure a well defined need statement, which is necessary to optimize the relationship between human and machine and will aid in the diffusion process.

The Interactive Evaluation Model is used to focus on a life-span approach to product design and development. The project seeks to: 1) involve student design engineers and older people in intergenerational needfinding and design; 2) provide students with a broader perspective to design and development; 3) develop methodologies to better educate engineering design students to meet the needs of older users; 4) develop a model from structuring communication between users and designers, 5) develop criteria for evaluation of marketed assistive devices; 6) provide feedback to manufacturers of assistive devices; 7) facilitate interaction between academia, industry, and government; and 8) identify new projects to benefit the aging through the application of microcomputer technology.

Progress — The VA RR&D and the Stanford University Mechanical Engineering Design Division collaborated on two student projects. Both were designed to highlight the needs of the elderly and to educate the students in a life-span approach to design. In one of the VA/Stanford projects, the interaction between academia, government, and industry was of primary concern. In the evaluation effort, retired professionals are involved in the identification of needs and definition of appropriate technology for their peers. A computer class at one of the local senior centers (average age of the programmers: 69) helped in the evaluation of commercial and homebrew robotics for home and health care. Other seniors served as advisors and community liaisons for a project in needfinding at Stanford. The results of this research were presented at the 30th Annual Meeting of the Western Gerontological Society in March of 1984. While formal research is not ongoing, staff members continue to interact with students in the classroom and on an individual project basis, and seniors continue in the evaluation effort.

Development of a Life Satisfaction Scale Applicable for People with Severe Disabilities

Steve Shindell, Ph.D.; Gregory L. Goodrich, Ph.D.; Michael Dunn, Ph.D.; Edwenna Werner, Ph.D; and Andre de Cordova, B.S.
VA Medical Center
Palo Alto, CA 94304

Sponsor: National Institute of Handicapped Research

Purpose — This study seeks to develop a clinically useful questionnaire that will allow insight upon the adjustment process of people with various disabilities. Four different clinical populations will be used, including visually impaired adults from the Western Blind Rehabilitation Center, spinal cord injured adults from the Spinal Cord Injury unit, Palo Alto VAMC, patients from the Rehabilitation Medicine Department, Palo Alto VAMC, and a control population of members from a local Veterans of Foreign Wars chapter. The questionnaire's short, concise format will enable it to fit anywhere from an ongoing program evaluation, to an individual clinical assessment, to a diagnostic screening device, or as a central core to more specialized research. Also, the development of normative, reliability, and validity data on four distinctly different populations will allow statements concerning the intercorrelations of age, type of injury, activity level, support systems, coping mechanisms, and satisfaction of one's own quality of life.

The unique aspect of this study is the incorporation of the concept of the subjective appraisal of quality of life as a useful and important aspect of rehabilitation care. Use of this concept allows researchers and clinicians access to each person's perceptions of life satisfaction at various times of their lives, rather than viewing adjustment as a dichotomous variable that occurs sometime during the inpatient rehabilitation program. This will aid in a more comprehensive rehabilitation program as well as tailoring rehabilitation to each person's individual needs.

Progress — Data collection was completed for the pilot group of 30 veterans at the Western Blind Rehabilitation Center. The questionnaire was administered at intake, discharge, and 6 months following discharge. Only preliminary analysis of a few questions has been done to date; it indicated a high degree of satisfaction with the rehabilitation received.

On the basis of this pilot study, the questionnaire was revised somewhat and has been given to a large sample at the Western Blind Rehabilitation Center, as well as a small sample of veterans in the other two clinical settings—the Spinal Cord Injury unit and the Rehabilitation Medicine Department. Approximately 34 students at the Western Blind Rehabilitation Center have been administered the revised questionnaire all 3 times, and another 70 have been given the intake and discharge questionnaire and are awaiting the 6-month follow-up. All incoming students are routinely given the intake interview as part of their initial interview with the staff psychologist. At the Spinal Cord Injury unit, 23 interviews have been done with patients who are in for either initial general rehabilitation or for a second visit. One intake interview has been done at Rehabilitation Medicine. The appropriateness of the questionnaire for these additional settings is being assessed carefully, and plans are being developed for data storage, and for analyzing the pilot data and the data currently being collected.

It is expected that the results of this project will lead to changes in the clinical tests that are provided by psychologists and other psychosocial team members involved in rehabilitation. Clinicians and rehabilitation researchers will have a

more objective basis from which to identify who will be most likely to benefit from a variety of rehabilitation services, as well as what specific services should be offered to each individual person. In addition, clinicians will have a more objective basis in determining each individual's satisfaction with life at various points in time during their life, and be able to compare this level of satisfaction with other people of similar age and disabilities.

Minimizing Occupational Barriers for Physically Handicapped Farmers and Agricultural Workers

W. E. Field, Ed.D.
Department of Agricultural Engineering
Purdue University
West Lafayette, IN 47907

Sponsor: Deere & Company and the National Institute for Handicapped Research

Purpose — The project is designed to assist agricultural producers with physical handicaps who desire to remain actively involved in their farm or ranch operation. Five basic objectives of the project are:

1) determine the proportion of active agricultural producers who have physical handicaps;

2) identify the types of physical handicaps which hinder active agricultural producers in completing essential work-related tasks;

3) evaluate essential operating and servicing procedures on modern agricultural equipment to identify design factors which reduce or contribute to the barriers facing agricultural producers with physical handicaps;

4) develop, identify, and compile practical alternative designs, modifications, and accessories to aid agricultural producers with physical handicaps in operating agricultural equipment and completing other farm-related tasks; and

5) establish a resource center to compile and distribute information to physically handicapped agricultural producers and their families in order to assist them in remaining productive in an agricultural setting.

Progress — Presently, the project is involved with the following activities.

1) Publishing the *Breaking New Ground Newsletter* on a quarterly basis. Designed specifically for agricultural producers with physical handicaps and rehabilitation professionals, the newsletter provides case histories; information on modifications for farm tools, equipment and facilities; descriptions of new products and resources; and a calendar of upcoming events.

2) Information and referral service in response to specific requests from agricultural producers.

3) Assistance with designing, organizing, and conducting workshops for producers and rehabilitation professionals. These are conducted on a regional or statewide basis.

4) Research, design, and construction of hand controls and tractor manlifts that provide the greatest versatility and control for operators at the least cost.

5) Evaluation of existing lifts, controls, and other modified farm equipment and buildings to determine effectiveness and insure safety.

6) Development of a comprehensive resource center containing information on modified farm tools, machinery, equipment, and buildings.

7) Assembly of a product information file on companies who manufacture equipment that can be utilized by producers with various disabilities.

Future Plans — Over the next several years the newsletter, workshops, and research will continue as resources become available. In addition, a series of audio-visual materials will be developed that will focus on problems such as: design and construction of manlifts for tractors and self-propelled harvesters; design and construction of modified controls for agricultural equipment; farm building accessibility; and adapted farm tools and accessories.

