

THE DEVELOPMENT AND VALIDATION OF THE SEATING AND MOBILITY SCRIPT
CONCORDANCE TEST (SMSCT)

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Although participation in continuing education activities is the most widely accepted method of upgrading professional training in the area of seating and mobility, the impact of these educational experiences has yet to be documented. Specifically, reliable and valid measures of the outcomes of educational experiences or clinical practice on the ability to make specialized clinical decisions are needed. This dissertation is comprised of a series of three, inter-related studies, which, develop and validate the Seating and Mobility Script Concordance Test (SMSCT); a performance-based measure intended for use with professionals that recommend seating and mobility devices to individuals with spinal cord injuries. The SMSCT is designed to assess clinicians by examining the organization of their knowledge, associations between items of their knowledge, and adequacy of their clinical decisions compared to expert consensus. The first study presents the conceptual foundation, item generation process, and content validity evidence leading to the final version of the SMSCT. Results indicate that the 67-item SMSCT adequately represents the dimensions of assessment and intervention knowledge for seating and mobility for spinal cord injury. In the second study, 15 spinal cord injury experts assisted with the development of the scoring system, and 100 physical and occupational therapists were used for obtaining internal and external validity evidence. Appraisal of the technical quality of the test showed reasonable item performance, with some items performing better than others. Other evidence showed the SMSCT distinguished between intervention subscores for two groups of

known differences. Proxy measures of clinical expertise on the whole did not prove to be strong predictors of SMSCT scores for a population of clinicians with varying amounts of seating and mobility experience. The third study, comprised of 50 seating and mobility clinicians, further explored the validity of the SMSCT as a measure of educational effectiveness. No one proxy measure of clinical expertise accounted for a considerable change in posttest scores following an educational program. Changes in SMSCT scores were detected following an educational program. Initial psychometric testing maintains that the SMSCT is a promising measure of seating and mobility clinical expertise. Further SMSCT development, revision and validation are needed.

KEYWORDS: Professional practice, clinical competence, rehabilitation, seating and mobility, educational measurement, validity evidence

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PREFACE

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I. INTRODUCTION

In the United States, the prevalence of persons with mobility impairments has increased as mortality rates have declined (Field, 1999; Jones & Sanford, 1996). This trend results from advances in medical science and technology, increased survival rates at birth, increased life expectancy, and the aging of the U.S. population (Jones et al., 1996). Because of this, the demand for assistive technology (AT) devices and services will continue to increase; the availability of skilled service providers will not meet this demand unless training opportunities are developed to increase the supply of skilled AT practitioners (Fifield & Fifield, 1997). Unfortunately, experienced and/or specially educated physical therapists (PT's) and occupational therapists (OT's) trained to provide seating and wheeled mobility recommendation can be hard to find (Fifield et al., 1997; Herman & Lange, 1999).

Multiple factors influence the level of care received by persons with mobility impairments. A team consisting of the client, rehabilitation technology supplier, therapist and physician frequently are involved in recommending wheelchairs and seating systems. The therapist usually performs the physical, functional and environmental evaluation. The scope and depth of evaluation skills of the therapist can vary widely. Varying levels of competence result in varying quality of advice and equipment recommendation for consumers (Herman et al., 1999). Expert opinion indicates that targeted professional training will maximize the consumer/technology match (Fifield et al., 1997). Yet, the most effective method of professional training is still unknown.

Currently, in the United States, professional examinations are required to demonstrate entry-level competence for newly trained PT's and OT's. Basic and advanced guidelines for

seating and mobility (SM) skills and knowledge have been defined through the work of the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) (RESNA, 1997; RESNA, 1996). In 1996, RESNA instituted a voluntary credentialing program for Assistive Technology Practitioners (ATP's) and Assistive Technology Suppliers (ATS's). The program's purpose is to identify practitioners and suppliers who demonstrate a minimal level of competence in entry-level knowledge and skills across the areas of AT practice (RESNA, 2000; RESNA, 1996; Hammel & Angelo, 1996; Lenker, 1998). Eligibility requirements to qualify for this credential include a combination of education, work experience and successful completion of an exam. RESNA credentialing consequently only ensures a consistent minimal level of proficiency and expertise.

There is, nonetheless, inconsistency between performance expectations for licensed therapists (PT's and OT's) and therapists that practice AT, specifically, SM. Currently the entry-level PT or OT practitioner enters the field with minimal or no prior AT training. If the job demands it or if an individual demonstrates interest, he/she may pursue on-the-job training and participation in continuing education programs to gain further knowledge in this area.

Yet there is no method to evaluate the effectiveness of these educational programs in changing professional behaviors and influencing patient outcomes (Davis, Thomson, Oxman, & Haynes, 1992; Grossman, 1998). There is also no method to measure continued professional competency in the area of SM.

A review of the literature reveals a lack of research related to effective means of increasing the levels of competence and expertise of professionals working in the field of SM, or for that matter in any other area of medical practice (Davis et al., 1999). With ever changing and emerging technologies available in the area of SM, it is imperative that clinicians continually

update their knowledge, skills and clinical competencies in order to provide quality care. Still, at present, the most widely accepted means to participate in upgrading professional training is participation in continuing education activities. In fact, approximately, 26 states in the U.S. require proof of continuing professional education in the form of continuing education units (CEU's) for PT's (Federation of State Boards of Physical Therapy, 2002), 35 states require proof of professional development activities (PDA's) for occupational therapy (OT) professionals (Commission on Practice, 1998) and CEU's are required for RESNA, ATP and ATS recertification.

While the need to train more skilled practitioners is clear, the most effective means of training and the tools to assess the effectiveness of training programs have yet to be identified. Understanding the way experts practice, think, solve problems, and operate is necessary in order to define essential skills and clinical competencies. This is also necessary in promoting the continued preparation of practicing professionals and the development of the next generation of professionals (Jensen, Gwyer, Shepard, & Hack, 2000). To better prepare future AT professionals, we need to better understand the way experts in seating and wheeled mobility practice.

A. EXPERTISE

Several questions continue to challenge members of healthcare professions: What is the nature of the expert practitioner? How can we increase the supply of expert practitioners? The study of expertise has been an active area of investigation within cognitive psychology and cognitive science since the early 1960's (Chi & Glaser, 1988). Yet, while health professions such as medicine and nursing have commonly contained active areas of expertise research, only relatively recently have specific studies been done in ancillary health care services such as

physical and occupational therapy (Chi et al., 1988; Guest, Regehr, & Tiberius, 2001; Jensen, Gwyer, Hack, & Shepard, 1999; Jensen et al., 2000; Manley & Garbett, 2000).

Agreement exists that certain factors, identified across professions, distinguish experts from novices (Chi et al., 1988; Patel & Groen, 1991). For the most part identification of experts has been described as intrinsically problematic (Davis et al., 1999; Manley et al., 2000). Research involving expertise has employed a range of criteria to identify and/or select experts including: length of experience, educational qualifications, professional qualifications, personal qualities, professional activities and status (Manley et al., 2000; Ericsson & Smith, 1991). However, overall there seems to be little consistency between studies in terms of criteria employed to identify experts or expertise.

Historically, categorization of an individual as an expert has been relatively subjective. As stated by Timothy Salthouse, “the dimension along which expertise is most appropriately evaluated should represent some measure of actual competence, rather than a possible correlate of competence such as amount of experience or social consensus.” (Ericsson et al., 1991, p. 286).

Experience alone may not be sufficient to produce high levels of proficiency and may be dependent on other factors (i.e. knowledge, reflection, clinical reasoning, judgment and skill acquisition) (Jensen et al., 1999; Ericsson et al., 1991). Salthouse cautions that consensual judgments of expertise should also be avoided, because they can be influenced by a variety of characteristics other than true competence, such as popularity or reputation. Whenever possible more precise criteria are recommended in documenting the competencies of individuals suspected of differing expertise. Alternative indicators have been investigated establishing that an individuals’ amount of experience and peer rating correlate with differing levels of

competence and can be used as a less precise alternative indicator of expertise (Ericsson et al., 1991).

Another key characteristic of experts' performance – organization of knowledge-- has been uncovered in research and been found to be robust and generalizable across the various domains that have been studied. *Organization of knowledge* is viewed as a clinical determinant of expertise in medicine. Over the last 30 years there has been an active line of research and an accumulation of evidence in medicine about the process of how knowledge is: a) initially learned, b) organized in memory, c) accessed later to solve problems and d) changed with experience (Charlin, Roy, Brailovsky, & van der Vleuten, 2000; Schmidt, Norman, & Boshuizen, 1990).

Authors have hypothesized that in clinical medicine, differences between experts and novices lay primarily in experts' recall of meaningful relationships and patterns, that is, the structure of knowledge, versus the problem solving strategy applied to the problem (Charlin et al., 2000; Schmidt et al., 1990). The acquisition of expertise in an area can be characterized by the development of distinctive memory structures called *scripts*, which are meaningful sets of connections among abstract concepts and/or specific experiences (Tardif & Boshuizen, 2000; Charlin et al., 2000; Schmidt et al., 1990). Research in this area is attempting to portray how a script as a memory structure might be organized for specific diagnostic, investigative or treatment tasks. Information (such as the assumptions and hypotheses that are necessary to diagnose and manage cases) is retrieved through the activation of these scripts. "Thus, when teaching, new information must be embedded meaningfully in relevant, previously existing knowledge to ensure that it will be retrievable when necessary" (Regehr & Norman, 1996). It follows then that in testing clinical expertise it is necessary to access these scripts by using

specific, relevant clinical situations in the test items in order to assess the organization of knowledge.

B. THE SCRIPT CONCORDANCE TEST

The Script Concordance (SC) test is a relatively new assessment tool developed by Charlin, et al (Charlin et al., 2000). The SC test, founded in the theoretical framework of cognitive psychology, is intended to evaluate the reflective clinician. It is designed to probe memory organization, knowledge use, problem representation and how they change with experience (Tardif et al., 2000). The scoring system of the test is designed to measure the distance or the gap that exists between examinees scripts and the scripts of a panel of experts. “Scripts of experienced clinicians vary on details [based on each clinician’s professional clinical experience]... but they are similar of the essential elements. If it were not the case, clinicians would be unable to communicate efficiently and would not reach the same diagnoses in similar situations” (Charlin et al., 2000).

Preliminary studies by Charlin, (1998), Charlin, (2000), and Brailovsky, (2001), include development, administration and testing of SC tests in the different content areas of gynecology, radiology and surgery. In these studies, SC tests were developed and administered to different groups of participants in various phases of medical education (undergraduate, postgraduate or continuing medical education). Results showed significant differences between students, residents and faculty groups with scores increasing with clinical expertise of group participants (Beausoleil & van der Vleuten, 2001; Charlin et al., 1998; Charlin et al., 2000). These results are encouraging because most research concerning assessment of clinical competence showed an intermediate effect, where experienced clinicians scored little better or even worse than recently trained clinicians on competency tests. SC test scores in these studies (Beausoleil et al., 2001)

(Charlin et al., 1998) (Charlin et al., 2000) showed test scores increased with clinical experience, suggesting that the SC tests go further than merely assessing simple recall of factual data concomitantly exploring the capacity of a practitioner to interpret data while making clinical decisions, a skill that clearly belongs to clinical competence.

