REHABILITATIVE ENGINEERING—A NEW ERA

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. . . an editorial

Rehabilitative engineering has entered a new era. There is growing awareness, within the professions involved and among the general public, that science and technology have helped some of the physically disabled and can be applied more effectively to improve the quality of life for many others. The mounting concern over the high cost of acute and chronic health care is coupled with increasing awareness of the economic, as well as personal, benefits of investment in devices, techniques, and training that can free the seriously disabled from dependence on others. There is a need not only to continue but to strengthen an integrated program, making maximum use of the unique qualities of the nation-wide Veterans Administration program, not only to serve disabled veterans directly, but to launch new developments, establish high standards, and disseminate results effectively so that all of the disabled may benefit.

The term "rehabilitative engineering" (or "rehabilitation engineering" as used by others) is itself not totally clear. It is likely that some name that will mean the same thing to all concerned will evolve—that happened when the word "orthotics" was chosen to cover the art and science of prescribing or designing "orthoses," a term replacing numerous names such as splints, devices, supports, braces, orthopedic appliances, etc. "Orthotics" and "orthoses" are now routinely used and well understood in many countries and disciplines.

Beginning with the development of Rehabilitation Engineering Centers under sponsorship of the Social and Rehabilitation Services, and continuing under the Rehabilitation Services Administration of

the Department of Health, Education and Welfare, the boundaries of this field were chosen in an arbitrary manner but they have stood the test of time. The field comprises the science and technology applied on behalf of the physically disabled, with the goal of improving the quality of life rather than the prolongation or saving of life (even though certain tools or techniques may be useful for several purposes). This same description of the field has been chosen by the Rehabilitative Engineering Research and Development Service, Veterans Administration.

The timing is appropriate, because there is a general awakening of our society to the fact that the plight of the seriously physically disabled has been generally neglected in comparison to many other medical and social problems. The White House Conference on the Handicapped, certain legislative proposals, and the enthusiastic efforts of students, are all signs of this awakening.

The outstandingly successful exception to this generalization (of neglect) was the earliest application of the general format of what we hope will be followed in the future, namely, the "total care" of the patient with an amputation. Here, the assignment since World War II of substantial financing for a significant, concerted, and continuing effort has resulted in a most handsome payoff. There have been radical improvements in the mechanisms and fitting of prostheses, in surgical and rehabilitation management, and in the psychosocial and vocational aspects. Thus the overall management of the totality has replaced isolated concern for surgical site of election, material for the artificial limb, design of its joints, or the obsolete assumption that many amputees would become grade-crossing watchmen or pensioners.

The success of the aritficial limb program illustrates the truism that we are not just looking for a new device. It must be widely recognized, as we progress further in this entire field, that even though the device appears to be (and may actually be) the central focus of our activity, much more is necessarily involved. The less tangible aspects such as expeditious prescription and management by an educated clinic team, application of biomechanical principles of fitting and alignment, and speedy return to meaningful activity, are probably far more important than the modern use of plastic instead of rawhide-covered wood, or of a hydraulic knee control instead of mechanical friction. The hardware is important not only to support the amputee but to serve as the lattice supporting and giving expression to the "software."

The individual, whether he be called a patient or a client, is now being looked at as having residual permanent loss of motor or sensory functions—usually both. Rehabilitative engineering seeks to

help all these categories.

The magnitude of this problem is enormous. A recent study by Kelsey, et al., 1978, documents the fact that about 20 million people in the United States have musculo-skeletal impairments of varying degree. These conditions rank third in the frequency of occurrence of acute conditions, second in the number of visits to a hospital, and third in the number of operations in the hospitals.

The cost of care of musculo-skeletal conditions exceeds 20 billion dollars a year. The vast majority of these individuals have residual impairments that would benefit from better application of technology. An example that immediately comes to mind is the need for a still better total hip prosthesis. We particularly need a better total knee prosthesis despite the fact that thousands are being installed, generally with phenomenal success.