Extending the Management Control Project: Assessing Impact, Outcome, and Client Satisfaction

Jeanne Boland Patterson, Ed.D., CRC
Rehabilitation Services Program
Florida State University
Tallahassee, FL 32306

Sponsor: National Institute of Handicapped Research

Progress — The Management Control Project has significantly improved eligibility decisions, understanding of client needs, and increased agency fiscal accountability in state vocational rehabilitation agencies that have implemented the Management Control System. This project is analyzing pre- and post-implementation data of the first three states to implement the Management Control System. This analysis may have implications and suggest trends for states presently implementing the system.

Specific areas which are being assessed are: 1) time in status for clients successfully and not successfully rehabilitated; 2) case service costs for successful and unsuccessful rehabilitation clients; 3) acceptance rates of clients; 4) success rates of clients; 5) severity of disability; 6) number of clients placed in competitive employment following rehabilitation; and 7) occupational categories of clients successfully rehabilitated.

How the Congenitally/Physically Deformed Learn to Be Independent

David B. Shurtleff, M.D.
Division of Congenital Defects
University of Washington
Seattle, WA 98195

Sponsor: National Institute of Handicapped Research

Purpose — Existing information on survival, long-term management, and development of children born with open neural tube defects of the spine (spina bifida operta, meningomyelocele, myelodysplasia) is incomplete or becoming obsolete. We propose a multicenter data collection and analysis network to provide current information about survival rates and morbidity associated with modern medical and surgical care, therapy, and education of the child born with myelodysplasia. In years one through three, participating center staff will be trained to implement a comprehensive biomedical management protocol. Concurrently, a psychosocial protocol to assess community, family, and the myelodysplastic child will be developed and field-tested in Seattle. In year four, the psychosocial protocol would be transferred to participating centers and implemented parallel to the biomedical protocol. Years four and five will involve extensive evaluation and analysis. Approximately 4,000 patients will participate in four to five centers over the five years of this start-up phase.

This project will test multivariate hypotheses concerning:

1) Type, technique, and time of surgical repair of the lesion and cerebrospinal fluid shunt placement including coordination of back closure with caesarean-

section birth, scheduled because the fetus was diagnosed as having an open spine;

2) The relationship of type of ambulation to functional mobility as affected by biomedical, social, and educational variables;

3) The ability of an affected child to develop into an independent, socially adjusted, employable adult as related to age of learning independent self-care skills and socialization; and

4) Cost-effectiveness of medical and surgical care, therapy, and educational programs.

Rehabilitation International Study on Social Security Benefits for Disabled Persons

Barbara Duncan
Rehabilitation International
New York, NY 10010

Sponsor: U.S. Social Security Administration

Purpose — The contract was designed by the SSA Office of Disability in consultation with the SSA International Policy Staff.

In 1980 the US Congress ordered reviews of eligibility of the majority of people currently receiving work disability benefits from the SSA. The reviews were ordered because of federal investigations which suggested the possibility of wide-spread abuse of the benefit system. Since 1981 nearly 500,000 beneficiaries were advised that they no longer met the medical criteria for benefits. Of these, more than 200,000 people regained their benefits following appeals.

Due to numerous court cases and conflict concerning eligibility criteria, a moratorium has been called on reviews of eligibility of beneficiaries. The SSA is now developing new criteria to assess medical improvement of beneficiaries. The SSA is taking this opportunity to study all aspects of its work disability benefits system and one of the methods it has chosen is an international assessment of how similar systems work in other countries.

The countries to be studied are: Austria, Canada, the Federal Republic of Germany, Finland, Israel, the Netherlands, Sweden, and the United Kingdom.

Progress — The study will be carried out by investigators familiar with the system in each country. Rehabilitation International member organizations in each country have identified primary investigators and consultants to conduct the eight national studies. A sub-group of the investigators developed a questionnaire for the study. Each primary investigator is responsible for preparing a national monograph based on the data and information collected. A cross-national analysis will be prepared on the basis of the monographs.

The three major aspects of the systems to be studied are: 1) definitions of work disability used and how eligibility criteria determinations are carried out; 2) how continuing eligibility of beneficiaries is monitored and reviewed; and 3) methods of encouraging and facilitating the return to work of beneficiaries.

The major research tool of the project, a specially designed questionnaire is constructed to elicit information about the process, starting from the point of entry into the system and describing the various possibilities and procedures which may occur.

The U.S. Social Security Administration has also identified three areas for particularly close examination of the experience of other countries. They are: 1) the evaluation of pain, particularly in situations where the clinical evidence is not

supportive of the claim to disabling pain; 2) definitions and criteria used to evaluate mental illness and to predict recovery; and 3) criteria for cardiovascular and musculoskeletal impairments.

The main products of the study will be eight national monographs describing the various benefit systems and a cross-national research analysis based on the monographs. A small international working conference on the results of the study and areas showing promise for future research will be held in Washington, D.C. in March 1986.

Toward Better Methods of Nerve Repair and Evaluation

Victor R. Hentz, M.D.
VA Medical Center
Palo Alto, CA 94304

Sponsor: VA Rehabilitation Research and Development Service

Purpose — This study involves the parallel development of adjuncts to mechanical methods of reapproximating severed nerves and systems that permit more accurate evaluation of nerve lesions.

Progress — To date we have determined that several non-suture methods of nerve approximation permit regeneration equal to that obtained by the best suture repair methods in both rats and primates. Early, but incomplete, data indicate that agents which decrease the inflammatory response of injury permit greater numbers of axons to regenerate across a repair site. Present efforts involve investigation of such trophic factors as nerve growth factor and pulsed electromagnetic fields.

To better analyze a nerve lesion we have investigated the potential of measurements of the magnetic field that is associated with a passing wave of depolarization along a nerve to provide better information about the health and numbers of excited axons. We have demonstrated that the magnetic corollary of the compound action potential can give additional valuable information about the nerve. Ongoing studies include an analysis of the added delays at a repair site as a determinate in clinical decision making and the development of easy to use intraoperative recording systems.

Aesthesiometry in Screening and Prevention of Neurotrophic Ulcerations

John J. Holewski, D.P.M.
VA Medical Center
San Francisco, CA 94121

Sponsor: VA Rehabilitation Research and Development Center

Purpose — Development of neurotrophic ulceration in the diabetic patient leads to amputation of limb and disability of these patients. Currently most information and effort is directed at treatment of the already formed neurotrophic ulceration. Information is known on prevention, but effective methods for quantitating the overall status of the diabetic foot are lacking. New criteria are needed on the variables which cause ulcer formation. This study will focus on peripheral neuropathy and its relationship to the diabetic's loss of protective sensation leading to ulceration.

It is proposed that Semmes-Weinstein Aesthesiometry measuring cutaneous touch pressure sensation could be an effective, practical method for quantitating the extent of peripheral neuropathy in the lower extremity of diabetic patients. New criteria utilizing aesthesiometry can be established which can assist in the

diagnostic process to predict the relative risk of development of neuropathic foot ulceration in the diabetic population. This project will follow 100 diabetic patients divided into three risk groups of equal size: low, medium, and high on the basis of cutaneous touch sensation.