Initial work (Charlin, 2000) describes the test development process, such as practical information, needed to build a SC test: item writing, item format, development of a scoring system, and test validation (Charlin et al., 2000). According to Charlin et al (2000), item writing and item format is described as follows: (Chapter 2, Figure 1)

“Each test item consists of three parts. The first part includes a diagnostic hypothesis, and investigative action, or a treatment option that is relevant to the situation. The second presents new information (e.g. a sign, condition, ...[or finding]) that might have an effect on the diagnostic hypothesis, investigative action or treatment option. The third part is a 5-point Likert scale.... Each item is built so that a reflection is necessary to answer it, and each is independent of the others. To prevent examinees from considering data on several following questions as cumulative information about the patient, hypotheses or options change for each question.... The goal of each item is not to determine the additive effect of a series of clinical information elements but to determine the effect of an isolated item of clinical information on a hypothesis, action, or treatment option.... The number of tested hypotheses should not exceed five, although there should be at least two.... The exact number depends on the relevance of the hypotheses to the situation” (Charlin et al., 2000).

The scoring process is also an original aspect of the SC test (Desaulniers, Gagnon, Blouin, & van der Vleuten, 2002). The answer grid is developed based on the responses of

experts. Each answer of an expert clinician is a reflection of expertise even if this answer is not in agreement to answers of other expert clinicians. Complete agreement is not expected. A detailed explanation of the scoring system development follows in Chapter 3.

Internal structure evidence from each of Charlin's preliminary studies (Beausoleil et al., 2001; Charlin et al., 1998; Charlin et al., 2000) was assessed using generalizability studies. Generalizability (G) studies allow the researcher to consider all potential sources of unreliability or measurement error simultaneously (i.e., internal consistency, parallel forms, test/retest, etc.) (Brennan, 1983). The results of a G study are then used to design a Decision (D) study. D studies are used for actual decision making (i.e., to help determine the actual number of items, raters, and/or subjects needed) for a dependable reliable measure (Brennan, 1983).

Based on the D-studies from Charlin et al. (Charlin et al., 2000), the number of items that are necessary in each test administration to achieve an alpha of 0.8 is between 50 and 60 items. For a CEU pretest where the goal is to activate participants' prior knowledge and induce reflection on the appropriateness of that knowledge, the number of items needed should be minimal (20-30 items) (Charlin et al., 2000). In the case of a high stakes test that will be used for certification or promotion purposes reliability is a major issue, and the number of necessary items will be higher and will depend on the size of the probed domain.

A later study by Brailovsky in 2001, investigated the predictive validity of the SC test. In this study the SC test was administered to 24 medical students at the end of clerkship and compared SC scores and two clinical reasoning assessments of known validity, obtained two years later at the end of residency. Results showed that SC test scores would predict part of the performance on the measures of clinical reasoning but predicted less well the performance on the measures that assessed both clinical skills and clinical reasoning (Beausoleil et al., 2001).

Students that showed good organization of clinical knowledge at an early point in training then could be expected to show good organization in later measurements of this kind of knowledge, even if, later measurements included a larger clinical content domain (Beausoleil et al., 2001).

C. VALIDITY EVIDENCE

Validity is the most fundamental consideration in developing and evaluating tests. It is not an assessment of the actual test instrument itself, but applies to the process of gathering evidence to support the ways a test is interpreted and used (American Education Research Association, American Psychological Association, & National Council on Measurement in Education, 1999; Nitko, 2001; Wass, Shatzer, & Jones, 2001). Assessment results have different degrees of validity for different purposes and for different situations. Judgments about the validity of interpretations can only be made after several types of validity evidence have been studied. There are a number of different types of validity evidence including: 1) content evidence, 2) internal structure evidence, 3) external structure evidence, 4) reliability evidence, 5) generalization evidence, and 6) consequential evidence.

- Content evidence refers to the content representativeness and relevance; how well the assessment task represents the domain of important content.
- Internal structure evidence investigates the relationships among the assessment tasks. Do all the assessment tasks contribute toward assessing the quality of interest?
- External structure evidence refers to the relationship between an assessment and a comparison to a criterion (test or known quality such as experience) and determines if the assessment results diverge or converge with the results in the expected manner.
- Generalization evidence is collected to determine if there are any significant differences in results when used with subjects of different backgrounds or abilities.

- Consequential evidence refers to studies conducted to describe the intended outcomes of the given assessment procedure and to determine the degree to which these outcomes are attained for all students.

Validity of an assessment depends on the appropriateness of the scores, their intended use and the social consequences of their use (Nitko, 2001). Initial psychometric properties of the SC tests by Charlin et al (2000) show encouraging results in terms of reliability, content and internal structure evidence (Charlin et al., 2000).

D. SPECIFIC AIMS

This dissertation is comprised of a series of three, inter-related studies which, develop and validate the Seating and Mobility Script Concordance Test (SMSCT); a performance-based measure designed for use with professionals that recommend SM devices to individuals with spinal cord injuries. The SMSCT is designed to assess clinicians by examining the organization of their knowledge, associations between items of their knowledge, and adequacy of their clinical decisions compared to expert consensus. This dissertation was modeled after the work of Charlin et al. and is intended to follow standards for educational and psychological testing in the specification and development of tests (Charlin et al., 2000; American Education Research Association et al., 1999).

The specific aims of each of the three components that comprise this dissertation are to:

- Chapter 2: present the conceptual foundation, item generation process, and content validity evidence leading to the final version of the Seating and Mobility Script Concordance Test (SMSCT).

- Chapter 3: describe the development of the scoring system, provide evidence to support the internal structure of the SMSCT items and obtain external structure evidence to support how the SMSCT is interpreted.
- Chapter 4: further validate the SMSCT as a measure of educational effectiveness by determining if the test is capable of differentiating subjects by background and ability before and after an educational program.

Greater understanding of expertise and different levels of practice will enable better professional preparation. Hence, this dissertation was designed to pursue the development of an assessment tool in the area of seating and wheeled mobility recommendation for individuals with spinal cord injury. Links between different levels of practice and client outcomes may then be explored in terms of linking clinical effectiveness and the value of professional practice (Manley et al., 2000). Purposes of measuring and assessing expertise may include: professional credentialing to enable public protection, benchmarking of best practice, and establishment of clinical pathways. The iterative process employed in this dissertation for SMSCT development and validation may benefit others interested in developing similar tests in varied content domains.

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**II. DEVELOPMENT OF THE SEATING AND MOBILITY SCRIPT
CONCORDANCE TEST (SMSCT) FOR SPINAL CORD INJURY: OBTAINING
CONTENT VALIDITY EVIDENCE**

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A. ACKNOWLEDGEMENTS

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B. ABSTRACT

The appropriateness of a consumer's seating and wheeled mobility system varies considerably depending on the competence, proficiency and experience of the professionals assisting the user. At present, there is a scarcity of skilled and knowledgeable therapists to evaluate and recommend seating and mobility devices. There is also a lack of measurement tests available to evaluate the impact of educational experiences or clinical practice on the ability to make specialized clinical decisions about seating and mobility needs. The Seating and Mobility Script Concordance Test (SMSCT) is a new assessment tool, grounded in the hypothetico-deductive and schema theories of clinical reasoning. The test is designed to assess therapists by examining the organization of their knowledge, associations between items of their knowledge, and the adequacy of their clinical decisions, as compared to expert consensus. This paper describes the interview, test development, and content/item review processes utilized for the collection of content validity evidence. The iterative process employed and the appraisal of the content validity evidence that resulted in the final version of the SMSCT is presented. The SMSCT appears to be a promising assessment tool representing content within the domain of seating and mobility for individuals with spinal cord injuries. The process utilized to develop the SMSCT in spinal cord injury can be replicated for other diagnoses and domains.

Key words: Professional practice, clinical competence, rehabilitation, seating and mobility, educational measurement, validity evidence

C. BACKGROUND

The competence, proficiency, and experience of therapy professionals evaluating and recommending wheelchairs and seating systems vary considerably (Bergen, Presperin, & Tallman, 1990; Herman & Lange, 1999; Trefler, Hobson, Taylor, Monahan, & Shaw, 1993). Historically, training for physical therapists (PT's) and occupational therapists (OT's), in the recommendation and fitting of wheelchairs and seating systems, has not received adequate attention (Cooper, 2003; Hoenig, Peiper, Schenkman, & Branch, 2002). Yet, it is generally understood that a well-fitted seating and wheeled mobility system promotes a more functional posture, enhances independent mobility, improves comfort and decreases the risk of pressure sores for individuals who use wheelchairs (Bergen et al., 1990; Herman et al., 1999; Trefler, 1998; Trefler et al., 1993; Zollars, 1996). Consequently, due to the disparity of seating and mobility (SM) recommendation skill among therapy professionals, a need exists for the development of 1) training programs, 2) measures of training effectiveness and 3) measures of clinical effectiveness.

As a result of inadequate professional training, there is a scarcity of PT's and OT's experienced and/or specially trained to provide seating and wheeled mobility prescription (Fifield & Fifield, 1997; Herman et al., 1999). With the aging of the U.S. population and the increasing prevalence of persons with mobility impairments (Jones & Sanford, 1996), the demand for assistive technology (AT) devices and services is anticipated to continue to rise. The availability of skilled service providers will not meet this demand unless training opportunities are developed to increase the supply of skilled AT practitioners (Fifield et al., 1997).

Ideally, a team, consisting of the client, rehabilitation technology supplier, therapist and physician are involved in recommending and prescribing wheelchairs and seating systems to

individuals with mobility impairments. The therapist is the team member responsible for performing the physical, functional and environmental evaluation. The scope and depth of evaluation skills of the therapist can vary widely, which can result in unpredictable quality of advice and equipment recommendation for consumers (Herman et al., 1999). It is agreed that individuals with mobility impairments have the most potential for success when there is a suitable match between their needs and the equipment features of the SM technology they use (Batavia & Hammer, 1990). Failure to understand the factors involved in recommending an appropriate wheelchair and seating system may result in technology abandonment, the consumer being without necessary equipment for extended periods, or overuse of third party payment to replace poorly prescribed equipment (Angelo, Buning, Schmeler, & Doster, 1997; Cooper, Trefler, & Hobson, 1996). Providing effective educational programs to elevate the level of competency and proficiency by which professionals recommend wheelchairs and seating systems may diminish such negative outcomes.