When we include those with visual, hearing, or speech impairments, and particularly those with various forms of paralysis or other neuromusculoskeletal permanent disabilities, the numbers are far greater. It is most fortunate and timely that society is recognizing its responsibility in this area.

Although the military services initiated amputation centers, they quickly turned to the Veterans Administration to direct the program of total care for amputees. The VA Prosthetics and Sensory Aids Program has provided, since 1945, a comprehensive effort to supply high-quality devices and services. New laws as well as increasing survival and new technological opportunities have contributed to broadening coverage and greater emphasis in some areas, such as automotive adaptive equipment, vans, and environmental controls. The clinic team approach, developed in following suction-socket amputees, was quickly applied to many other disabilities. Prosthetics Treatment Centers were established. The program is now coming full circle, in a sense, with renewed interest in concentrating on elective amputations (especially for vascular disease) in special centers.

The more widespread application, which we now think of as rehabilitative engineering, was largely initiated in Social Rehabilitation Service and later Rehabilitation Services Administration, Health, Education and Welfare. Rehabilitation engineering centers were chosen in which the professional scientific engineer who now addressed himself to the problems of the disabled was brought into the clinical environment. In contrast to the typical 3-year grants for specific projects, the centers were assured of the relatively long-term support needed for major development by a relatively stable inter-disciplinary professional staff aided by short-term graduate students. Each center concentrated on a different core area.

The Veterans Administration chose a similar path. Two centers have been named – Rehabilitative Engineering Research and Development Center, Hines, Illinois, and Rehabilitative Engineering Research and Development Center, Palo Alto, California. Each will develop relationships with other institutions. It is the author's conviction that numerous other centers will evolve in the not-too-distant future. Indeed, the Veterans Administration has listed this goal as a top priority for the next 5 years. Similarly, Congress has urged that other federal agencies such as National Institutes of Health, National Science Foundation (as well as, of course, RSA, HEW) increase their efforts in this area of technological aid to the disabled. President Carter has designated this as an area of high priority.

In the Veterans Administration there will be a clearer distinction between (i) research, development, and early evaluation and (ii) the technical analysis of the earlier applications to actual patients in order to define more sharply the indications and contraindications of use of each aid, as well as to point up further improvements.

As far as the conduct of research is concerned, there will be very strong emphasis on high-level peer review. Programs will be repeatedly evaluated for their scientific merit and progress. This process has been well developed in the Medical Research Service of the Veterans Administration. Admittedly, the review process for the field of rehabilitative engineering is more complex because of the many disciplines involved in a single project.

Development per se has proved to be even more complex and difficult than the research itself. The next, and crucial, step of getting promising devices commercially produced, distributed, sold, and serviced (which of absolute necessity entails substantial risk as well as potential profit) is still more complicated. To foster this step in an ethical, sound, and appropriate manner will involve continuing major effort. The Veterans Administration has had a long and productive history of using its leverage as a "using agency" to foster pump-priming purchases of early models. In addition, the VA Clinic Teams, benefitting from special education in the use of new devices, have served not only to provide new services to veterans but also to indoctrinate the participating prosthetists from commercial facilities, who then can similarly improve service to their far more numerous nonveteran clients. In many cases the consultants serving as chiefs of the VA Clinic Teams also teach at local medical schools and direct clinic teams for handicapped children or vocational rehabilitation services, thus further spreading the use of new developments. Nevertheless, the total process needs substantial refinement and acceleration.

It will be the policy of this office to insist that manufacturers be brought into this process very early. Thus they can participate in the evolution of successful concepts through development and testing into production and widespread use. This earlier participation should lead to a much more rapid reduction to practical and economical design, and particularly to a higher rate of success.

With the rapid demise of the public hospital system as we have known it heretofore, the Veterans Administration will almost certainly play an ever-greater role in this process of transferring the fruits of research into clinical use. A major challenge for all of us is the need to develop better methods for evaluating devices—these methods must meet the unique problems presented by devices, and still approximate the objectivity and scientific validity of the randomized double-blind placebo studies successfully used in tests of new drugs and vaccines.