Progress — These patients will be followed with noninvasive screening tests three times annually, in addition to their regular routine foot care. This proposed project is a survey of a patient population, no alterations in patient treatment will be done. The screening tests will include cutaneous sensation testing, a photograph of the plantar surface of the foot to document lesions and foot structure, and completion of a history/physical questionnaire which will be used as a database. The database will be analyzed by Clinfo statistical packages on the station-wide PDP11-24 computer, especially noting changes in cutaneous touch sensation and occurrence of ulcerations. Data will be evaluated to determine if cutaneous sensation is an effective parameter for division of risk groups. Each risk group will be evaluated to determine what other variables cause differences within the group.

In addition to determining the efficacy of aesthesiometry in quantitating peripheral neuropathy, this analysis of the database will provide a clearer understanding of the variables of ulcer formation and their relation to peripheral neuropathy. Clinically, this information can be used to enable one to intervene with appropriate treatment or preventative measures to control or prevent occurrence of diabetic neurotrophic pedal ulceration.

Epidemiological Index of Disabled Pacific Basin Veterans

Claude M. Chemtob, Ph.D.
VA Medical Center
Honolulu, HI 96850

Sponsor: VA Rehabilitation Research and Development Service

Purpose — This project is aimed at developing a database on the disabilities of Pacific Basin Veterans (especially from Hawaii, Guam, and American Samoa). This extremely dispersed population often are hindered in getting adequate care for disabilities because of geographic location. In addition, a range of cross cultural issues must be recognized and addressed in dealing with disabled veterans in the Pacific Basin.

A number of variables are of concern to us. They include: 1) type of disability; 2) availability of care; 3) level of care; 4) impact on community adaptation; 5) ethnic meaning of disability; 6) quality of general health care management; and 7) relationships between aging and disability. We intend to develop a cooperative relationship with the University of Hawaii in pursuit of the above data. An important design consideration in developing the database is that it be capable of continuous updating.

The project has been proceeding in preliminary data gathering on multiple fronts: 1) panels of experts have been interviewed; 2) prior efforts at developing such a database have been reviewed and analyzed; 3) archival data, including census data, are being considered, and pilot interviews have been done. We presently plan a three-pronged approach. First, we will identify all currently known disabled veterans and sample them in order to conduct extensive interviews and evaluations. Second, we will develop case-finding methods to

enable us to find other veterans with disabilities and interview them. Finally, we will conduct a telephone survey of veterans to establish the rate and nature of disabilities in the veteran population.

Thermographic/Spectroscopic Comparison of Soaks, Exercise, and Trental® on Diabetic Feet

Kathryn M. Moss, D.P.M.
VA Medical Center
San Francisco, CA 94121

Sponsor: VA Rehabilitation Research and Development Service

Purpose — The objective of this project is to delineate any thermographic or spectroscopic differences within the diabetic population that could be used to screen out patients "at risk" of ulceration.

Using liquid crystal thermography and magnetic resonance spectroscopy, this project will study vascular reactivity in skin and the level of ischemia in muscle in the face of various therapeutic maneuvers. This project will evaluate patients equally divided into four population groups. Each patient will be interviewed and a standard questionnaire, including pertinent medical history and physical examination of the foot will be completed. Based on this information, patients will be placed in one of four study groups: 1) non-diabetic controls; 2) diabetic patients with no prior history of foot ulceration; 3) diabetic patients with a prior history of foot ulceration but without active foot ulcers; and 4) diabetic patients with active foot ulceration. Thermographic evaluation of all patients will be completed before and following three different therapeutic maneuvers: 1) exercise; 2) uniform warming; and 3) an 8-week therapeutic trial of Trental®. Magnetic resonance spectroscopy will be completed on a smaller set of patients in a similar manner evaluating exercise and Trental.®

Using the Clinfo statistical package, the database will be analyzed to determine how one population differs from the other and how exercise, warming, and Trental® affect thermographic and spectroscopic patterns. This information will aid in the development of a prospective index in the assessment of the diabetic foot.

Computerized Treatment of Acquired Reading Disorders

Leslie Gonzalez Rothi, Ph.D.
VA Medical Center
Gainesville, FL 32602

Sponsor: VA Rehabilitation Research and Development Service

Purpose — Normal reading is dependent upon the integrity of two routes or functional systems (the phonological route and the lexical route). Dysfunction of either route results in alexia. The objective of our project, "Computerized Treatment of Acquired Reading Disorders," is threefold: 1) to develop therapy tasks suitable to improve deficient reading strategies associated with the lexical route or the phonological route; 2) to develop computer programs for an interactive computer which would provide the patient with self-paced practice on the above tasks; and 3) to assess the efficacy of these treatments when presented via computer interaction.

We have completed development of the six alexia treatment tasks and are in the final stages of selecting appropriate stimuli. We have completed equipment acquisition and installation. The first version of the computer programs were completed and we are beginning a 6-month debugging process with patient usage.

Rehabilitation Electronic Access Project

D. L. Jaffe, M.S.; R. Chase, M.D.; G. Goodrich, Ph.D.; R. Steele, Ph.D.; S. Phillips; S. Shindell, Ph.D.; P. Webber; and R. Delgado
VA Medical Center
Palo Alto, CA 94304

Sponsor: VA Rehabilitation Research and Development Service

Purpose — The rehabilitation community with its numerous members, their varied professions and abilities, and geographic dispersion has developed its own special needs and problems. For example, without continued communication, informationally isolated islands of community members can develop. As a result, research activities and funding are often duplicated, new techniques and devices are not widely disseminated, the experiences of members are not communicated, and users of aids do not have a voice in their own development.

Computer-based information systems such as NARIC and ABLEDATA have been developed to address users' need to acquire rehabilitation information. Although the data these systems provide are a potential source of solutions, its primary means of access requires personal possession of computer or terminal and modem equipment, knowledge of their use, and proficiency with the system's specific command language. The need for such devices and skills are major barriers preventing the widespread and effective use of these on-line resources.

Dissemination of users' information currently presents another significant problem. There is presently no way of efficiently communicating needs, solutions, and experienced-based information among the members of the rehabilitation community. An independent solution is often pursued despite the possible existence of a solution somewhere within the community—a duplication of effort.

An ideal solution to this situation is a mechanism that enables rehabilitation community members to make informed decisions based upon an enhanced ability to interact in an effective and synergistic manner. If methods existed that allow easy access to information, the barriers that distance, schedule, finances, ability, and possession of equipment impose would be reduced, permitting wider participation by all.

By employing new methods to increase interaction with computer-based information systems, several improvements in the rehabilitation process could follow. First, a greater subscribership would be fostered by the elimination of the requirement for the traditional means of electronic communication—the modem and CRT terminal. Portions of the rehabilitation community that were excluded from this type of participation due to the burden of acquiring this equipment, the inappropriateness of the display, and/or the effort in learning its use then would be able to engage in information exchange. Easier access to computer-based information systems could provide a wealth of opportunities to members of the rehabilitation community. Information on devices, job opportunities, travel, and resources could all be obtained if user-appropriate electronic interfaces were available. Access to, and the use of, information systems employing easy access schemes would permit many users to make educated decisions on issues that affect work, purchases, prescriptions, and achievement of life's goals.