While the need to train additional skilled practitioners is clear, the most effective means of training and the tools to evaluate the effectiveness of training programs, have yet to be identified. A review of the literature reveals a dearth of research related to effective means of increasing the competence and expertise of professionals working in the field of seating and wheeled mobility (Fifield et al., 1997; Hinojosa et al., 2000; Lenker, 1998). With ever changing and emerging technologies available in the area of SM, it is imperative that clinicians continually update their knowledge, skills and clinical competencies in order to provide quality care. New measurement tools that can evaluate the impact of educational experiences or clinical practice on the ability to make clinical decisions are needed. The authors embarked on developing such a measurement tool entitled the Seating and Mobility Script Concordance Test (SMSCT).

1. Purpose of the SMSCT

The SMSCT is designed to be a measurement tool rooted in the hypothetico-deductive and the schema theories of clinical reasoning.^{1, 2} In accordance with the work of Charlin et al. (Tardif & Boshuizen, 2000; Desaulniers, Gagnon, Blouin, & van der Vleuten, 2002; Charlin, Roy, Brailovsky, & van der Vleuten, 2000), test items are designed with the intention that therapists are required to make a clinical judgment based on information provided in a clinical vignette(Charlin et al., 1998). The item format used is: if you are thinking of A and you discover B, what is the effect on your hypothesis (Charlin et al., 2000)? Figure 1 provides an example of the item formats created by Charlin et al.

¹ The hypothetico-deductive theory of clinical reasoning consists of the generation of multiple competing hypotheses from initial patient cues and collection of data to confirm or refute each hypothesis (Charlin et al., 2000; Tardif et al., 2000).

² The schema theory of clinical reasoning presumes networks of knowledge adapted to goals of clinical tasks. These distinctive memory structures, also known as “scripts”, are meaningful sets of connections among abstract concepts and/or specific experiences (Schmidt, Norman, & Boshuizen, 1990; Charlin et al., 2000; Tardif et al., 2000).

<u>For diagnostic knowledge assessment</u>		
If you were thinking of	And then you find	This hypothesis becomes
(A diagnostic hypothesis)	(A new clinical information, an imaging study or a laboratory test result)	-2 -1 0 +1 +2
-2	the hypothesis is almost eliminated	
-1	the hypothesis becomes less probable	
0	the information has no effect on the hypothesis	
+1	the hypothesis is becoming more probable	
+2	it can only be this hypothesis	
<u>For investigation knowledge assessment</u>		
If you were considering to ask	And then you find	This investigation becomes
(A diagnostic test)	(A new clinical information, an imaging study or a laboratory test result)	-2 -1 0 +1 +2
-2	contra-indicated totally or almost totally	
-1	not useful or even detrimental	
0	nor less nor more useful	
+1	useful	
+2	absolutely necessary	
<u>For treatment knowledge assessment</u>		
If you were considering to prescribe	And then you find	The relevance of this treatment becomes
(A therapeutic option)	(A new clinical information, an imaging study or a laboratory test result)	-2 -1 0 +1 +2
-2	contra-indicated totally or almost totally	
-1	not useful or even detrimental	
0	nor less nor more useful	
+1	useful	
+2	necessary or absolutely necessary	

Reprinted with permission from (Charlin et al., 2000a).

Figure II-1 Sample Script Concordance Test items

Items as developed by Charlin et al; designed to vary with the object of the assessment (e.g., diagnosis, investigative, treatment).

Specifically, the SMSCT is designed to evaluate the meaningfulness of the links within an item, and to examine whether the organization and associations between items of knowledge allow the making of adequate clinical decisions. The SMSCT is developed to assess whether OT's and PT's with differing amounts of experience possess the elements of knowledge that "expert" clinicians use in specific clinical situations. The scoring system of the test is designed to

measure the difference, or the disparity, that exists between examinees' scripts (networks of knowledge) and those of a panel of experts.

On the basis of well-accepted measurement standards (American Education Research Association, American Psychological Association, & National Council on Measurement in Education, 1999; Nitko, 2001), we specified *a priori* that the SMSCT be constructed to:

1. Distinguish between individuals with novice, intermediate and expert knowledge
2. Examine the results of pre and post-service educational programs
3. Determine level of competency for student or novice therapists

2. Content Domain: Spinal Cord Injury

In order to focus the scope and content of a new measurement tool, the content domain selected was narrowed to include only individuals with traumatic spinal cord injuries (SCI) who use manual wheelchairs. This decision was based on several factors: individuals with SCI customarily require SM technologies and portray similar clinical and functional findings based on level of injury. In addition, the researchers had access to a number of individuals who met the criteria of expert SM clinicians who have a high rate of exposure to individuals with SCI. The process used to develop the SMSCT in SCI will eventually be replicated for other diagnoses. Our overall aim was to characterize clinicians' skill level as well as measure changes in the level of expertise prescribing SM systems for individuals with SCI.

3. Content Representativeness and Relevance

Content validity evidence describes the extent to which test items are representative and relevant to an instrument's domain of important content (American Education Research Association et al., 1999; Nitko, 2001). Ideally, content validity evidence is obtained while an instrument is in the development phase since the appraisal helps to identify items that should be

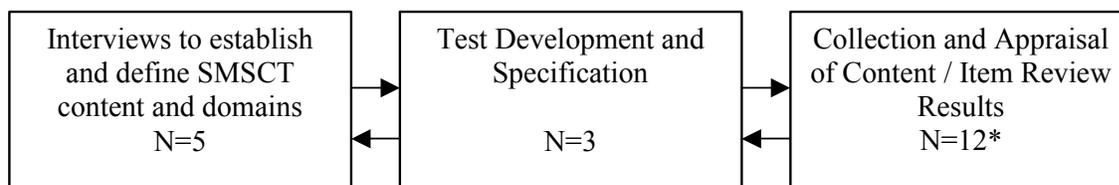
eliminated, revised or added to the instrument before it is finalized (Beck & Gable, 2001; Crocker, 1977; Nitko, 2001). The purpose of this paper is to present the conceptual foundation, item generation process, and content validity evidence leading to the final version of the *Seating and Mobility Script Concordance Test (SMSCT)*.

D. METHODS

1. Overview

Several phases were completed to develop and validate the SMSCT. This paper describes the results of the collection and appraisal of the content validity evidence, a process comprised of three components: interviews, test development and content/item review. This work guided the test development process and resulted in the final version of the SMSCT. In this overview section, the subjects and methods for the three components that comprise this work are initially described (Fig. 2). Subsequently, the methods of analysis employed for each component are specified.

Collection and Appraisal of Content Validity Evidence



Note. *All subjects were “expert clinicians” with the exception of 2 item reviewers recruited to examine items for clarity and use of terminology.

Figure II-2 Process and sample size used for collecting and appraising SMSCT content validity evidence.

2. Subjects

Subjects were comprised of “expert clinicians” unless indicated otherwise. For the purpose of this work we defined “expert clinician” as a person with:

- A physical or occupational therapy license
- A combination of SM service provision, which equates to full time work for at least 5 years (Full time work is defined as, approximately, forty hours per week)
- Completion of professional development (i.e. continuing education courses, manufacturer in-services, graduate course work etc.) to include a minimum of 10 contact hours/year for a minimum of 5 years in the area of SM as verified by self-report

3. Interviews

a) Interview Subjects

Six “expert” PT’s and OT’s who work at different Model Centers on SCI and who regularly prescribe SM equipment to individuals with SCI were recruited and interviewed. A request for volunteers who met the eligibility requirements was distributed through e-mail.

Initially, four experts were recruited and participated in the first round of interviews during the 18th International Seating Symposium in Vancouver BC, March 2002. Two additional experts were recruited by email and subsequent interviews were conducted via telephone for the second round of interviews. Informed consent was obtained from each subject per IRB protocol. Upon completion of one interview, it was discovered that study eligibility was not met; therefore that subjects’ data were not included in analysis. Table 1 provides the demographic information of the remaining five experts.

Table II-1 Therapist profiles - expert SCI clinicians

Therapist	1	2	3	4	5
Age	48	47	31	44	46
Gender	M	F	F	F	F
Profession	PT	PT	PT	OT	OT
Entry level degree	BS	BS	MS	Advanced MS	MS
Yr of graduation	1984	1978	1996 MS	1982 BS 1992 MS	1979 BS 1984 MS
Yrs of clinical practice	18	23	5	19	24
Yrs of SM experience	10	23	5	14	24
U.S. Region	SE	W	NW	NW	SW

Note. M=male, F=female; PT=physical therapist, OT=occupational therapist; BS=Bachelor of Science, MS=Master of Science; SE=southeast, SW=southwest, NW=northwest, W=west.

b) Interview Methodology

Two rounds of interviews were completed using the same protocol. One researcher conducted, audiotaped and then transcribed all interviews with the five experts. Interviews typically lasted 60-75 minutes resulting in transcripts that were, on average, 20 pages in length.

The primary purpose of the first round of interviews was to identify similarities and themes describing standards of practice for professionals prescribing seating and wheeled mobility technologies to individuals with SCI's. The second round interview questions focused on identifying: 1) unique skills of SCI SM experts, 2) knowledge and skills that differentiate SCI experts from other SM clinicians and novice therapists, and 3) common misconceptions in

clinical practice. The purpose of these interviews were to obtain information that would allow further refinement of the SMSCT vignettes and items progressing towards the final version of the test.

Two other documents, in addition to the interview transcripts, were used to verify the data as representative of the scope of clinical situations encountered in SM service provision. These documents were developed by RESNA: 1) RESNA Guidelines for Knowledge and Skills for Provision of Assistive Technology Products and Services: Assistive Technology Practitioner and, 2) RESNA Guidelines for Knowledge and Skills for Provision of the Specialty Technology: Seating and Mobility (RESNA, 1996; RESNA, 1997). These documents were developed by work groups made up of stakeholders (physical therapists, occupational therapists, rehabilitation engineers, educators and others) in the service delivery process to reflect content specific knowledge. Interview data were triangulated with these two RESNA documents to validate the thoroughness of our findings to ensure that no important aspects of SM clinical practice were overlooked. Details of this analysis are provided in the Interview Results section.

4. Test Development

a) Test Developers

Two physical therapists, each with greater than 13 years of SM experience, fulfilled the role of SMSCT test developers. Another SM clinician, recognized by both RESNA and expert peers as an authority in the field, edited the preliminary test items and provided input to the test developers throughout the test development process.

b) Test Development Methodology

As the first step in the test writing process, the test developers were asked to describe problematic clinical situations common to individuals with SCI who use manual wheelchairs.

Multiple clinical vignettes were then written to illustrate common, problematic clinical situations. Table 2 shows sample vignettes.

