FIFTH EDITION

REHABILITATION RESEARCH

Principles and Applications

Russell E. Carter
Jay Lubinsky

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Mathematical and Statistical Symbols

DESCRIPTIVE STATISTICS	
Σ (capital sigma)	The sum of what follows
N	Number of observations or number of participants
μ (mu)	The population mean
$\bar{X}$	Sample mean
x	The deviation score
σ^2 (sigma squared)	The population variance
s^2	The sample variance
σ (sigma)	The population standard deviation
s	The sample standard deviation
INFERENTIAL STATISTICS	
H_0	The null hypothesis of no difference between levels of the independent variable on the dependent variable of interest.
H_1	The alternate hypothesis of a difference between levels of the independent variable of the dependent variable of interest.
p	The probability of the given test statistic if the null hypothesis is true; a statistical difference is identified if the probability is less than the α set by the researcher.
α (alpha)	The probability of making a Type I error; set by the researcher.
β (beta)	The probability of making a Type II error; inversely related to α.
t	Test statistic for use with mean differences between two groups.
F	Test statistic for use with mean differences between two or more groups.
χ^2 (chi squared)	Test statistic for use with nominal data.
CORRELATIONAL STATISTICS	
r	Pearson product moment correlation.
r^2	Coefficient of determination.
R	Multiple regression correlation coefficient.
R^2	Proportion of variability accounted for by a multiple regression correlation coefficient.
ρ (rho)	Spearman's rho. Correlation coefficient used with ranked variables.
τ (tau)	Kendall's tau. Correlation coefficient used with ranked variables.
ϕ (phi)	Correlation coefficient used with nominal data.
κ (kappa)	Reliability coefficient used with nominal data.

REHABILITATION RESEARCH

Principles and Applications

As in any work of this magnitude, authors need the support and patience of those whose time was intruded upon. In this case, our wives, Diane Carter and Arlene Lubinsky, provided both qualities and in generous quantity. We dedicate this book to them.

R. C.

J. L.

Preface

In this fifth edition of **Rehabilitation Research**, the intents and purposes of earlier editions, particularly the fourth edition, continue. We have especially kept and, we hope, enhanced, our emphases on providing a text to clearly address the needs of students in addition to those of practicing clinicians. Therefore, we have maintained and, where possible, increased the emphasis on the scientist-practitioner model and significantly enhanced information on single-subject research, feeling that rehabilitation clinicians will often rely on those designs in their everyday practice. We have maintained and, when possible, updated relevant information on evidence-based practice and have consistently encouraged readers to utilize its principles and methods. This book acknowledges that all rehabilitation professionals have several common needs as consumers and producers of research. The same holds true for students in the rehabilitation professions. Specifically, all need to understand the bases of research, methodologies, and uses. Perhaps most important, they need to understand not only how to apply the research findings of others in daily practice but also how to employ the rigorous methods of science to their daily practice. This is *sine qua non* of the scientist-practitioner. For these reasons, we have attempted to make this book *useful* to students and practicing professionals as well as to those whose primary function is research.

Rehabilitation professionals share a belief that the exercise of our professional expertise, in partnership with the patients or clients with whom we work, makes a difference in their lives. This deeply held belief is a positive force when it leads to the high levels of professionalism and commitment that are demonstrated daily by rehabilitation professionals around the globe. This belief, however, can also serve as a negative force when it leads practitioners to the uncritical acceptance of all of rehabilitation practice.

The purpose of research is not to give validity to what we do as rehabilitation professionals; it should determine purposes. This is an important distinction. The former leads to a search for weak evidence that supports our current practices; the latter leads to strong evidence that can help us improve our future practices.

Evidence-based practice in rehabilitation can be realized only by a joint effort of the producers and consumers of research. This is a textbook that will serve many needs of research consumers and can serve foundational needs of research producers. It does so by using straightforward language and relevant examples to capture the diversity and complexity of research that is of interest to rehabilitation professionals. Readers will note a great deal of updated literature relevant to the topics at hand. We have included updated studies for two reasons. First, having recent literature signifies the ongoing relevance of the type of research being discussed. Second, updated literature provides the reader with examples of the complexities and variations of research designs that might not otherwise be discussed in the text. At the same time that we have updated a great deal of examples from published literature, we have maintained some older references—even to "classic" studies—when we felt those studies best exemplified or clarified the discussion in the text.