Progress — The Palo Alto Veterans Administration Medical Center's RR&D Center and Western Blind Rehabilitation Center (WBRC) have cooperated on numerous projects during the past several years. These projects include the joint VA/Stanford project to develop a personal information system for the visually impaired. Preliminary work conducted at the RR&D Center has demonstrated the

feasibility of a universally accessible information system serving the rehabilitation community. The WBRC has operated the Electronic TeleCommunications, Education, Training, Evaluation, and Research Activity (ETCETERA) and, more recently, the Computer Training and Education Program (C-TEP), which provides a community locus for training and research on computer-based aids for the visually impaired. Other local resources, including the Sensory Aids Foundation, provide a vocational setting for the practical application of this training. While other systems such as Abledata, Special Net, Wellnet, and Handicapped Education Exchange offer information in computer form, they all require the use of a modem and terminal or computer. A system that requires no special equipment for access (other than a telephone) and provides interaction between users is easy to learn and use. It is equally suited for all those interested in rehabilitation issues who promote a significant improvement in information dissemination and informed decision-making.

A computer-based information system accessible by Touch-Tone and voice recognition input and machine-produced synthetic speech can be developed and employed within the local rehabilitation community to foster increased information exchange and consumer involvement. These alternate means of retrieving and entering computer-based rehabilitation information could be incorporated into both existing and future systems permitting more members of the rehabilitation community to participate in electronic information exchange.

The goal of this project is to design, develop, and evaluate mechanisms that permit universal access to computer-based information systems. Its potential beneficiaries are both agencies and individuals. Federal and private organizations such as the Veterans Administration (RRD and WBRC Centers) and Sensory Aids Foundation will be involved initially. Individual participants include those with disabilities, physicians, manufacturers, therapists, policy makers, employers, those seeking employment, educators, and senior citizens.

This project seeks to evaluate alternate methods of access to computer-based information systems. Voice output, Touch-Tone signalling, and voice input strategies all will be researched as substitutes for the terminal and modem. Several data retrieval dialog schemes will be designed and studied as well. Their successful implementation would provide an alternative to the varied computer command syntax that must be learned presently. This could lead to enhanced information exchange that would benefit all those concerned with rehabilitation.

To foster wider participation with computer-based information systems, this project also will focus on enhancing the system interface. Data selection methods other than system-specific computer command syntax will be explored. Mechanisms such as a personalized on-line electronic librarian could make the process of information exchange easier, more interesting, and motivating. If these improvements were designed into many systems, a common means of accessing information could emerge.

Some activity on this project has already begun. Several speech synthesizers have been acquired and their characteristics have been investigated. Programming has been started, resulting in a set of software modules that perform spoken file output, Touch-Tone encoding and decoding of letters, and telephone management functions. Microcomputer hardware systems have been surveyed for their suitability for this project and a database software search has begun.

IPA Radiology

Jim L. Gattis, Ph.D., P.E.
Department of Electrical Engineering
University of Electrical Engineering
University of Arkansas
Fayetteville, AR 72701

Sponsor: VA Medical Center, Little Rock, AR

Purpose — The purpose of this research is to investigate the feasibility of generating a three-dimensional model of the carotid artery from a limited number of views of the artery produced by digital angiography techniques. The model generated could be displayed and rotated in space so that the radiologist could better visualize any restrictions or occlusions that might be present. Such a technique is desirable because restrictions or occlusions are often not directly visible in the few views that are practical to make. The radiologist has no way of knowing beforehand which views will yield the most informative images of the artery and, thus, may not be able to identify the obstructions.

The research investigation is based on the principle that X-rays passing through a constant density medium will be absorbed at a rate that is proportional to the thickness of the medium, and on the assumption that the blood passing through the artery is nearly uniform in density. The investigation is divided into two parts: 1) image processing for the extraction of the artery thickness from the digital radiological image; and 2) the generation of an artery model from a limited number of radiographic views.

Progress — To create a controlled experiment for the image processing aspect, a glass model of an artery was created with restrictions and occlusions. This model was X-rayed with and without radiopaque dye, and the resulting images were stored on disk. The images were acquired using a Picker Digital Radiographic System and were generated from several look angles, with and without movement, and with and without background clutter. The images were processed using several techniques of image processing, including image averaging, image subtraction, and histogram modification. A careful investigation of these images is being conducted to determine if one can estimate the thickness of an artery along one of the ray traces accurately enough to generate a suitable model for meaningful radiographic analysis.

The graphic generation of the three-dimensional model of the carotid artery was pursued with simulated data to allow researchers to investigate the two aspects of the problem simultaneously and to help isolate the limiting factors of the proposed method. First, cross sections of a hypothetical diseased artery were drawn on drafting paper. These cross sections were then digitized with a Summagraphics Tablet. Measurements of the lengths of parallel rays passing through each cross section at several angles were recorded. These data points were then used to evaluate algorithms for reconstructing the cross sections using one or more views. Reconstructions of each cross section were compared with the originals on a ray-by-ray basis, on a unit cross section basis, and on a statistical basis. Three-dimensional shaded and colored models of the arteries, original and reconstructed, were generated and compared. Many algorithms were investigated and evaluated with respect to accuracy, noise immunity, and computational requirements.

Preliminary Results — The image processing portion of the research was hindered by the lack of a method of transferring digital image data between the Digital Radiographic System and the University's Image Processing Laboratory. Although the hardware and software exist to execute this transfer, they have not

been made available by the manufacturers of the Digital Radiographic System. The images processed, therefore, had to be recorded on film and then captured into the University of Arkansas' system with an imaging camera. This film step introduced a large amount of noise and reduced image data dramatically. Still, it appears that one can extract the data necessary for the reconstruction from the digital radiographic images.

The graphical reconstruction of the artery cross sections and the entire sample arteries was not successful for one or two views, as expected. The reconstructions were quite good for most cross sections using three views, but gave erroneous results in specific types of abnormalities. The reconstructions using four views resulted in very good approximations for the cross sections and the sample arteries for every case of shape and distortion investigated.

Future Plans — Future research will investigate the effect of noise and motion on the results. In addition, a method of automatically extracting the required data will be investigated.

Treatment of Peripheral Arteriosclerosis with Diadynamic Current

Mohamed A.M.M. Atia
Physical Medicine and Rehabilitation Center
Misr Spinning & Weaving Co.'s Hospital
Mehalla-Kubra, Egypt

Sponsor: Mohamed A.M.M. Atia

Purpose — Peripheral arteriosclerosis has many victims all over the world and the struggle against it must be a universal goal. A number of valuable agents are available that can be applied to specific areas without causing any undesirable side actions in the treatment of this condition. Properly applied, they are of more value than any medicinal agents in the treatment of uncomplicated arteriosclerosis.

Progress — Twenty patients with lower limb arteriosclerosis were selected for the study. The male to female ratio was four to one. The ages ranged from 45 to 69 years old and symptoms duration ranged from 1 to 8 months. The claudication distances ranged from 200 to 500 meters. A control normal individual walked 1500 meters without experiencing a calf pain.