Table II-2 Sample vignettes

Vignette	Example
1	A first time manual wheelchair user with a new traumatic low-level tetraplegia (i.e. C5, C6 or C7 injury), ready for discharge from acute rehabilitation.
2	An experienced manual wheelchair user with a diagnosis of spinal cord injury, presenting to the clinic with poor sitting posture (i.e. kyphotic posture, posterior pelvic tilt, cervical hyperextension, etc.) and/or complaints of pain (i.e. neck, low back, and shoulder pain) and/or need for a replacement wheelchair and/or seating system
3	An individual with either a short (i.e., <8 months) or long history of SCI (i.e. >10 years), and a recent diagnosis of skin breakdown on the buttocks with etiology of unknown origin.
4	An active manual wheelchair user who has funding for only one wheelchair and uses a manual wheelchair in multiple settings (i.e. indoor level surfaces such as carpet, tile, linoleum; outdoor surfaces such as hills, gravel, dirt, grass, pavement; inclement weather such as snow, rain, and heat), for multiple purposes (i.e. attending soccer games, basketball, outdoor trails, city obstacles, etc.)
5	A person with mid-level paraplegia (i.e., T5, T6, T7, T8) who uses a manual wheelchair, and has new onset of upper extremity motor and/or sensory deficits.

Following the pre-established test development process developed by Charlin et al. for physicians, the initial form of the SMSCT was created with the dimensions of diagnosis, investigation and treatment (Fig. 1). Consequently, test performance targets for all three dimensions of the test were established. After, the initial sets of items (n=74) were written, a combination of 25 diagnostic (33%), 21 investigative (28%), and 28 treatment items (37%) using the pre-established item format (Charlin et al., 2000). The test developers were asked to specify for each clinical vignette: A) the relevant hypotheses, investigation strategies, or treatment options; B) the questions they asked, physical examinations they performed, and tests they would review in order to solve the problem; and C) the clinical information, positive or negative, they would look for in these inquiries (Charlin et al., 2000).

Based on the D-studies from Charlin et al, the number of items that are necessary in each script concordance test administration to achieve a coefficient alpha of 0.8 is between 50 and 60 items (Charlin et al., 2000). We selected to write a pool of items larger than required in order to allow for attrition of potentially poorly performing items.

Actual test items were built from presenting the clinical vignette followed by a series of related items (based on the model illustrated in Fig. 1) and item format differing with the dimension of the test (diagnostic, investigative or treatment) (Charlin et al., 2000). Answers are placed on a 5-point Likert scale. The test taker is required to decide whether components of clinical information are relevant, or not, to the given clinical situation (Charlin et al., 1998; Tardif et al., 2000; Charlin et al., 2000). The 74 test items for the initial SMSCT were built from the information obtained during this stage.

5. Content/Item Review

a) Content/Item Reviewers

Twelve reviewers with varying levels of experience and SCI expertise were recruited to serve as content and item reviewers. Reviewers were verbally invited by the investigators to participate. Informed consent was obtained from each subject per IRB protocol.

b) Content/Item Review Methodology

Draft SMSCT test items were reviewed for content on two separate occasions to determine if the items were reflective of genuine diagnostic, treatment, and intervention situations as well as to ensure item clarity, terminology, and brevity. Reviewers were mailed content or item review packets consisting of SMSCT performance targets, test items and either content or item review questions. Sample review questions are provided in tables 3 and 4.

Table II-3 Sample content review questions

#	Question
1	Does this question set represent the scope of practice with patients with SCI? What other content is needed?
2	Describe some other scenarios that are needed to embody the scope of practice with patients with SCI.
3	Describe some real life situation you encounter in practice.
4	Indicate any hypotheses you think should be added, changed, or omitted.
5	Do you think the words for this scale should remain the same or do you have alternative wording?
6	Do you think the order of the information presented is according to the way clinicians' think? Do you think the order of the columns should remain the same or be reversed? Please explain your reasoning.

Table II-4 Sample item review questions

Type	Question
Wording	Do you find this item clearly stated?
	Is the item as succinct as possible?
	Could the wording of the item mean different things to examinees from various setting, locations, or regions?
Subject Content	Do you find this item relevant to your practice?
	Do you typically pose this type of question to yourself in your practice?
Context	Is the item context likely to mean different things to professionals with different backgrounds?

6. Methods of Analysis

a) Interview Analysis

The computer software program NUD*IST N4 (Non-numerical Unstructured Data: Indexing Searching Theorizing) was used for data analysis (Scolari Sage Publications Inc., 1997). Two types of data were imported to N4 for analysis: 1) five interview transcripts, and 2) two RESNA guideline documents (RESNA, 1996; RESNA, 1997).

Interview transcripts were then analyzed to determine how experienced physical therapists (PT's) and occupational therapists (OT's) practice and what unique knowledge they employ in evaluation and equipment specification. The goal of the analysis was to understand the major evaluation processes employed by PT's and OT's to ensure that the SMSCT vignettes and items would be reflective of standard practice. Since we wanted to clarify common practices shared by PT's and OT's and variations of practices in each evaluation stage, we began the analysis with descriptive coding. First the transcripts were coded using an iterative process

beginning with reading the transcripts line-by-line and identifying open codes. As patterns and themes evolved open codes were categorized, revised and reorganized into axial codes and core codes. The N4 software package was instrumental in exploring, interacting, and querying the data (Gahan & Hannibal, 98 A.D.; Scolari Sage Publications Inc., 1997; Miles & Huberman, 1994).

Next the two RESNA knowledge and skill documents (basic and advanced guidelines for SM skills and knowledge) (RESNA, 1997; RESNA, 1996) were cross referenced with the coding of the transcripts, comparing the process of evaluation indicated by the expert therapists and the processes presented in the RESNA documents. We expected that this comparison would suggest to what extent expert therapists display the identified skills, tasks and knowledge outlined in the established guidelines. In addition, we envisioned that this comparison would provide us with aspects that may be missed in the analysis of the transcripts. We expected that this comparison of documents would identify perspectives and questions to explore in greater depth during future interviews.

b) Test Specification and Revisions

Based on an iterative process of test development and specification, numerous modifications and improvements were made to the preliminary version of the SMSCT prior to initiating successive content and item reviews and test finalization. Founded in comments and recommendations from the content and item review, changes were made to the subtest categories, item formats, and item response scales.

First, the original subtest dimensions were changed from, diagnostic, investigative and treatment, to final subtest dimensions, assessment and intervention. This change was completed based on feedback from both the test developers and content experts in order to better represent

clinical practice in the domain of SM opposed to medical practice. Assessment subtest items were designed to reflect the dynamic process in which the practitioner makes clinical judgments based on data gathered during the three components of the examination: patient/client history, analysis of function, and tests and measures (i.e. supine mat assessment, range of motion). Intervention subtest items were designed to reflect the process of selecting an intervention solution based on the clinical findings identified during the assessment process. The intervention process encompasses three components: problem solving, equipment trial/simulation, and patient education/training.

Within each dimension (assessment and intervention) the following content categories were identified as key to representing the population of individuals served by SCI SM practitioners: level of injury, duration since injury, activity level and complication. The test blueprint was written to include a representative sample of clinical vignettes for these four categories:

1. Level of injury (low tetraplegic [C5-C8], high paraplegic [T1-T7], low paraplegic [below T8])
2. Duration since injury (acute injury, 5-10 years post injury, >15 years post injury)
3. Activity Level (low activity, high activity)
4. Complications
 - a. skin (redness, ulcer, moisture),
 - b. orthopedic (postural instability, scoliosis, kyphosis, obliquity),
 - c. pain (lowback, neck, headaches, shoulder), and
 - d. diagnosed repetitive stress injury (impingement at shoulder, carpal tunnel)

Next, the item format was revised by reordering and renaming the columns of the test items to better reflect the clinical information gathering sequence, and clinical reasoning, specific to the field of SM.

Finally, the wording for the Likert Scales for the two subtests were modified to provide softer endpoints to encourage the full use of the 5-point scale (Schaeffer N.C., 1991). Since it is necessary to have an assortment of item responses (1-5), it was also necessary to revise several items in order to get a representative range of possible responses. Which items required revision was determined by the test developers based on the results of a trial test administration and feedback from the content experts.

c) Content and Item Review Analysis

Content and item review forms were administered and analyzed on two separate occasions. Comments were reviewed and careful examination of each item was undertaken. Based on the responses from the content and item analyses the SCSMT items were either discarded, revised or rewritten as previously described. The revised version of the SMSCT was then reviewed for a second time and compared to the original test blueprint. Modifications were then completed for the test blueprint in order to accurately reflect the final SMSCT.

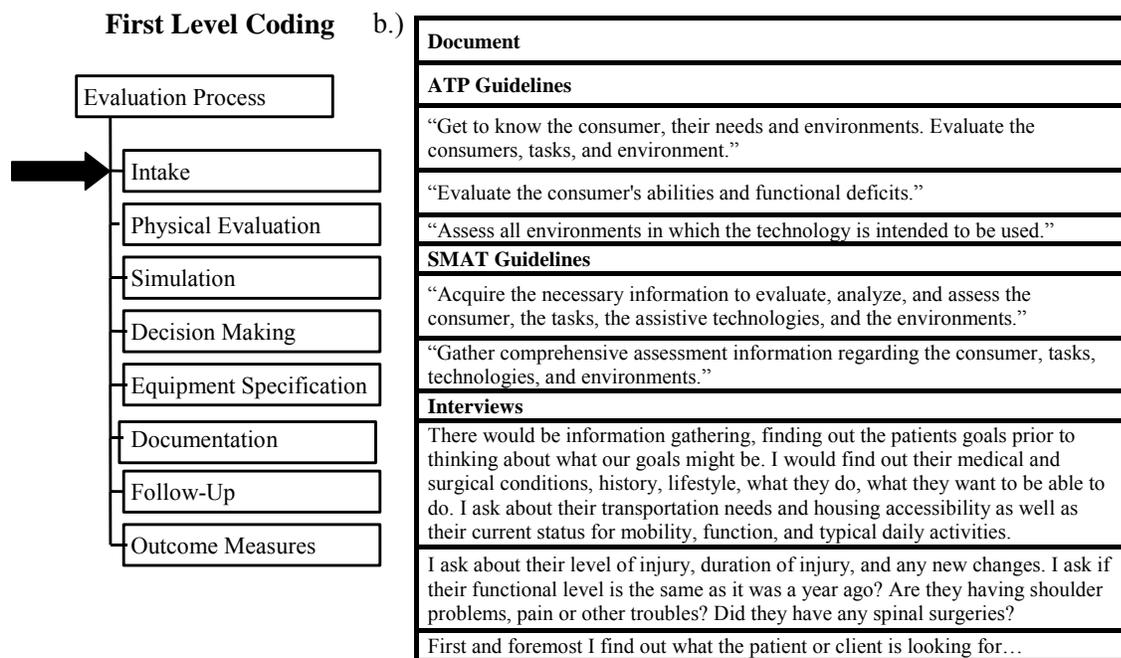
E. RESULTS

1. Interviews

a) Round 1

With the use of the software program N4 the investigators developed a coding tree. First level coding of the evaluation process revealed the coding tree shown in Figure 3a. We were primarily interested in the data pertaining to the evaluation process to provide evidence that the content for the SMSCT was comprehensive and representative of standard practice. Next, using N4, a document report was generated for the Evaluation Process nodes for all interview and

guideline documents. From this report we could review all text units coded under each node of the coding tree. Quotes were found to compare what the guidelines and the subjects said about each node identified as part of the evaluation process. Figure 3b provides a sample of the data substance identified in the code report for the intake node. This method was repeated for each node on the coding tree to explore the data and verify that we had captured the most important concepts of the evaluation process. Results of the cross referencing of interview data and the RESNA documents revealed no major discrepancies in the key aspects of SM clinical practice identified. The descriptions identified through this process were used to guide the test developers in creating representative clinical vignettes during test development.