The text is divided into nine sections. Although divided into sections, we have taken the view that information in all sections forms a unified whole for the location, understanding, consumption, production, and dissemination of research as relevant to clinical practice.

From the very first edition, this text has provided a solid grounding in traditional research design and analysis as well as an introduction to emerging research topics such as qualitative and single-system (now called single-subject) designs. Subsequent editions introduced even more emergent research paradigms, such as outcomes research and epidemiology (among others). More recently, and continuing into the present edition, the text has increasingly incorporated research from a broader array of rehabilitation professions in order to demonstrate the commonalities of their research methodologies. We think this is critical as we see increased incorporation of team and co-treatment approaches to rehabilitation.

In this fifth edition, we have endeavoured to impart enthusiasm for a few ways of thinking about rehabilitation research and a textbook on that topic. Those ways of thinking include usefulness, incorporation of a scientist-practitioner model, and use of evidence-based practice. We sincerely hope that readers find these appealing and helpful.

Russell E. Carter, PT, EdD
Jay Lubinsky, PhD, CCC-A/SLP, ASHA Fellow

Acknowledgment

Elizabeth Domholdt was the sole author of the first three editions of **Rehabilitation Research** and author emerita of the fourth edition. We wish to express our gratitude to her as this edition could not have been completed without her pioneering authorship. Her vision in previous editions, her knowledge coupled with outstanding writing and organization, and her commitment to bringing research principles and applications into the clinical milieu were invaluable stepping stones as we fashioned the new edition. We sincerely hope that we have enhanced her vision and labors.

Russell E. Carter, PT, EdD
Jay Lubinsky, PhD, CCC-A/SLP, ASHA Fellow

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SECTION ONE RESEARCH FUNDAMENTALS

CHAPTER 1

Rehabilitation Research

CHAPTER OUTLINE

Rehabilitation professionals believe that the work we do makes a difference in the lives of the people we serve. Rehabilitation research is the means by which we test that belief. In the rapidly changing and increasingly accountable world of health care, it is no longer enough to say that we do good work or to note that patients or clients feel better after we've intervened. Rather, we must be willing to search for, or even create, evidence about the value of our practices and then modify those practices in response to the evidence. Rehabilitation professionals who embrace evidence-based practice also embrace the challenge of learning about rehabilitation research.

Learning about rehabilitation research involves developing a diverse set of knowledge and skills in research methodologies, research design, statistical and qualitative analysis, presentation, and writing. At the same time a practitioner or student is acquiring these new skills, he or she is forced to reexamine the status quo, the conventional wisdom of the rehabilitation professions. This combination of trying to learn new material while challenging previously held beliefs can engender frustration with the new material and doubt about previous learning. Some clinicians, unable to cope with such uncertainty, retreat to anecdotes and intuition as the basis for their work in rehabilitation. Others delight in the intellectual stimulation of research and commit themselves to developing an evidence-based practice. Such clinicians balance the use of existing but unsubstantiated practices with critical evaluation of those same practices through regular review of the professional literature and thoughtful discussion with colleagues. Furthermore, these professionals may participate in clinical research to test the assumptions under which they practice.

This introductory chapter defines research, examines reasons for and barriers to implementing rehabilitation research, and considers the current status of rehabilitation research. Based on this foundation, the rest of the book presents the principles needed to understand research and suggests guidelines for the application of those principles to rehabilitation research.

DEFINITIONS OF RESEARCH

Research has been defined by almost every person who has written about it. Kettering, an engineer and philanthropist, had this to say:

> "Research" is a high-hat word that scares a lot of people. It needn't; ... it is nothing but a state of mind—a friendly, welcoming attitude toward change.... It is the problem-solving mind as contrasted with the let-well-enough-alone mind. It is the composer mind instead of the fiddler mind. It is the "tomorrow" mind instead of the "yesterday" mind.[1(p. 91)]

We think his words, published in 1961, still ring true.

Payton, a physical therapist who has written widely about research, indicates that "research should begin with an intellectual itch that needs scratching."[2(p. 8)] Kazdin, a psychologist, speaks about various research methods, noting that "they have in common careful observation and systematic evaluation of the subject matter."[3(p. 2)] Portney and Watkins,[4] Polit and Beck,[5] Stein and colleagues,[6] and Nelson,[7] who have written texts on clinical, nursing, occupational therapy, and communication disorders research, respectively, all emphasize the organized, systematic nature of research. Three important characteristics about research emerge from these different authors: (1) research challenges the status quo, (2) it is creative, and (3) it is systematic.