Medium-sized electrodes were applied paravertebrally one over the other in the lumbar region with the negative electrode in the caudal position. The Diaphase Fixe current was used for 4 minutes. The sessions were given daily for eight consecutive days with a bearable intensity, followed by an eight-day interval and another course for 4-month treatment.

Preliminary Results — The pain was relieved in 16 patients receiving three to seven courses of treatment. Eight patients became able to walk 1500 meters without experiencing any pain in the calf muscles notwithstanding their original claudication distances. The remaining eight patients were classified as follows. The first patient's claudication distance improved from 300 meters to 1450 meters after treatment. The second patient's claudication distance improved from 300 to 1400 meters. The third patient's claudication distance improved from 250 to 1300 meters and the fourth patient's claudication distance improved from 320 to 1350 meters. Finally, the fifth patient's claudication distance improved from 250 to

1300 meters. Three patients with rest pain improved and their claudication distances became 1250, 1200, 1100 meters respectively. Three patients discontinued the treatment for special causes. One male patient (aged 69 years) with 4 months duration symptoms and a claudication distance of 240 meters showed no improvement, despite receiving seven courses of treatment.

Only in the first and second decades of this century, advanced medical and surgical procedures have been used. Although physical therapy is only part of the total management of the peripheral arteriosclerosis, it plays an important role. Very few references were found in the literatures concerning the use of the diadynamic current in the treatment of peripheral arteriosclerosis.

This work has shown that the diadynamic current is capable of increasing the circulation in the muscles and with prolonged treatment, a considerable significant improvement of the circulation can be achieved in the case of lower limb arteriosclerosis.

This current influences not only the superficial circulation but also circulation at a depth. The mechanism of this action is due to the sympathicus effect. Apart from the increase in the pain threshold and the muscular excitation threshold, there is also an increase in the threshold for sympathicus stimulation. The paravertebral application shows more importance to the sympathicus action than to the direct action on the vasomotor.

The results obtained in the treatment of lower limb arteriosclerosis by means of the diadynamic current are based on a number of different effects. First, there is the sympathicus action. Second, the analgesic action of this current deserves special attention since it is the cause of the subjective improvement frequently preceding the objective improvement in the case of severe arteriosclerosis where pain is felt even while resting. Also, rest pain does not indicate the presence of irreversible pathologic change as the three patients with rest pain showed improvement to a good degree. The patient who showed no improvement with seven courses of treatment might have an irreversible pathologic change.

As a whole, diadynamic current therapy may answer many questions regarding peripheral arteriosclerosis and can be able to influence it beneficially. Hence, diadynamic current therapy is a special consideration in the treatment of peripheral arteriosclerosis.

Serum Antimyelin Activity in Chronic Relapsing Experimental Allergic Encephalomyelitis

Ruth Witham
Oregon Health Sciences University
Portland, OR 97207

Sponsor: Paralyzed Veterans of America, Spinal Cord Research Foundation

Purpose — The purpose of this project is to investigate the role of circulating antibodies in an animal model of multiple sclerosis (MS). The steps involved are as follows: 1) reproducible induction of chronic relapsing experimental allergic encephalomyelitis (CR-EAE) in SJL/J mice; 2) pathological examination of animals at various stages of disease; 3) collection of serum samples at various stages of disease; 4) application of serum samples to slices of brain and spinal cord tissue grown in culture to look for effects on myelin; and 5) measurement of serum antibody levels to various myelin components. Significant progress has been made on the first three steps.

Progress — CR-EAE was induced in SJL/J mice by two different methods. Using the first method, 37 mice were inoculated with a homogenate of mouse spinal cord tissue. Thirty-six of the 37 mice developed an acute attack of neurologic dysfunction 2 to 4 weeks after inoculation, characterized primarily by hind limb weakness with or without forelimb weakness. This was followed by gradual improvement, leaving the animals with variable degrees of residual weakness. Twenty-nine of the mice have experienced a relapse of disease, similar to the acute attack, and 14 have had 2 or more relapses. The relapses generally occurred at 2- to 5-week intervals, and resulted in a gradual accumulation of permanent neurologic deficits. This clinical picture is consistent with that described by other researchers and has features in common with clinical profiles of patients with MS.

Preliminary Results — Preliminary pathological material is available on six of the mice inoculated with spinal cord tissue. Three mice died 33 to 35 days after inoculation, during the first relapse of the disease. Microscopic examination of the brain and spinal cord showed evidence of inflammation around blood vessels and in the nervous system myelin in all three animals. Three mice died or were sacrificed in the chronic phases of disease, at 91 to 96 days after inoculation. These animals showed less marked inflammation, which was primarily around blood vessels. Special stains for myelin damage are still being processed. Based on other pathological reports of mice with CR-EAE, it is expected that the degree of myelin damage will increase with duration of disease. The pathological features of CR-EAE are quite similar to what is seen in patients with MS.

A second method of producing CR-EAE in SJL/J mice was also used. Seventeen donor mice were inoculated with guinea pig myelin basic protein (MBP), an important protein component of myelin. Ten days later these mice were sacrificed and a suspension of lymph node cells was prepared from the donors. The lymph node cells were then cultured for 4 days in culture medium containing MBP. Eight normal mice were injected intravenously with these MBP-stimulated lymph node cells. Six of the eight mice received optimal injections. All six of the optimally injected mice developed an acute attack of disease 5 to 12 days after the injection, characterized by limb weakness with or without incoordination. Five mice developed a spontaneous relapse of disease, usually 4 to 5 weeks after the injection of cells. Four had two or more relapses at several week intervals. The animals were left with a progressively more severe neurologic deficit after each attack, again mimicking the clinical picture of MS.

This model of passively transferred CR-EAE is particularly useful because the confounding variable of exogenously introduced nervous system tissue is eliminated. Successful use of this model has been reported by only one other group of researchers thus far. Pathological material on the six mice that received injections of lymph node cells will be compared with the pathology on mice receiving injections of spinal cord tissue. In addition, approximately 15 to 20 more mice will be injected with MBP-stimulated lymph node cells for study of serum samples and pathological material.

A total of 227 serum samples have been collected from the mice, during both exacerbations and remissions of disease. One hundred and forty-one of the sera are from mice with CR-EAE due to injection of spinal cord tissue, and 51 sera are from mice to whom the disease was transferred by lymph node cells. In addition,

15 sera were collected from control mice and 20 sera from mice injected with MBP. The serum samples have been frozen and stored for future use.

Future Plans — The serum samples will be analyzed for antibodies in two different ways. First, antibody levels to myelin components will be measured by a technique known as the microtiter ELISA assay. Antibody levels to MBP will be measured initially. Depending on the results, antibody levels to galactocerebroside, a myelin lipid, also may be measured. The serum samples will be checked for anti-myelin activity by a second method. The sera will be applied to slices of brain or spinal cord grown in tissue culture. By this method, the presence of serum factors, such as antibodies, which damage myelin or interfere with myelin formation, can be evaluated microscopically. The results of the tissue culture studies and the ELISA assays should provide complementary information.

The results of this study will clarify the role of antibodies in CR-EAE, which may further our understanding of the mechanisms responsible for perpetuation of disease and production of clinical attacks in multiple sclerosis.