Note. Interview data have been paraphrased for conciseness. ATP Guidelines = *RESNA guidelines for knowledge and skills for provision of assistive technology products and services: Assistive Technology Practitioner*; SMAT Guidelines = *RESNA Guidelines for Knowledge and Skills for Provision of the Specialty Technology: Seating and Mobility*.

Figure II-3a and 3b Coding of the evaluation process

3a) First level coding tree 3b) Subset of data from “intake” code report comparing information from the interviews and RESNA guideline documents.

b) Round 2

Transcripts from the second round interviews were referred to during the SMSCT test revision process. Items were revised based on specific examples, situations and common misconceptions identified during these interviews. Item hypotheses and findings were fine-tuned based on this input.

2. Final Test Specification

The resulting version of the SMSCT was comprised of 67 items. There were 33 items (49%) in the Assessment dimension and 34 items (51%) in the Intervention dimension each with 5 clinical vignettes. This version of the SMSCT was used for preliminary test administration and psychometric testing.

F. DISCUSSION

1. Participants

One major constraint we faced in designing eligibility criteria for this study is that there are no established and recognized criteria for identifying “expert” SM clinicians. In general, research involving expertise has employed a range of criteria to identify and/or select experts including: extent of experience, educational qualifications, professional qualifications, personal qualities, professional activities and status (Chi & Glaser, 1988; Ericsson & Smith, 1991; Manley & Garbett, 2000; Patel & Groen, 1991). However, overall there seems to be little consistency between studies in terms of criteria employed to identify experts or expertise. In their work in script concordance test development within the field of medicine, Charlin, et al defined expertise by choosing certified specialists in the domain of interest (gynecology, radiology, surgery) (Charlin et al., 1998; Charlin et al., 2000; Tardif et al., 2000). Still, within the field of SM for individuals with SCI there is no certification for specialists, so therefore we used a combination of criteria.

2. Interviews

Our first round interview subjects were a homogeneous group by design. We would expect a different scope of responses to be found in a more heterogeneous sample of subjects. In hindsight it may have been more beneficial to include a more heterogeneous sample of clinicians and to focus interview questions on identifying differences in knowledge/expertise specific to SCI SM service provision in order to minimize the need for second round interviews.

3. Test Representativeness

The validity of an instrument such as the SMSCT depends greatly on how well the test samples pre-established learning targets (Nitko, 2001). The authors of some instruments have argued that the content of an instrument should be defined based on interviews with experts in the field (American Education Research Association et al., 1999).(Nitko, 2001) We relied not only on the opinion of those who had expertise in the area of SM with SCI, but also on the review of existing documents for the triangulation of data. This methodology has been used by others to develop similar Script Concordance Tests (Charlin et al., 1998; Charlin et al., 2000). While it is possible that this method may have resulted in underrepresentation of construct, we believe that the current instrument reflects an adequate representation of the SM for SCI dimensions of assessment and intervention.

The SMSCT is anticipated to measure some, but not all, attributes of clinical competence. Results in other content domains (e.g. medicine) have shown that script concordance test scores would predict part of the performance on the measures of clinical reasoning but predicted less well the performance on the measures that examined both clinical reasoning and clinical skills (Beausoleil & van der Vleuten, 2001). Since this test is not performance based, we would expect the same sort of limitations from the SMSCT. Unfortunately, since there currently is no “gold

standard” measure of competence or expertise in this content area we are unable to fully validate this finding.

4. Item Format

Feedback from the content and item reviewers resulted in several changes to the SMSCT item format. Comments indicated that it took some time to “warm up” to the response formats for the SMSCT. In order to minimize errors due to the response formats, instruction sheets with sample items have been provided in the final version of the SMSCT for each subtest dimension in order to allow test takers an opportunity to tryout, ask questions, and reflect on the item format prior to beginning the scored portion of the test. Another outcome of the content review resulted in revisions to the response option scales for each subtest, to provide softer endpoints, in order to maximize the use of the entire range of the scale.

5. Future Work

Additional validity evidence is being obtained for the SMSCT. The development of the scoring system and preliminary psychometric analyses (internal structure evidence, external structure evidence, and generalization evidence) are in progress. A related educational intervention study has been conducted using a pretest /posttest design to collect additional validity evidence. Results of the intervention study will describe the degree to which SMSCT test scores change for all clinicians following an educational intervention. These activities are in progress and will be presented in future publications.

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III. VALIDATION OF THE SEATING AND MOBILITY SCRIPT CONCORDANCE TEST (SMSCT)

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B. ABSTRACT

The Seating and Mobility Script Concordance Test (SMSCT) is a performance-based measure intended for use with professionals that recommend seating and mobility devices to individuals with spinal cord injuries. The SMSCT is proposed to evaluate the impact of educational experiences or clinical practice on the ability to make specialized clinical decisions about seating and mobility needs. The SMSCT consists of 67 items divided into two subtests: 33 assessment items and 34 intervention items. This study describes the development of the scoring system and appraisal of internal and external validity evidence. A convenience sample of 106 clinicians (15 spinal cord injury experts, 15 seating and mobility experts, 10 orthopedic experts and 66 clinicians with varying levels of seating and mobility expertise) participated in the study. The 15 spinal cord injury experts contributed to the development of the SMSCT scoring system. The remaining 91 subjects provided validity evidence. All subjects completed a demographic questionnaire and 67-item SMSCT. Results suggest that the technical quality (internal structure) of the SMSCT may include evidence of reduced item performance but satisfactory convergent and discriminate evidence by construct definition. The SMSCT was found to differentiate between seating and mobility experts and orthopedic experts' intervention subtest scores ($t = -2.2$, $p = 0.04$). The proxy measure of clinical expertise, seating and mobility hours/week was found to predict SMSCT intervention scores ($F = 10.62$, $p = 0.002$). Preliminary validation of the SMSCT suggests that the test may be a promising measure of clinical expertise. Further item development, revision and pilot testing are needed. Future SMSCT development and validation are planned.

C. BACKGROUND

The appropriateness of a consumer's seating and mobility (SM) system varies considerably depending on the competence, proficiency and experience of the professionals assisting the user (Herman & Lange, 1999). At present, there is a scarcity of skilled and knowledgeable therapists to evaluate and recommend SM devices (Fifield & Fifield, 1997; Herman et al., 1999). With ever changing and emerging technologies available in the area of SM it is necessary that clinicians continually update their knowledge, skills and clinical competencies in order to provide quality care. The most widely accepted means to upgrade professional training is participation in continuing education activities. Yet, the effectiveness of professional training is still unknown. While the need to train more skilled practitioners is clear, the tools to assess the effectiveness of training programs and the most effective means of training have yet to be identified (Davis, Thomson, Oxman, & Haynes, 1992; Grossman, 1998).

Understanding the way experts practice, think, solve problems, and operate is necessary in order to define essential skills and clinical competencies. This is also necessary in promoting the continued preparation of practicing professionals and the development of the next generation of professionals (Jensen, Gwyer, Shepard, & Hack, 2000). A key characteristic of experts' performance that has been found to be robust and generalizable across various domains of research, in the areas of cognitive psychology and cognitive sciences, and viewed as a clinical determinant of expertise in medicine, is *organization of knowledge* (Chi & Glaser, 1988; Charlin, Roy, Brailovsky, & van der Vleuten, 2000; Schmidt, Norman, & Boshuizen, 1990).

Over the last 30 years there has been an active line of research and an accumulation of evidence in medicine about the process of how knowledge is: a) initially learned, b) organized in memory, c) accessed later to solve problems and d) changed with experience (Charlin et al.,

2000; Schmidt et al., 1990). Authors have hypothesized that in clinical medicine, differences between experts and novices lay primarily in experts' recall of meaningful relationships and patterns, that is, the structure of knowledge, rather than the problem solving strategy applied to the problem (Charlin et al., 2000; Schmidt et al., 1990). The acquisition of expertise in a content area can be characterized by the development of distinctive memory structures called *scripts*, which are meaningful sets of connections among abstract concepts and/or specific experiences (Tardif & Boshuizen, 2000; Charlin et al., 2000; Schmidt et al., 1990). Research in this area is attempting to portray how a script as a memory structure might be organized for specific clinical tasks. Information such as the assumptions and hypotheses that are necessary to assess and manage clinical cases is retrieved through the activation of these scripts. Thus it follows, that in testing clinical expertise it is necessary to access these scripts by using specific, relevant clinical situations in the test items in order to assess the organization of knowledge.

At present, no validated measurement tests exist to evaluate the impact of educational experiences or clinical practice on the ability to make specialized clinical decisions about SM needs. The Seating and Mobility Script Concordance Test (SMSCT) is a tool designed to assess clinicians by examining the organization of their knowledge, associations between items of their knowledge, and adequacy of their clinical decisions compared to expert consensus. The SMSCT is modeled after the development of a similar Script Concordance Test (SCT) in the field of medicine created by Charlin et al (Charlin et al., 2000). The SMSCT consists of 67 items divided into two subtests: 33 assessment items (49%) and 34 intervention items (51%) (Cohen, Fitzgerald, Lane, & Boninger, 2003). In order to focus the subject matter for the SMSCT, the content domain was limited to SM for individuals with spinal cord injuries (SCI).

Several phases were dedicated to the development and validation of the SMSCT (Cohen, Fitzgerald, Treffler, Boninger, & McCue, 2002; Cohen et al., 2003). To date, only the content validity evidence of the SMSCT has been investigated (Cohen et al., 2003). Determining the validity of the SMSCT is the most fundamental consideration in evaluating its usefulness as a measure of clinical expertise for clinicians who work with SCI. The purpose of this study was two-fold. First, to provide evidence to support the internal structure of the SMSCT items and second to obtain external structure evidence to support how the SMSCT is interpreted. This paper describes A) the development of the scoring system and B) the collection and appraisal of internal and external structure evidence. We sought evidence to explore the following research hypotheses.

1. There is a significant relationship between each item response and total SMSCT score
2. There is a significant relationship among item responses, within a subtest, as compared to item responses in other subtests (assessment, intervention)
3. SMSCT subscores can differentiate between SM experts and Orthopedic (Ortho) experts
4. Proxy measures of clinical expertise (i.e. years of clinical practice, years of seating and mobility provision, hours per week of seating and mobility services, number of spinal cord injured patients treated per year or professional level degree) will predict SMSCT subscores

D. METHODS

1. Participants

Overall 115 clinicians agreed to participate in this project. Among them 15 contributed to the development of the SMSCT scoring system. The remaining 100 were recruited for acquiring validity evidence. Figure 1 illustrates the subject groups used for this work. All subjects signed a consent form approved by the Internal Review Board.