Research Challenges the Status Quo

Definers of research all indicate it as a way of answering questions. Thus, the first characteristic is that research challenges the status quo. Sometimes the results of research may support current clinical practices; other times the results point to treatment techniques that are not effective. But whether research does or does not lead to a revision of currently accepted principles, the guiding philosophy of research is one of challenge. Does this treatment work? Is it more effective than another treatment? Would this person recover as quickly without intervention? The status quo can be challenged in several ways, as illustrated in the three examples that follow.

One way of challenging the status quo is to identify gaps in our knowledge—for example, to identify common practices about which we know very little. Because much of our practice as clinicians is based on the collective wisdom of past professionals, we forget that much of this practice has not been verified in a systematic way. However, we are increasingly in the process of validating our clinical practices. Many clinicians, professional associations, and scientists are engaged in outcomes research (see Chapter 16). Emphasis and literature on evidence-based practice (see Chapter 3) continue to grow. The increasing number of meta-analyses and critical reviews validates some of our clinical practices and challenges others (see Chapter 4). These recent developments suggest a powerful research agenda for rehabilitation providers.

Despite recent efforts, we continue many rehabilitation practices about which few, if any, data exist. A second approach to challenging the status quo, therefore, is to systematically test the effects of these practices.

A third way of challenging the status quo is to test novel or traditionally avoided treatments. Some examples of such treatments are (1) use of human magnetic fields to manage pain[8] and (2) application of sensory integration training to a very wide variety of clinical conditions.[9–11]

These examples of challenges to the status quo identified gaps in knowledge about rehabilitation practice, may provide support for one set of clinical practices, and suggest a need for review of another set of clinical beliefs. Research is about embracing these kinds of challenges. It is about the willingness to test our assumptions, to use what works, and to change our practices in light of new evidence.

Research Is Creative

The second characteristic of research is that it is creative. Rothstein, in an editorial, chastised physical therapists for their willingness to accept authoritarian views of their profession: "Our teachers and our texts tell us how it should be, and we accept this in our eagerness to proceed with patient care."[12(p. 895)] Researchers are creative individuals who move past the authoritarian teachings of others and look at rehabilitation in a different way. And, in at least a partial answer to Rothstein, we note the increasing emphasis on evidence-based practice and the emergence of the scientist-practitioner. Virtually every piece of research is the product of a creative question.[13] In any science, "the dualism between science and creativity is unfounded."[14] "Why?" and "Why not?" are core questions, as is, "What if ...?"

Creative aspects of rehabilitation research are emphasized in Chapter 2, which presents information about the use of theory in practice and research, and Chapter 4, which provides a framework for the development of research problems.

Research Is Systematic

The third characteristic of research is that it is systematic. In contrast, much of our clinical knowledge is

anecdotal, or is passed on by prominent practitioners who teach a particular treatment to eager colleagues or students. As Hicks noted,... "after all, many of the therapeutic techniques currently in practice have been developed over the years and consequently are tried and tested."[15(p. 3)] Anecdotal claims for the effectiveness of treatments are colored by the relationship between the clinician and patient and typically do not control for factors, other than the treatment, that may account for changes in the condition of the patient or client. The systematic nature of some research methodologies attempts to isolate treatment effects from other influences not ordinarily controlled in the clinic setting. Other methodologies focus on systematic description of the phenomenon of interest, rather than control of the research setting. Much of this text presents the systematic principles that underlie research methods: Sections 2 through 5 (Chapters 6 through 17) cover research design, Section 6 (Chapters 18 and 19) discusses measurement tools, and Section 7 (Chapters 20 through 24) introduces data analysis.

REASONS FOR DEVELOPING REHABILITATION RESEARCH

There are at least three reasons for conducting rehabilitation research: (1) to develop a body of knowledge for the rehabilitation professions, (2) to determine whether interventions work, and (3) to improve patient and client care. Each of these reasons is examined in the sections that follow.