Evaluation of a Comprehensive Cardiac Rehabilitation Program: Treatment Effectiveness and Long-Term Programmatic Outcome

Edward J. Hickling, Psy.D. and Maria-Paz Alfonso, M.D.
VA Medical Center
Albany, NY 12208

Sponsor: VA Rehabilitation Research and Development Service

Purpose — The major project idea to be developed into a pre-proposal will be the controlled comparison of a comprehensive Cardiac Rehabilitation Program (CRP) with a more traditional, non-rehabilitation treatment program. The proposal will ideally investigate three major questions: 1) do patients in the program show better outcome (as measured on behavioral, psychological, medical tests; self reports; or recurrence rates) than patients not in the program?; 2) what components of the program are most important in determining positive treatment outcomes?; and 3) is it possible to identify potentially successful and unsuccessful participants early in the program?

Progress — Initial programmatic studies have demonstrated many positive effects for patients who regularly attended and completed a comprehensive cardiac rehabilitation program. These changes have included improved metabolic equivalents, oxygen consumption, NYS Heart Associations' Functional Classification of heart disease, more sustained and regular exercise, reported knowledge of heart disease, improved psychological functioning, and positive lifestyle modifications. Compliance with sustained treatment recommendations and continuation of improvements have not been determined yet through systematic evaluation. Given the available literature reporting on compliance with even the simplest of medical treatment recommendations, as many as 50 percent of the patients may become noncompliant. Thus, early identification of participants who are likely to be compliant or not may be helpful in ascertaining factors which are likely to enhance treatment.

This proposal would initiate the following investigation methodology: The first fifty patients or more, if completed within a 6-month period of time, will be evaluated with the Cardiac Rehabilitation Questionnaire Comprehensive and

medical protocol currently in use for the Cardiac Rehabilitation Program. At that point, subjects who, due to distance or other factors such as the limited accessibility to the program, were not referred for cardiac rehabilitation will be matched for inclusion in the study. Completion of the post treatment measures used to assess participants in the CRP will then be obtained, and all necessary medical tests conducted (ejection fractions, BP, heart-rate resting, VO2, metabolic rating of physical activity). Initial comparison across treatment and non-treatment groups then will be made to assess the benefit of program intervention. Comparison will be made of targeted behavioral, psychological, dietary, lifestyle, and physical changes for the specified follow-up period of time. The effects of treatment outcome will be measured through the expansion of current follow-up efforts within the program to include systematic 1-, 3-, 6-, 12-, 18-, and 24-month follow-up visits or contacts.

Preliminary Results — The CRP has already initiated program evaluation studies documenting desired changes across the time of intervention. Factors relating to successful compliance, sustained lifestyle change, and continued physical benefits have not yet been initiated. While present staffing and resources have allowed for these initial investigations to be made, further funding will be necessary to expand the program in the desired directions and to design a proposal which will yield reliable and valid information.

Future Plans — By five years, the successful completion of this proposal will have demonstrated through objective evaluation of treatment outcomes the efficacy of our present program, the means to complete this type of evaluation, as well as some of the determinants of successful treatment at the time of treatment onset.

Nerve Conduction Velocity Study of the Palmar Cutaneous Branch of the Median Nerve

Peter B. Lum, M.D. and Raghavaigh Kanakamedala, M.D.
VA Medical Center
Long Beach, CA 90822

Sponsor: Rehabilitation Medicine Service, VAMC, Long Beach, CA

Purpose — It is well documented that the palmar cutaneous branch of the median nerve arises from the radial side of the main nerve about 2–5.5 cm proximal to radial styloid. The nerve innervates the skin of the thenar eminence. It may be involved in trauma at the wrist or transected accidentally during decompression for carpal tunnel syndrome or during surgery for ganglion removal or Volar synovectomy in that location. Neuroma formation also has been reported.

Electrophysiologic study of the nerve has not been reported so far. In order to make a precise diagnosis of pathologic involvement of the nerve, it is essential to establish normal conduction values of this nerve. This will confirm clinical diagnosis of neuropathy of the nerve. The data obtained in this study on normal subjects prove to be useful to diagnose its involvement. DISA neuromatic electromyograph available in the electrodiagnostic laboratory of Rehabilitation Medicine Service will be utilized for this project.

At least 25 individuals (50 nerves) consisting of healthy volunteers among VA employees who are 20 or more years of age will be randomly selected without regard to sex or race. A history of peripheral neuropathy, diabetes mellitus,

alcohol abuse, or any systemic or local disorders that are likely to affect the nerve will be excluded from the study. A brief sensory examination of the tested hand to make sure that there is no clinical neurologic abnormality of the nerve will be performed prior to the test. Only individuals with a normal index finger digital nerve latency will be included in the study.

These individuals will be told the objective of the study and a signed consent will be obtained. There is a noninvasive and routine testing procedure in our laboratory that may take less than 30 minutes for each person.

The subject will be tested in a supine position with the forearm and hand supine. The active (pick up) disc electrode will be placed over the center of thenar eminence with the reference electrode 3 cm distally. The ground electrode will be placed over the dorsum of the hand. The median nerve will be stimulated 10 cm proximal to the active electrode using a surface stimulator, and the best response will be recorded. The stimulating electrodes at the wrist will be rotated as necessary to minimize baseline distortion due to stimulus artifact. When in doubt, orthodromic response also will be obtained from the nerve. The mean distal latency, amplitudes of the evoked response, and the standard deviations will be established.

Serial Short Segment Stimulations (Inching) of Ulnar Nerve at the Elbow in Normal Subjects and in Neuropathy

R. Kanakamedala, M.D. and D.G. Simons, M.D.
VA Medical Center
Long Beach, CA 90822

Sponsor: Rehabilitation Medicine Service, VAMC, Long Beach, CA

Purpose — Ulnar nerve compression across the elbow is a well recognized common clinical entity. The nerve is prone to compression either in the condylar groove or in the cubital tunnel as it runs between two heads of flexor carpi ulnaris. The exact incidence of these two lesions in ulnar neuropathy is not known. Precise localization of the lesion, which is essential for appropriate surgical management, can be done most accurately by short segment stimulation of the nerve across the elbow.

The primary objective of the study is to obtain normal configuration of motor and sensory responses by short segment stimulation along the course of the nerve for about 100 mm in normal subjects. Motor nerve conduction velocity of the nerve in the forearm, across the elbow, and in the arm will be obtained in the conventional way using surface electrodes. Also, similar studies will be done on patients referred to Rehabilitation Medicine Service Electrodiagnostic laboratory with possible neuropathy of the nerve across the elbow. We also will evaluate whether stimulation with a needle is useful to more clearly resolve entrapment of the nerve as it passes between the heads of the flexor carpi ulnaris. Special attention will be paid to delay in conduction, drop in amplitude, and changes in shape and area under the curve of the responses across the elbow.

This method will be performed on 50 nerves in 25 normal volunteers who are 20 or more years of age selected without regard to sex or race. Subjects with symptoms or neurologic findings on examination for sensory changes and motor weakness in the ulnar nerve distribution will be disqualified. Persons with a history of alcohol abuse within the last 6 months also will be excluded from the study. Patients will be selected from those referred to Rehabilitation Medicine Service for electrodiagnostic testing. Electromyography of the ulnar nerve innervated muscles will be done to detect evidence of axonal loss in the nerve.