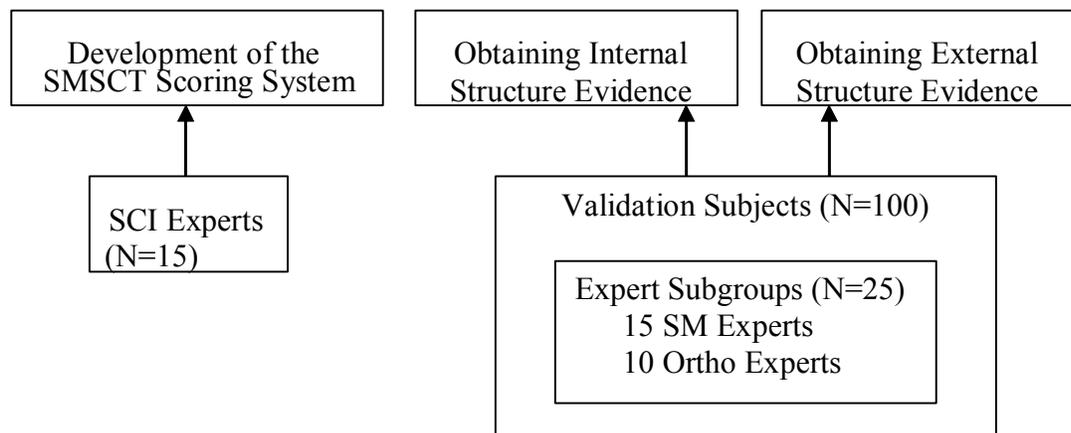


Figure III-1 Subject groups and study components

For the purpose of developing the SMSCT scoring system, 15 expert SM clinicians were recruited from different Model SCI Systems across the United States. These clinicians, hereafter referred to as SCI experts, were selected because they regularly recommend SM equipment to individuals with SCI.

For the purpose of this work we defined expert SM clinicians as individuals with:

- A physical or occupational therapy license
- A combination of SM service provision, which equates to full time work for 5 years (Full time work is defined as, approximately, forty hours per week)
- Completion of professional development (i.e. continuing education courses, manufacturer in-services, graduate course work etc.) to include a minimum of 10 contact hours/year for a minimum of 5 years in the area of SM as documented by self-report

In order to obtain external validity evidence and compare groups of known qualities, a subset of the 100 validation subjects, 15 experts in SM and 10 Ortho PT experts, were recruited

separately. The SM experts were selected because they differed from the SCI experts that developed the scoring system, in that they worked with a diverse patient population not exclusive to SCI. The Ortho experts were chosen in order to recruit a homogenous group that had expertise related to the musculoskeletal spine but not specific to SM service provision.

The SCI experts and SM experts were recruited through invitation by the investigators whereas; the Ortho experts were recruited through invitation by the President and Delegate of the Research Section of the American Physical Therapy Association (APTA). Volunteer physical therapy (PT) and occupational therapy (OT) clinicians with differing levels of SM experience made up the remainder of the validation group. These subjects were recruited in person at the International Seating Symposium, the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) annual conference, and to a limited extent by word of mouth.

The correlation coefficient for the test is influenced by the total number and the diversity or spread in experience of the respondents. Anticipating a conservative minimal effect correlation of $r = 0.3$ and $\alpha = 0.05$, one hundred subjects were required to get a power of 0.87 (Cohen, 1988).

2. SMSCT Test Administration Procedures and Data Management

All subjects (SCI experts and Validation subjects) completed a demographic questionnaire and the 67-item SMSCT. Demographic information included gender, profession, professional level degree, years of clinical practice, years of SM service provision, number of SCI patients seen per year, type of AT training, diagnoses commonly treated, and professional development activities. Professional level degree was defined as the clinicians' highest degree acquired to practice physical or occupational therapy (i.e. entry-level associates, bachelors, masters, or clinical doctorate versus advanced level masters, clinical doctorate or PhD).

Each subject took the SMSCT and recorded their answers on a machine scored answer sheet. The test took approximately 60 minutes to complete. All demographic data were entered into a Microsoft Access® database, coded and verified for accuracy. SMSCT data were processed by the Office of Measurement and Testing at the University of Pittsburgh resulting in an electronic document that was used for scoring and further analysis by the research team.

3. Procedures for the Development of the Scoring System

The scoring system for the SMSCT is modeled after Charlin et al's innovative work (Charlin et al., 2000). The scoring system for the SMSCT is founded in the principle that any answer given by an expert has an intrinsic value, even if other experts do not agree with it. Hence, scores for each item of the SMSCT are computed from the frequencies given to each point of the Likert scale by the experts (Charlin et al., 2000). Based on the work of Charlin et al (Charlin et al., 2000), the number of experts used to develop a similar SCT scoring system must be sufficient to express the variability in answers that experts may show for each item. Their work suggests a sample size of 9-12 experts (Charlin et al., 2000; Charlin, Desaulniers, Gagnon, Blouin, & van der Vleuten, 2002). We chose to recruit a total of 15 SCI experts for the development of the scoring system in order to allow for attrition. Previous research has established that answers of experts' vary when they have to solve clinical problems, even in their own field of expertise (Charlin et al., 2000; Norman, 2000). Other studies using the test format for a SCT, support this finding and show that experts provide the same answers on some items but also provide different answers on others (Charlin et al., 2000; Beausoleil & van der Vleuten, 2001; Charlin et al., 1998).

The item responses of the 15 SCI experts were used to prepare the scoring key based on the preestablished process (Charlin et al., 2000). For each item, answers were assigned a weighted value corresponding to the proportion of experts who selected the response. An

example of the item format and item scoring are illustrated in Figure 2 and Table 1. The score for each question is the proportion of experts who gave the same answer for the question and is weighted by the degree of agreement between experts. The modal answer on each item was used to transform item raw scores in order that the modal expert response on each item receive a maximum score of 1 and other experts' choices receive a partial credit score. Answers not chosen by experts receive a score of 0. The total score for a specific test is the sum of credit obtained on each item for each subject. Finally, the total score is transformed to get a maximum test score of 100 for ease of interpretation. A score of 100 signifies that the subject gives on each item the answer that most SCI experts provide, and the lower the score the farther the examinees are from the SCI experts' prototypic script for the situation.

A 42- year old female with T10 paraplegia presents with a complaint of pain when she lifts her right arm overhead.

<i>If you were thinking of (a hypothesis)</i>	<i>And then you find</i>	<i>This hypothesis</i>
Partial rotator cuff tear	No longer able to transfer to her tub seat without assistance	1 2 3 ④ 5

1. becomes almost eliminated
2. becomes less probable
3. is not affected by the new information
4. becomes more probable
5. becomes most likely probable

Figure III-2 SMSCT Item format – example assessment item

Table III-1 Example of item scoring

	1	2	3	4	5
# of experts' answer	0	0	0	7	2
Raw score	0	0	0	7/9 (.77)	2/9 (.22)
Modal transformed score	0	0	0	7/7	2/7
Credit for the item	0	0	0	1	.29

Note: Total SMSCT test score is the sum of credit obtained on each item transformed to 100 for ease of interpretation.

4. Procedures for Obtaining Internal Structure Evidence

To determine the level of internal consistency, item analyses were explored using responses of the SCI experts (n=15). Analyses included the study of the intercorrelation matrix, reliability coefficients, and corrected item/total correlations. We first examined the intercorrelation matrix to identify poorly performing items. Next we studied the reliability coefficients used to measure item internal consistency. Internal consistency is affected by homogeneity of items: the more homogeneous the items the higher the test score reliability. A stepwise reliability analysis was completed to exclude, one by one, all the variables having a negative impact on reliability, in order, to select the best performing items. Lastly, to determine if the two hypothesized domains (assessment and intervention) were indeed measuring different constructs; we explored correlations for items within a subtest and items across subtests. The results from these analyses combined with professional judgment guided decisions about which items were retained and/or eliminated from the final version of the SMSCT.

5. Procedures for Obtaining External Structure Evidence

Independent samples t-tests were used to determine if the SMSCT subscores could differentiate between SM experts (n=15) and Ortho experts (n=10). Then, to explore which proxy measures of clinical expertise could predict SMSCT subscale scores (assessment and intervention), bivariate correlations were first examined. Next, a stepwise linear multiple regression analysis was conducted to identify which factors could predict SMSCT subtest scores (assessment, intervention). The predictor variables (proxy measures of clinical expertise) are professional level, number of SCI/year, years of clinical practice, years of SM provision, and hours/week of SM. The criterion variables are SMSCT subtest score (assessment or intervention). Two models were explored first using the assessment scores as the criterion variable and next using the intervention scores as the criterion variable.

6. Methods of Analysis Used for Obtaining Validity Evidence

Initial analyses of data were completed to look at data normalcy, outliers and summary statistics. Descriptive statistics were used to describe group demographics. Frequency counts were used with nominal data, and measures of central tendency were used for continuous data. For all analyses, parametric statistics were used for normally distributed variables, homogeneity of group variances were estimated using the Levenes' test, nonparametric statistics were used to analyze data not normally distributed and significance levels were set at $p < 0.05$. For stepwise multiple regression analyses a stepping method criterion for entry was set at 0.05 and removal was set at 0.10.

E. RESULTS

1. Demographics of Sample

Fifteen SCI experts assisted in the development of the SMSCT scoring system. A total of 100 subjects consented to participate in the validation of the SMSCT. Eight subjects of 100, who enrolled in the study and planned to complete the test remotely, withdrew from the study due to

time constraints; one subject opted to withdraw due to lack of experience in SM. Table 2 provides descriptive summary statistics for subjects by group.

Table III-2 Demographic summary by group

Variable Mean (\pm SD)	Scoring System Developers	Validation Subjects		
	SCI Experts N=15	All Subjects N=91	External Validity Subgroups	
		Validation subjects N=15	SM Experts N=15	Ortho Experts N=10
Age	40.7 (7.0)	42.3 (10.4)	47.9 (8.1)	36.4 (5.4)
Gender	2 males 13 females	18 males 73 females	3 males 12 females	4 males 6 females
Years of clinical practice	15.1 (7.7)	15.9 (11.1)	24.7 (8.2)	9.2 (3.9)
SM service provision	12.2 (7.6)	9.0 (9.3)	20.6 (5.8)	0.1 (0)
Hours/week SM	22.0 (15.4)	12.3 (13.9)	26.2 (12.9)	0.0 (0)
SCI/year	405.6(278.8)	34.1 (73.0)	72.4 (83.7)	0.2 (0.0)
Prof. Level Degree	13 entry level 2 adv. level	56 entry level 35 adv. level	11 entry level 4 adv. level	3 entry level 7 adv. level

Abbreviations: SD, standard deviation; SCI, spinal cord injury; Ortho, orthopedic; SM, seating and mobility; SCI/yr, number of spinal cord injured patients treated per year; prof. level degree, professional level degree; adv, advanced.