Develop Body of Knowledge

The "body of knowledge" rationale for rehabilitation research is related to the concept of a profession. The characteristics of a profession have been described by many authors but include several common elements. Houle[16] divided the characteristics of a profession into three broad groups: conceptual, performance, and collective identity characteristics (Box 1-1). One of the critical performance characteristics is mastery of the theoretical knowledge that forms the basis for the profession.

The theoretical foundations of the rehabilitation professions, discussed further in Chapter 2, include concepts such as occupation, disablement, and movement science.

Although the knowledge base for our professions has grown and continues to grow, rehabilitation professionals and students still work to develop ways of identifying important theoretical constructs as well as ways of understanding them. Kinsella and Whiteford[17] offer, as an example, a way of structuring the concept of "evidence-based practice," a concept that has achieved widespread recognition. Kenyon and Blackinton applied aspects of motor-control theory to a clinical case, further integrating theory and the development of the knowledge base for physical therapy.[18] The search for definition and understanding of what may seem like basic concepts is far from complete.

Box 1-1

Characteristics of a Profession

Conceptual Characteristic
Establishment of a central mission

Performance Characteristics
Mastery of theoretical knowledge
Capacity to solve problems
Use of practical knowledge
Self-enhancement

Collective Identity Characteristics
Formal training
Credentialing
Creation of a subculture
Legal reinforcement
Public acceptance
Ethical practice
Penalties
Relations to other vocations
Relations to users of service

List developed from Houle CO. *Continuing Learning in the Professions*. San Francisco, Calif: Jossey-Bass; 1981.

Determine Whether Interventions Work

The second major rationale we offer for performing rehabilitation research relates to determining whether interventions work.

The need for research on the effectiveness of rehabilitation interventions was highlighted by Brummel-Smith[19] when he summarized the research recommendations of a National Institutes of Health Task Force on Medical Rehabilitation Research and applied them to rehabilitation of older adults. He noted four major areas in need of study: the natural history of disability, functional assessment and performance evaluation, intervention issues, and rehabilitation service delivery. In discussing intervention issues, he identified a need both to "evaluate effectiveness of existing interventions and to develop novel approaches to care,"[19(p. 895)] noting that "current interventions have not received the type

of careful scrutiny that is now expected of medical interventions."[19(p. 895)] More recently, the sentiment is summarized by Hicks, who notes, "healthcare professionals have an imperative to ensure that their clinical decisions can be justified on empirical grounds ..." and further laments, "good quality research studies that address fundamental issues in care provision have not been as plentiful as is either desirable or necessary."[15(p. vii)]

Improve Patient and Client Care

The third reason for rehabilitation research is perhaps the most important one: improving patient and client care. This, of course, is not completely separate from the reason of finding out whether our treatments work. However, once we find out what works and what does not, and under what circumstances, research can improve care by helping clinicians make good decisions about the use of existing practices or by providing systematic evaluation of the effectiveness of new practices.

When we know what has or has not been supported by research, we can make intelligent, evidence-based decisions about which clinical procedures to use with our clients. Clinical research about these procedures could provide additional evidence that would help practitioners make informed decisions about recommending the procedures.

Although there are many areas of rehabilitation practice for which evidence is thin, there are other areas in which clinicians who are committed to evidence-based practice can find a rich body of evidence on which to base their work. Chapter 4 gives a hint about the large and growing amount of literature available (and how to find it) to rehabilitation scientist-practitioners. The increase in meta-analyses and critical reviews (see Chapters 4 and 26) points to not only how much is available but also how useful it is. A search for meta-analyses and critical reviews in the period 2009 through 2012 for all journals related to physical therapy or occupational therapy indexed in the CINAHL search engine (see Chapter 4) yielded more than 16,000 results. Results of the same search for speech-language pathology in the same period yielded more than 11,000 results.

In addition to helping clinicians make judgments about the use of existing treatments, research can be used to test new procedures so that clinicians can make evidence-based decisions about whether to add them to their clinical repertoire. For example, body-weight–supported treadmill ambulation, although established, continues to undergo modifications in need of such testing. In theory, body-weight–supported treadmill ambulation should enable patients to improve their ambulation function by training in a way that ensures safety, does not require handheld assistive devices, uses relatively normal gait patterns, and has reduced energy demands when compared with unsupported walking. A recent innovation included the use of robots to assist with body-weight support.[20] Clinicians with a good knowledge base in research will be able to critically evaluate this article to determine whether they can apply the results to the clinical situations in which they work. Chapters 25 and 26 present guidelines for evaluating research literature.