Patients with a history of bleeding tendency or an anticoagulant will not have electromyography. Patients with a definite history of ulnar neuropathy also will be studied to exclude the coexistence of: 1) motor radiculopathy of C_8T_1 roots in the extremity; 2) peripheral neuropathy; and 3) entrapment of ulnar nerve at the wrist or of other nerves at different locations.

This is a collaborative project with neurosurgery. The neurosurgeons will help locate patients for this study, provide operative reports of those patients who come to surgery, and help with postoperative follow-up. Individuals selected for the study will be told the objective of the study and a signed consent obtained.

Job Club

Robert P. Liberman, M.D.; Harvey Jacobs, Ph.D.; and Alan Simpson, Ph.D.
Rehabilitation Medicine Service—Brentwood Division
West Los Angeles Medical Center
Los Angeles, CA 90073

Sponsor: National Institute of Handicapped Research

Purpose — The Brentwood Job Club has been developed under a basic skill building and self-help framework to help persons with chronic psychiatric disabilities gain employment. Unlike traditional job placement programs that rely upon vocational rehabilitation counselors to find jobs for their clients, the present program was designed to teach participants how to find their own jobs and then motivate them to persist in the job-seeking process. This approach not only uses available staff time more effectively, but also provides the participants with important job-finding skills that they are likely to need again in the future. Previous reports of Job Clubs among other populations have been notably successful, although this approach had not been reported among psychiatrically-disabled people prior to the inception of this project.

The purpose of the present project was to determine if the Job Club approach could be adapted to the specific needs of psychiatric patients and if such an approach could improve employment for this population.

Progress — Data have been collected on 170 psychiatric participants focusing on client characteristics, employment outcome, and 6-month follow-up outcomes. Data analyses have focused on identifying relationships between the clients' ability to locate and maintain employment as well as the impact of the Job Club program and other variables such as demographic information, work history, psychiatric history, and current symptomatology.

Preliminary Results — While the literature indicates that only 20 percent of psychiatric patients obtain jobs subsequent to hospitalization, over 65 percent of patients at Brentwood VA obtained employment through the Job Club. Results revealed that program intervention is the most significant factor in facilitating employment outcome with other demographic, psychiatric, and work history variables having statistically negligible effects on employment outcomes. However, the severity of psychiatric symptoms did predict those patients who were returned to their ward treatment program prior to completing the first week of the Job Club curriculum. These findings are seen as supporting the importance of a structured, behaviorally-based psychosocial intervention in vocational rehabilitation of severely disordered psychiatric patients.

While this program offers promise in reversing the vocational misfortunes of chronic psychiatric patients, more information is needed regarding overall efficacy and generalizability across the varied needs of chronic psychiatric patients. Although a significant number of patients secured employment through the Job Club program, half of them became unemployed within the first year. Hence, job placement does not secure job tenure.

Future Plans — Future plans will address these issues through: 1) a programmatic evaluation of the Brentwood Job Finding Club with a broad spectrum of psychiatric patients; 2) a controlled investigation of the contribution of proactive job maintenance training in helping patients keep their jobs; and 3) the controlled dissemination of the overall project to other sites across the country that serve specialized psychiatric patient populations.

Patients will be recruited from four different settings representing a broad program of chronic psychiatric disorders and levels of functioning. Each participant will complete a thorough vocational, psychiatric, and social assessment prior to beginning the program and data will be maintained on individual participation and outcome while in the program. Results will be evaluated through a series of multivariate analyses, controlling for vocational skills, psychiatric status, and program participation and be compared against selected reference groups.

All individuals will have monthly follow-ups for 1 year upon leaving the Job Club. Those who leave the program employed will be randomly divided into two groups to assess the efficacy of job maintenance programming in helping employed patients keep their jobs. Individuals assigned to the treatment group will participate in a behaviorally-based job maintenance program that teaches individualized skills designed to help them meet job-related problems and remain employed. Participants in the comparison group will receive no training.

Finally, the validated job-finding club and job maintenance training programs will be disseminated via controlled field tests to selected sites across the country to determine the general ability of noted findings. Special emphasis will be made to include sites that represent the special needs of psychiatrically disabled persons including the homeless, those within the criminal justice system, as well as those from rural and urban populations. Upon completion of the field tests, the validated program will be disseminated nationally.

Stimulation of Industry and Evaluation of Technology

Samuel R. McFarland
Rehabilitation Engineering Center
Southwest Research Institute
San Antonio, TX 78284

Sponsor: National Institute of Handicapped Research

Purpose — Southwest Research Institute has initiated a Rehabilitation Engineering Center program focusing on "Stimulation of Industry and Evaluation of Technology." At the same time, a complementary Rehabilitation Engineering Center (REC) program was implemented at the Electronic Industries Foundation (EIF). The mission of these centers is to develop strategies and techniques for enhancing commercialization of a broad array of product types with an emphasis on devising, especially for the end-marketer, factual information about new applications of technology. The RECs solicit products to be used as experimental

models for the development of recommended practices. Most laboratory, user-trial, and limited clinical evaluations are conducted or managed by the Southwest Research Institute (SwRI) REC. Requirements of the cognizant regulatory agencies are studied, and evaluations are designed to assure acceptability. The EIF REC is responsible for linking the developer with potential manufacturers, investigating financial impediments, and planning marketing strategies.

Progress — The Rehabilitation Engineering Center has completed its pilot evaluation using the Storable Crutch developed through the Stanford Children's Hospital REC program. Initially, a pre-check safety and reliability analysis was performed. An engineering test and evaluation checklist encompassing criteria for human factors, strength, durability, and failure analysis was developed. Clinical evaluations then were performed through the University of Texas Health Science Center and the Audie L. Murphy VA Hospital. Concurrently, an engineering data package was developed from the prototype hardware to provide fabrication requirement information to possible manufacturers. Potentially-interested manufacturers were identified and put into direct contact with the crutch developer.

The Center also has participated in a round-robin laboratory test of manual wheelchair load-bearing ability. The full testing sequence of ISO static loading tests was performed in support of the RESNA-ANSI TAG effort at revising document DIS/7176/11. Managed by the FDA-Division of Medical Engineering, tests were conducted by SwRI, the VA Prosthetics Center, FDA laboratories, and Everest-Jennings, Inc. Test preparation required fabrication of specialized loading fixtures including a 100 kg test "dummy." All tests were conducted in a stress analysis laboratory according to the prescribed procedures. No permanent dimensional changes were recorded. Test results and recommendations were reported to the RESNA Wheelchair Standards Committee and the ISO.

Developed through the REC program at the Rehabilitation Institute in Ljubljana, Yugoslavia, the Vagicon X utilizes functional electrical stimulation to assist in controlling urinary incontinence in females. The Center staff has coordinated and participated in an engineering evaluation of this device, including laboratory analyses of materials, circuitry, and electronic function. An engineering acceptance and test procedure has been developed in preparation for formal clinical studies to be conducted in the United States.