2. Internal Structure Evidence

First, item analyses were conducted on all items to obtain internal consistency estimates of reliability for the two subscales. Since the original 67-item SMSCT had only a reliability coefficient of .50 for the assessment subscore and a negative coefficient of alpha of -.07 for the intervention subscore, we first looked at the intercorrelation matrix to identify poorly performing items. Next, we employed a stepwise reliability analysis to exclude, one by one, all the variables having a negative impact on reliability. The item with the largest negative correlation with the subscore was excluded and a new alpha coefficient calculated. This process was repeated until there were no negative correlations and only negligible changes in reliability resulted from excluding other items. In this fashion, the selection of the 40 “best” items resulted in Cronbach’s coefficient alphas for the assessment and intervention subscales of .78 and .71 respectively. The items remaining are listed in Table 3.

To assess the convergent and discriminate validity of the two subscales, we again correlated each item with its own scale (with the item removed) and with the other subscale. The results of these analyses are shown in Table 3. In six cases (questions 3, 19, 33, 41, 44, and 66), items were more highly correlated with the opposing subscale versus its own. A total of four items (questions 3, 17, 39 and 54) were found to be performing less than optimally, negligibly correlating with either subscale.

Table III-3 Correlations of items for convergent and discriminate validity evidence

Assessment Items	Domain		Intervention Items	Domain	
	Assessment	Intervention		Assessment	Intervention
Q1	0.33	-0.01	Q34	0.04	0.58
Q2	0.57	-0.19	Q35	0.12	0.16
Q3 †	-0.05*	0.16	Q37	0.12	0.17
Q4	0.37	-0.03	Q38	-0.08	0.30
Q5	0.43	-0.41	Q39 †	-0.21	0.01
Q7	0.30	-0.20	Q40	-0.14	0.55
Q8	0.48	-0.07	Q41	0.66	0.10*
Q11	0.31	0.19	Q42	-0.15	0.20
Q12	0.12	0.02	Q44	0.46	0.20*
Q13	0.49	-0.11	Q45	0.26	0.26
Q15	0.62	-0.38	Q46	0.07	0.48
Q17 †	0.08	-0.03	Q47	-0.15	0.39
Q19	0.35*	0.40	Q49	-0.38	0.34
Q21	0.11	-0.05	Q53	-0.02	0.45
Q24	0.38	-0.20	Q54 †	-0.07	0.04
Q27	0.39	0.09	Q55	-0.33	0.48
Q28	0.84	0.43	Q58	-0.38	0.61
Q29	0.37	0.03	Q64	0.00	0.15
Q32	0.31	-0.20	Q66	0.26	0.07*
Q33	0.13*	0.37	Q67	-0.28	0.22

Note: n =15 expert SCI Clinicians, * indicates items more highly correlated with the opposing knowledge scale versus its own, † indicates items performing less than optimally, negligibly correlating with either subtest

3. External Structure Evidence

Independent samples t-tests were used to evaluate the hypothesis that the SMSCT subscores (assessment and intervention) can differentiate between SM experts and Ortho experts. No significance was found between groups for the assessment subtest ($t= -0.3, p= 0.77$). However on the intervention subtest, subjects in the Ortho expert group (49.2 ± 9.2) scored lower

than those in the SM expert group (58.6 ± 11.1). The mean difference was significant ($t = -2.2, p = 0.04$). Figure 3 shows the distributions for all groups including SM and Ortho groups.

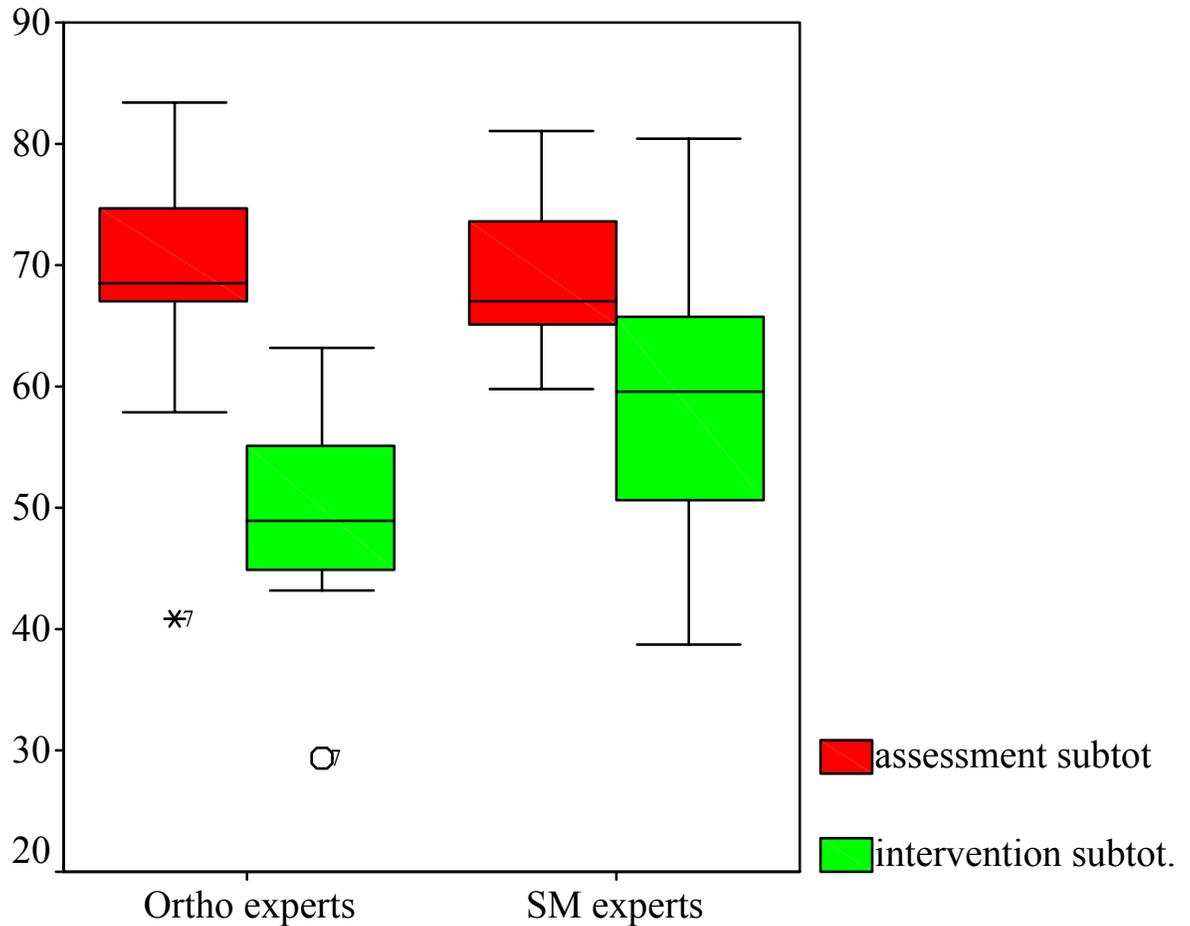


Figure III-3 Box plot of subtest scores by criterion group

Bivariate correlational analyses showed no significant relationships between assessment subscores and predictor variables of clinical expertise. The stepwise multiple linear regression analysis was, therefore, only completed using the intervention criterion variable. Just one variable was identified as a predictor of intervention score. This variable was SM hours/week and accounted for 11% of the variability of the intervention score ($F(1, 87) = 10.62, p = 0.002$).

F. DISCUSSION

To provide valid score interpretation, the technical quality of the test needs to be examined. Results for the SMSCT indicate some significant and noteworthy findings in addition to areas in need of further development. The intercorrelation matrix results showed reasonable item performance, with some items performing better than others. The initial pool of 67 SMSCT items had only a reliability coefficient of .50 for the assessment subtest and negative .07 for the intervention subtest. Test reliability was improved to satisfactory levels by removing 27 poorly performing items resulting in reliability coefficients of .78 and .71 respectively. Since reliability is a measure of item consistency, it is understood that low reliability indicates item inconsistency. Results indicate a number of poorly functioning items may be attributed to several reasons. There may be difficulty with item clarity, terminology, vignette information or hypotheses. Although item reliability was increased to satisfactory levels in removing poorly performing items, the tradeoff was decreased coverage of content identified as key to representing the population of individuals with SCI served by SM clinicians (Cohen et al., 2003). The breadth and scope of content covered was therefore narrowed. Clearly, several test items require further work in order to improve overall test and individual item performance. The revision and addition of items previously removed will increase content coverage to correspond with the original test blueprint and defined test content.

The second analysis, in combination with previously obtained content validity evidence, provides some degree of support that the SMSCT measures two unique constructs: knowledge and intervention. We anticipated high correlations for items within a subtest and lower correlations for items across subtests (assessment and intervention). The results indicated that on the whole this was the case. Six items, however, were more highly correlated with the opposing scale. Closer inspection of these items did not reveal an apparent reason for this contrary finding.

Based on professional judgment, we decided to retain these 6 items since removing them did not have considerable impact on reliability (Cronbach's alpha). Furthermore, 4 items were found to be contributing little to the overall subtest reliability. Visual inspection of these items did not reveal an obvious explanation. Therefore, we decided to rework all of these items prior to future administrations. For the purpose of these analyses, these problematic items were retained. Another potential limitation of these results might be that the values obtained in this work may overestimate the population reliability (alphas) because the sample that was used to create the scoring system was used for the item analyses and the reliability estimates. Therefore we recommend a pilot study in the future to verify the scoring system and to obtain item and test reliability statistics with unique but comparable groups of SCI experts.

In addition to the technical quality of the test, different sources of evidence are needed to support the meaning and interpretation of a test score. One type of evidence, external structure evidence, measures the extent to which scores converge or diverge with known qualities in the manner expected and are critical to the use and interpretation of the test (American Education Research Association, American Psychological Association, & National Council on Measurement in Education, 1999; Nitko, 2001). To provide evidence that the SMSCT differentiates between two groups of known qualities (SM and Ortho experts) we hypothesized that if the SMSCT is a measure of clinical expertise we would expect the scores of SM experts to be higher than Ortho experts. Merely because a clinician is an expert and, perhaps, knows a great deal about assessment and intervention, if their knowledge is not specific to SM for SCI, we would not expect their scores to be as high on the SMSCT. Results of the first analysis partially supported our hypothesis. No difference between groups on the assessment subtest was detected. Some may argue that assessment knowledge is not unique to expert group therefore resulting in

the inability to demonstrate the hypothesized relationships between assessment subscores and expert groups. Another possible explanation is that the actual assessment items may not be reflective of unique knowledge and skills specific to SM for SCI. A significant difference was detected between groups for the intervention subtest suggesting that these items were capable of detecting differences in intervention knowledge between two groups with known differences.