BARRIERS TO REHABILITATION RESEARCH

In 1975, Hislop, a physical therapist, articulated one major philosophical barrier to research in the profession:

> A great difficulty in developing the clinical science of physical therapy is that we treat individual persons, each of whom is made up of situations which are unique and, therefore, appear incompatible with the generalizations demanded by science.[21(p. 1076)]

Although this conceptual barrier may still loom large for some practitioners, many more concrete obstacles to rehabilitation research have been documented.[22–24] These obstacles include lack of familiarity with research methodology, lack of statistical support, lack of funding, lack of a mentor, and lack of time. An additional obstacle is concern for ethical use of humans or animals in research activities. Although the cited authors' comments go back several years, we think they are still valid; given the economy and demand for productivity at the writing of this book, they may be even more problematic than previously thought. However, this book should help to overcome several of the obstacles, particularly those pertaining to research methodology.

Lack of Funds

The scope of this text will not directly help in overcoming lack of funding, although information in Chapter 27 will help you gain access to funds that are available. Funding, especially from public sources, is largely a political process; we urge readers to take part in that arena to advocate for research budgets.

Lack of Research Mentors

Another example is lack of research mentors. Contemporary research is often done in teams. Ideally, novice researchers would be invited by experienced researchers to become members of working research teams with ongoing projects, external funding, and

access to a network of colleagues engaged in similar work. The importance of research mentors—and the difficulty in finding them in the rehabilitation professions—has been discussed for several rehabilitation professions.[25–27] The picture is possibly made bleaker by the documented shortage of research-prepared doctoral faculty in academic programs,[28–30] and, at least at this writing, it is difficult to predict how the advent of required entry-level professional (i.e., clinical) doctorates will affect the situation. There may be at least one bright light in the situation, however. Although the traditional model of mentoring is that the mentor and protégé are in the same institution, professional associations have recently developed research-mentoring programs in which the mentor and protégé are not necessarily in the same institution, giving more flexibility to establishing possible mentor-protégé relationships.[31–33]

Lack of Time

A third barrier difficult to overcome is lack of time. Testa[34] outlined six major factors that influence the completion of research. Two of the six factors referred to "time" directly, and two more (complexity and funding) are indirectly related to the time that a researcher has available to devote to the task. Hegde noted, "Clinicians do not have the needed extra time for research."[35(p. 10)]

Indeed, it is difficult to separate the "time" issue from the "funding" issue because a lack of external funding generally limits the time available for research. In the absence of external funding, tasks with firm deadlines are given higher priority than research, and the immediate time pressures of the clinic and classroom may lead clinicians and academicians alike to postpone or abandon research ideas. One solution is to design studies that are relatively easy to integrate into the daily routine of a practice. Chapters 11, 13, and 16 present a variety of research designs particularly suitable for implementation in a clinical setting.

Despite these difficulties, there are barriers to research that can be overcome, which are addressed in this text. They include lack of familiarity with the research process, lack of statistical support, ethical concerns, and the clinician-researcher dichotomy.

Lack of Familiarity with the Research Process

Clinicians sometimes view rehabilitation research as a mysterious process that occupies the time of an elite group of professionals, far removed from patient or client care, who develop projects of little relevance to everyday practice. Although this characterization is a caricature, and evidence exists of ways to implement a research culture in a clinical environment,[36] even the most clinically grounded research uses the specialized language of research design and data analysis, and those who have not acquired the vocabulary are understandably intimidated when it is spoken. One goal of this text is to demystify the research process by clearly articulating the knowledge base needed to understand it.

Lack of Statistical Support

Another barrier we think can be overcome is lack of statistical support. Section 7 (Chapters 20 through 24) of this book provides the conceptual background needed to understand most of the statistics reported in the rehabilitation research literature.[37,38] A conceptual background does not, however, provide an adequate theoretical and mathematical basis for selection and computation of a given statistic on a particular occasion, particularly for complex research designs. Thus, many researchers will require the services of a statistician at some point in the research process. Guidelines for working with statisticians are provided in Chapter 27.