Specifications and standards will have to be written as part of the transition into widespread use of a new device, material, or technique. Here again it is likely that this process will be best accomplished in the VA medical care system with maximum use of the consensus standard system as exemplified by the American Society for Testing and Materials and the Association for the Advancement of Medical Instrumentation. This should lead to acceptance by the American National Standards Institute, and a proposal to the International Standards Organization for international use.

Since the beginning of the Bulletin of Prosthetics Research in 1964, it has reflected the evolution of what we now think of as rehabilitative engineering. From its inception in prosthetics, the BPR included the engineering, medical, surgical, social and psychological care of the amputee. The scope of the Bulletin quickly encompassed orthotics, visual and hearing aids, means of mobility such as wheelchairs, automotive adaptive equipment, etc. The field of the Bulletin's concern has steadily enlarged, and it remains the only publication that has addressed itself to this broad area of professional activity. The field of involvement continues to expand rapidly.

It is possible that in the future some change of name for the Bulletin will evolve. After careful consideration, including presentation of this question of name change to the Committee on Prosthetics and Orthotics, American Academy of Orthopedic Surgeons, at a meeting in Seattle, in March 1978, it was unanimously agreed to retain the name Bulletin of Prosthetics Research, at least for the present.

There has also been discussion of whether a federal agency such as the Veterans Administration should publish a professional journal. There are a few distinguished precedents; for example, the Journal of Research of the National Bureau of Standards. After lengthy discussion it became quite obvious that there is presently no single journal for the entire field, and that no professional body covering this field at this time could in any way launch an appropriate professional journal of quality.

There are numerous professional journals that publish some papers which cover particular aspects of this field. There are those journals which are pertinent to orthopedic surgeons, and some portions of the Journal of Bone and Joint Surgery, or Clinical Orthopedics and Related Research, would cover very selective areas which might also be equally appropriate to the Bulletin of Prosthetics Research. Similarly, for the prosthetists and orthotists, Orthotics and Prosthetics (the official journal of AOPA) or Prosthetics and Orthotics International (the Journal of the International Society for Prosthetics and Orthotics) would cover clinically useful applications, whereas BPR would tend to emphasize the earlier research and development aspects. For those in rehabilitation medicine, the Archives of Physical Medicine and Rehabilitation, and the American Journal of Physical Medicine; for physical therapy, the Journal of Physical Therapy; for occupational therapy, the Journal of Occupational Therapy; for vision, the Journal of Blindness and Visual Impairment; and for loss of hearing, ASHA, the Journal of the American Speech and Hearing Association–all of these might cover selected areas as a relatively minor part of their total content.

Likewise, in engineering and in particular in the bioengineering aspects, there are the Annals of Biomedical Engineering, the IEEE Transactions of Biomedical Engineering, the ASME Journal of Biomechanical Engineering, the Journal of Biomechanics, and ASTM Standardization News. Any of these might well cover – but not concentrate upon – some aspect appropriate to rehabilitative engineering. Selected papers might appear in any of several journals if near the borderlines of their common interests, but concentration and focus is preferable to scattering. Thus it is possible that, as the field of rehabilitative engineering continues to evolve – with continued enthusiastic efforts by many workers – a new and more comprehesive name for the BPR may eventually appeal to all.

Some suitable comprehensive interdisciplinary society may emerge. Presently the Biomedical Engineering Society, and the United States Committee of the International Society for Prosthetics and Orthotics, are related but not fully adequate. Obviously the launching of a new society is itself a major enterprise which leads to

a long period of growth. Possibly such a society will become strong enough to assume responsibility for publication of an appropriate journal in the tradition of our western societies. In the meantime and probably for some years, the VA plans to continue to serve the seriously disabled needing modern technology through the Rehabilitative Engineering Research and Development Service and to publish the results through the Bulletin of Prosthetics Research. Its efforts are aimed at helping all disabled as well as at advancing this entire field.