The Center also focuses efforts on disseminating information related to evaluation activities and rehabilitation technology. The *TechEval* publication was developed to announce and report relevant instructional information. Additionally, the staff has made presentations at numerous conferences and workshops. Highlights include the development of an instructional course to enhance communication between rehabilitation device developers and product manufacturers and the presentation of workshop sessions addressing effective selection and utilization of technical devices. Articles were submitted for publication to various periodicals, exhibit booths were prepared, evaluation resources and manufacturers were visited, and responses to numerous information requests were processed.

Very few "standards" exist that apply to the evaluation of rehabilitation products. Consequently, the REC staff has supported the process of "consensus standardization" of performance criteria by actively participating in the RESNA

Subcommittee on Wheelchair Standards Development and the SAE Subcommittee on Adaptive (Automotive) Devices.

Future Plans — During the current performance period, the Center is planning to work cooperatively with the EIF/REC and other evaluation resources to produce a few, thoroughly documented, case studies of the combined evaluation/commercialization process that has evolved to this point. Efforts to develop and refine evaluation procedures will continue. The Center also will work toward attracting commercial and non-governmental support for evaluation service.

Predictive Criteria in Rehabilitation of ESRD Patients

Nancy G. Kutner, Ph.D.
Emory University School of Medicine
Center for Rehabilitation Medicine
Atlanta, GA 30322

Sponsor: National Institute of Handicapped Research

Progress — Evaluation of outcomes associated with dialysis patients' participation in a low-risk exercise program has been completed. Cybex assessments have indicated increases in muscle endurance in participants, and the data suggested a decrease in systolic blood pressure and an increase in hematocrit. Positive psychological changes included decreased depression and anxiety levels, increased feelings of control over own health status, and a general increase in life-satisfaction. The exercise program consisted of treadmill walking and riding an exercycle twice a week for approximately 40 minutes, plus encouragement to engage in brisk walking for 20 minutes three or more times a week.

Longitudinal assessment of medical, psychosocial, and vocational status of 150 ESRD patients first evaluated 1978-80, with two follow-up assessments at 18-month intervals, focused particularly on the effects of treatment changes.

Hypertension knowledge and treatment prior to renal failure of a stratified random sample of black dialysis patients and white dialysis patients were compared.

Attitudes toward, and experiences with, kidney transplantation among a stratified random sample of black dialysis patients and white dialysis patients were compared as well.

A survey of American Nephrology Nurse Association members was made to determine nurses' needs for additional training to facilitate patient rehabilitation. In addition, another survey contained reports from all hospital and clinic dialysis providers in the United States to determine the availability and nature of rehabilitation services.

Laryngeal Function in Normal and Abnormal Speech (Human)

Thomas Baer
Haskins Laboratories, Inc.
New Haven, CT 06510

Sponsor: National Institutes of Health

Purpose — We are investigating the larynx centers on their control and role as a source function for speech. The research method aims at revealing the relationship between the controlling muscular and aerodynamic forces, the resulting configurational and vibratory adjustments, and the final acoustic output. Muscular activity will be studied by electromyographic techniques. Plethysmorgraphy will be used for estimating lung volume. Aerodynamic data will

consist of sub- and supra-glottal pressure and flow measurements. Aspects of laryngeal configuration will be examined by comparing data from fiberoptic images, high-speed movies, glottal transillumination, and electroglottography. Acoustic measures will include use of inverse filtering. A practical goal of many of the comparative measurements is to develop noninvasive methods of assessing laryngeal function that can be used to replace more direct, but necessarily invasive techniques.

An understanding of speech function requires an understanding of glottal abduction and adduction, the control of fundamental frequency, and the control of glottal configuration, because these area fundamental parameters govern segmental manner distinctions, suprasegmental control, and voice quality control. As part of this general account, the larynx-vocal tract interaction is examined from two points of view—first, temporally in segmental articulation, and second, aerodynamically and mechanically as they interact in FO and voice quality control.

Studies on normal speakers are to be paralleled by studies of three clinical populations: the deaf, the fluent and dysfluent aphasics, and the stutterers. The object of these studies is to provide information about mechanisms that may prove useful in remediative therapy.

Gas Flux Through Human Skin: Effect of Temperature, Stripping, and Inspired Tension

J.E. Baumgardner, M.D.; D.J. Graves, ScD; G.R. Neufeld, M.D.; and J.A. Quinn, Ph.D.
Departments of Chemical Engineering, Anesthesia, and Bioengineering
University of Pennsylvania
Philadelphia, PA 19104

Sponsor: National Heart, Lung, and Blood Institute of the National Institutes of Health and Ben Franklin Partnership Program of the Commonwealth of Pennsylvania

Purpose — The transcutaneous monitoring of PO_2 is a technique that has gained much popularity in the last decade. It has fulfilled the greatest need in the intensive care setting, especially neonatal intensive care. The technique has also been extended to such diverse areas as fetal monitoring, exercise physiology studies and stress testing, assessment of skin flap graft viability, and cardiovascular/pulmonary drug evaluation. The devices have demonstrated their greatest utility as trend monitors, and are especially useful as monitors of peripheral oxygen delivery. As a noninvasive monitor of arterial PO_2, $tcPO_2$ has been less successful. The correlation between arterial blood gas values and $tcPO_2$ has been good under stable and controlled conditions, but not entirely satisfactory, especially in adults in the clinical setting.

We sought to test experimentally the hypothesis that markedly increased skin O_2 flux at high temperature is due to arteriolization. We developed a mass spectral technique for examining simultaneous flux of H_3 and O_2 through intact adult human skin; the monitoring of H_e flux was used as an indicator for local perfusional changes. We have interpreted the data in terms of a simple model for O_2 and H_e flux that incorporates perfusional and diffusional resistances.

Progress — The flux of helium and oxygen through intact adult human skin was measured at various inspired concentrations and skin temperatures. The skin surface was then stripped with cellophane tape to alter the diffusional conductance of the stratum corneum. Helium flux for stripped skin was used to estimate skin perfusion as a function of local temperature, and diffusional conductance for oxygen was estimated from oxygen flux and perfusion. The flux of helium or

oxygen at constant skin temperature was related to inspired concentration by a simple linear model. Increasing surface temperature in the range 33-43°C produced a much larger increase in oxygen flux than in helium flux for intact skin. Skin stripping greatly increased skin oxygen flux. Estimated skin conductance for oxygen showed a more marked temperature dependence than estimated skin perfusion.

The results suggest that raising skin temperature in the range 38-43°C has only a modest effect on skin perfusion, and that stratum corneum conductance may have a major role in the large increase of oxygen flux with temperature.

Future Plans—These findings open new possibilities for investigation of cutaneous blood flow and oxygen transfer in patients with peripheral vascular disease. For example, the use of local hyperbaric oxygen to treat skin ulcers might be enhanced by raising the local skin temperature and providing a high humidity during hyperbaric treatments. We will explore this idea initially as a pilot project in the coming year.

We have taken delivery of a Liebold helium mass spectrometer and have ordered the supplies and components necessary to use it for skin blood flow measurements.