Ethical Concerns About Use of Human Participants and Animal Subjects

Often, rehabilitation research is halted by ethical concerns related to the use of either human participants or animal subjects. Those who choose to study animal models should follow appropriate guidelines for the use, care, and humane destruction of animal subjects. Clinicians who use human participants in their research must pay close attention to balancing the risks of the research with potential benefits from the results. Chapter 5 examines ethical considerations in detail; Chapter 27 provides guidelines for working with the committees that oversee researchers to ensure that they protect the rights of research participants.

The Clinician-Researcher Dichotomy

Yet another barrier to research implementation is the apparent and widely held belief that clinicians and researchers have little in common. We refer to this as the "clinician-researcher" dichotomy. The history of this situation is a long one, especially in clinical psychology, and accounts of its development are offered by Hayes and associates[39] and Merlo and colleagues.[40] Hayes and associates offer two primary reasons for the dichotomy: "(a) the almost universally acknowledged inadequacies of traditional research methodology to

address issues important to practice and (b) the lack of a clear link between empiricism and professional success in the practice context."[39(p. 15)] By "traditional research methodologies," the authors are referring to large-scale group-data experiments, especially clinical trials. Hegde also offers the doubt "regarding the extent to which research affects day-to-day practice."[35(p. 10)] Fago confirms a "widening division between psychology's clinical investigators and clinical practitioners."[41(p. 15)] Bishop notes the "general consensus ... that the translation of sport-science research to practice is poor."[42(p. 253)] Clearly, if clinicians do not think that they have much in common with researchers (including time available, research training, etc.) and that the research that is completed has little applicability to their practice, the production and even consumption of research is going to be significantly curtailed.

Overcoming Barriers

Overcoming these barriers depends on leaders who are willing to commit time and money to research efforts, individuals who are willing to devote time and effort to improving their research knowledge and skills, and improved systems for training researchers and funding research. Cusick's qualitative study of clinician-researchers underscores the importance of making an individual commitment to becoming a researcher, accepting responsibility for driving the research process, and learning to negotiate the administrative and social systems that make clinical research possible.[43] Research is, however, rarely an individual effort. Therefore, one key to overcoming barriers to research is to develop productive research teams composed of individuals who, together, have all the diverse skills needed to plan, implement, analyze, and report research. The different rehabilitation professions are working to develop such teams in different ways: the Foundation for Physical Therapy in 2002 funded its first Clinical Research Network, designed to increase research capacity in physical therapy through collaborative arrangements between academic and clinical sites[44]; and building research capacity in the allied health professions has been of interest to policy-making bodies in the United States[45] and the United Kingdom.[46]

The Scientist-Practitioner

We wish to make special note of the possible solution to the barrier of the clinician-researcher dichotomy. That is the development of the scientist-practitioner model of education first developed in clinical psychology and later applied to other rehabilitative professions. Thorough histories of the effort are offered by Hayes and associates[39] and Merlo and colleagues.[40] Essentially, the model seeks to provide education so that clinicians have good research training and researchers have good clinical training at least to the extent of good understanding of both roles.

The history of attempts at developing scientist-practitioners is far from over, but we see hopeful trends. In an abridged meta-analysis of 10 articles, Chang and colleagues[47] concluded that current education of scientist-practitioners is based on a flawed version of the model and needs to be more flexible and versatile. That is, with changed attitudes, attainment of the scientist-practitioner is a reasonable goal. Proposing an educational model based on dialectics, Fago[41] offers several suggestions for overcoming the clinician-researcher dichotomy and fostering development of the scientist-practitioner. In a survey of students from 163 Council of University Directors of Clinical Psychology (CUDCP) programs, the returns from 611 students, representing 55 programs, showed that students overwhelmingly "indicated that science training was very important to them. Overall, students reported experiencing a fairly balanced emphasis on science and clinical work, and endorsed receiving a good amount of high-quality training in science."[40(p. 58)] Pettigrew[48] and Brobeck and Lubinsky[49] offer examples of how students in training are actually immersed in the scientist-practitioner model during the clinical rotations of their graduate programs in occupational therapy and/or speech-language pathology.

Although the past certainly has supported the notion of a clinician-researcher dichotomy, we are encouraged by the growth of and attention to "evidence-based practice" in academic programs and in the rehabilitation professions. Examination of academic curricula by one of the authors, an accreditation site visitor in communication sciences and disorders, reveals universal attention to ways in which students can incorporate an evidence base into their clinical practice. The Web site of the American Speech-Language-Hearing Association devotes considerable space to the subject,[50] as do the Web sites of the American Physical Therapy Association[51] and American Occupational Therapy Association.[52] Only time will tell if, and to what extent, the emphasis on evidence-based practice has influenced the everyday lives of rehabilitation clinicians.

We do not expect that all clinicians will be prolific (or even occasional) researchers, but we do ascribe in this text to the notion that the clinician who is a scientist-practitioner will be able to fulfill at least two of the three roles suggested by Hayes and associates[39]: (1) a knowledgeable consumer of new research, using

scientifically based clinical procedures; (2) an evaluator of his or her own clinical practices; and (3) a producer of new data.

STATUS OF REHABILITATION RESEARCH

The rehabilitation professions are relative newcomers to the health care arena, as the "conflagrations of World War I and II provided the impetus for the development and growth of the field of rehabilitation."[53(p. 1)] Mindful of the way in which new professions grow, in 1952 Du Vall, an occupational therapist, wrote about the development of the health care professions into research:

> A study of the growth and development of any well established profession will show that, as it emerged from the swaddling clothes of infancy and approached maturity, research appeared.[54(p. 97)]

Research has indeed appeared across the rehabilitation professions. A great deal can be learned about the current status of rehabilitation research by examining the role of research in the professional associations of the various rehabilitation disciplines, by reviewing the development of research publication vehicles, by examining the educational standards for the different rehabilitation professions, and by reviewing research funding opportunities for rehabilitation and related research.

Professional Association Goals

All of the major professional associations that promote the rehabilitation professions take a leading role in advancing rehabilitation research. The American Occupational Therapy Association works "through standard-setting, advocacy, education, and research on behalf of its members and the public."[55] As part of its mission statement, the International Society for Prosthetics and Orthotics includes, "Promoting research and evidence based practice."[56] The American Physical Therapy Association developed a clinical research agenda in 2000 designed to "support, explain, and enhance physical therapy clinical practice by facilitating research that is useful primarily to clinicians."[57(p. 499)] That association has recently revised and broadened the agenda to include all research, eliminating the limiting word "clinical."[58] Common Program Requirements of the Accreditation Council for Graduate Medical Education require that "the curriculum must advance residents' knowledge of the basic principles of research, including how research is conducted, evaluated, explained to patients, and applied to patient care" and also that "residents should participate in scholarly activity."[59] Their recently introduced "core requirements" include the ability to "appraise and assimilate scientific evidence."[60] Furthermore, these associations do not simply make empty statements about their roles in research—they follow through with actions to promote research in their respective professions. For example, the American Speech-Language-Hearing Association's commitment to research is shown by its development of a national outcomes measurement system.[61]

Research Publication Vehicles

Dissemination of rehabilitation research findings in peer-reviewed journals is an important indicator of the status of rehabilitation research. Over the past several decades, the number of journals with a primary mission to publish research related to rehabilitation has increased dramatically, as a journey through any relevant database (see Chapter 4) will attest. As of February 2015, searching the CINAHL database (see Chapter 4) for journal titles added just since 2000 reveals that 40 new titles have been added relevant to physical therapy, 16 for occupational therapy and 32 for speech-language pathology and audiology. The increased importance of rehabilitation research across time is apparent both in the ability of the professions to sustain these new journals and in the emergence of new types of publications: specialty journals (e.g., *Journal of Pediatric Physical Therapy*), interdisciplinary journals (e.g., *Journal of Occupational Rehabilitation*), and international journals (e.g., *International Journal of Language and Communication Disorders*).

Educational Standards

As research becomes more important to a profession, the standards against which education programs that prepare new practitioners are evaluated can be expected to reflect this emphasis. A review of educational program requirements for the various rehabilitation professions shows that this is indeed the case, with requirements for research content, research activities, or both. The American Speech-Language-Hearing Association,[62] in its standards for educational program accreditation, requires that "the scientific and research foundations of the profession are evident in the curriculum" to prepare speech-language pathologists and audiologists. The Commission on Accreditation in Physical Therapy Education notes that "physical therapy upholds and draws on a tradition of scientific inquiry while contributing to the profession's body of knowledge," requires a "scholarly agenda," and