Construct under representation refers to the degree to which a test fails to capture important aspects of the construct it purports to measure (American Education Research Association et al., 1999; Nitko, 2001). It implies a narrowed meaning of test scores because the test does not adequately sample the domain of interest. For example, the SMSCT may under represent the content domain of assessment knowledge because it does not contain a sufficient variety of skills and knowledge specific to SM for SCI including the spectrum of clinical vignettes, hypotheses and common misconceptions. This may be further complicated by the fact that 39% of the assessment items were removed due to poorly functioning items therefore further limiting content coverage in the assessment domain.

Finally, to explore which proxy measures of clinical expertise can predict SMSCT score, we studied characteristics that were hypothesized to affect clinical expertise. We thought that clinicians who saw many patients with SCI/year, provided more hours of SM services, worked more years providing SM services and had advanced level professional degrees would have higher SMSCT scores on a test specific to the content domain of SM for SCI. The regression results suggested that clinicians that work more hours per week providing SM services are more likely to have higher intervention subscale scores. However, although significant, SM hours/week only made a small contribution suggesting that perhaps there are alternate factors that may be stronger indicators of clinical expertise. Other results indicate that SMSCT subscores

were not related to hypothesized criterion variables of clinical expertise. It is unclear why the anticipated associations were not found. In the field of SM there exists no reliable and valid measure of clinical competence or expertise. We were therefore pressed to rely on less precise alternative indicators of expertise. In this work, it is evident that the proxy measures of expertise selected were lacking. It is quite possible that SM expertise is something more than the characteristics we hypothesized.

By design, we chose to explore associations between SMSCT scores and hypothesized measures of clinical expertise. However, previous research in SCT validation in the area of medicine employed comparison groups including faculty, residents and clerks as criterion groups for obtaining external structure evidence (Charlin et al., 2000). In order to closer approximate the methodology used in the field of medicine, future studies might employ comparison groups including Assistive Technology Practitioners (ATP), therapy interns that have completed all professional coursework and therapy students. The use of comparison groups with known differences would allow the exploration of potential causal relationships. Exploring the data in this manner would eliminate the impact that occurs from the use of untested associations. Nonetheless, it is clear that more work is needed to identify accurate predictors of clinical expertise.

There is concurrence in the findings indicating that further SMSCT item revision is recommended. More vignettes and additional hypotheses incorporating common misconceptions should be considered for inclusion. Pilot test administrations with various groups of known qualities would likely identify whether the SMSCT is comprehensively measuring assessment and intervention knowledge through a wider range of abilities. Further research is needed to establish if perhaps alternate domains (other than assessment and intervention) are more useful

as measures of SM expertise for SCI. Nevertheless, we genuinely believe in the SMSCT item format and conceptual theory underlying the test design as a promising approach to measuring clinical expertise.

G. CONCLUSION

Preliminary validation of the SMSCT suggests that the test may be a promising measure of clinical expertise. Additional research should consider further item development, revision and pilot testing specific to construct representation and item performance. Additional validation is recommended using pre-established groups of known qualities. Future work is planned for the SMSCT for SCI as well as the development of similar tests in other content domains.

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**IV. THE SEATING AND MOBILITY SCRIPT CONCORDANCE TEST (SMSCT): AS
A MEASURE OF EDUCATIONAL EFFECTIVENESS**

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B. ABSTRACT

The Seating and Mobility Script Concordance Test (SMSCT) is a performance-based measure that has been designed for use with professionals that recommend seating and mobility devices to individuals with spinal cord injuries. It is designed to assess clinicians by examining the organization of their knowledge, associations between items of their knowledge, and adequacy of their clinical decisions compared to the consensus of expert therapists. To date, select validity evidence has been appraised for the SMSCT. The purpose of this study was to determine the validity of the SMSCT as a measure of educational effectiveness by determining if the test was capable of differentiating subjects by background and ability, before and after an educational intervention. A convenience sample of 61 clinicians attending an 8-hour professional education course completed a demographic questionnaire and a 13-item pre and posttest. A significant change in SMSCT mean scores was found before and after an educational program, ($t(49) = -2.7, p = 0.01$). One significant proxy measure of clinical expertise was found to be associated with posttest scores after controlling for pretest scores. That factor, professional clinical degree, accounted for 9% of the variability of the intervention score ($F = 5.0, r^2 = .09, p = 0.03$). Pilot results suggest that the SMSCT may be a promising measure of educational effectiveness. Future work will include further validity studies for the SMSCT and the development of similar clinical measurement tools in other content domains.

C. BACKGROUND

Assistive Technology (AT) is of critical importance to people with mobility impairments resulting from spinal cord injury (SCI) and other diseases. AT devices, such as mobility bases and seating systems, can enhance functional capabilities, and help to promote full community integration. Individuals with mobility impairments have the most potential for success when there is a suitable match between their needs and the equipment features of the seating and mobility (SM) technology that they use (Batavia & Hammer, 1990). The appropriateness of a consumer's SM system varies considerably depending on the competence, proficiency and experience of the professionals assisting the user (Bergen, Presperin, & Tallman, 1990; Herman & Lange, 1999; Trefler, Hobson, Taylor, Monahan, & Shaw, 1993).

Unfortunately, experienced and/or specially educated professionals trained to provide SM recommendations can be hard to find (Fifield & Fifield, 1997; Herman et al., 1999). With ever changing and emerging technologies available in the area of SM, it is necessary that professionals continually update their knowledge, skills and clinical competencies in order to provide quality care. The most widely accepted method of upgrading professional training is participation in continuing education activities. In the United States, numerous states require that clinicians provide proof of continuing professional education in order to renew their professional license and/or certification (Federation of State Boards of Physical Therapy, 2002; Commission on Practice, 1998). Yet, while the need to train more skilled professionals is clear, the most effective means of training and the tools to assess the effectiveness of training have yet to be identified (Davis, Thomson, Oxman, & Haynes, 1992; Grossman, 1998).

The Seating and Mobility Script Concordance Test (SMSCT) is a performance-based measure that has been designed for use with professionals that recommend seating and mobility

devices to individuals with spinal cord injuries. The SMSCT described by Cohen et al (Cohen, Fitzgerald, Lane, & Boninger, 2003a), is designed to evaluate the impact of educational experiences or clinical practice on the ability to make specialized clinical decisions about SM needs. The SMSCT is intended to assess clinicians by examining the organization of their knowledge, associations they make between items of their knowledge, and adequacy of their clinical decisions compared to the decision of expert consensus. Authors have hypothesized that differences between experts and novices lay primarily in experts' recall of meaningful relationships and patterns, that is, the structure of knowledge, rather than the problem solving strategy applied to the problem (Charlin, Roy, Brailovsky, & van der Vleuten, 2000; Schmidt, Norman, & Boshuizen, 1990).

The acquisition of expertise in a content area can be characterized by the development of distinctive memory structures called *scripts*, which are meaningful sets of connections among abstract concepts and/or specific experiences (Tardif & Boshuizen, 2000; Charlin et al., 2000; Schmidt et al., 1990). Information, such as the assumptions and hypotheses that is necessary to assess and manage clinical cases is retrieved through the activation of these scripts. Thus it follows, that in testing clinical expertise it is necessary to access these scripts by using specific, relevant clinical situations in the test items in order to assess the organization of knowledge. The SMSCT is designed for this purpose and founded in these principles. The test is comprised of 67 items divided into two subtests: 33 assessment knowledge items (49%) and 34 intervention knowledge items (51%) (Cohen, Fitzgerald, Lane, & Boninger, 2003b).

To date, SMSCT development and item generation has been described. Preliminary validity evidence (i.e.; content evidence, internal and external structure evidence) has been obtained (Cohen et al., 2003b; Cohen, Fitzgerald, & Boninger, 2003; Cohen et al., 2003a).

Content validity evidence describes the extent to which test items are representative and relevant to an instruments' domain of important content (American Education Research Association, American Psychological Association, & National Council on Measurement in Education, 1999). The internal structure of a measure refers to the extent to which individual items of a measure contribute to the total score and the extent to which item responses in one subtest compare to item responses in other subtests (Nitko, 2001). External structure of a measure refers to the degree to which test scores diverge or converge with known criteria in the manner expected (Nitko, 2001). Preliminary validation of the SMSCT suggests the test may be a promising new measure of clinical expertise (Cohen et al., 2003b).

However, thus far, the validity of the SMSCT as a measure of effectiveness for professional education has not been investigated. Therefore, that was the purpose of this exploratory pilot study. There were two aims: 1) to determine if changes in SMSCT scores could be detected before and after an educational program and 2) to identify proxy measures of expertise (as defined by years of clinical practice, years of seating and mobility provision, hours per week of seating and mobility services, number of spinal cord injured patients treated per year, and professional clinical degree) associated with SMSCT postscores.

D. METHODS

1. Participants

Sixty-one professionals (i.e., occupational therapists, physical therapists, rehabilitation engineers, rehabilitation technology suppliers and others) that enrolled in the preconference workshop entitled "Applying Research to Daily Practice: An Update on Manual Wheelchair Selection, Configuration and Training" (ARDP) conducted during the 19th International Seating Symposium in Orlando, FL. were recruited to participate in this study. Informed consent was obtained for all subjects per Internal Review Board protocol.

2. Scoring System for the SMSCT

Previous research has established that answers of experts' vary when they have to solve clinical problems, even in their own field of expertise (Charlin et al., 2000; Norman, 2000). The scoring system for the SMSCT is founded in the principle that any answer given by an expert has an intrinsic value, even if other experts do not agree with it. Hence, scores for each item of the SMSCT are computed from the frequencies given to each point of the Likert scale by the experts (Charlin et al., 2000). An example of the item format and item scoring are illustrated in Figure 1 and Table 1 (Cohen et al., 2003b). The score for each question is the proportion of experts who gave the same answer for the question and is weighted by the degree of agreement between experts. The modal answer on each item is used to transform item raw scores in order that the modal expert response on each item receive a maximum score of 1 and other experts' choices receive a partial credit score. Answers not chosen by experts receive a score of 0. The total score for a specific test is the sum of credit obtained on each item for each subject. Finally, the total score is transformed to get a maximum test score of 100 for ease of interpretation. A score of 100 signifies that the subject gives on each item the answer that most experts provide, and the lower the score the farther the examinees are from the experts' prototypic script for the situation.

A 42- year old female with T10 paraplegia presents with a complaint of pain when she lifts her right arm overhead.

<i>If you were thinking of (a hypothesis)</i>	<i>And then you find</i>	<i>This hypothesis</i>
Partial rotator cuff tear	No longer able to transfer to her tub seat without assistance	1 2 3 4 5

1. becomes almost eliminated
2. becomes less probable
3. is not affected by the new information
4. becomes more probable
5. becomes most likely probable

Figure IV-1 Sample SMSCT item

Table IV-1 Example of item scoring

	1	2	3	4	5
# of experts' answer	0	0	0	7	2
Raw score	0	0	0	7/9 (.77)	2/9 (.22)
Modal transformed score	0	0	0	7/7	2/7
Credit for the item	0	0	0	1	.29

Note: Total SMSCT test score is the sum of credit obtained on each item transformed to 100 for ease of interpretation.

3. SMSCT Test Administration Procedures and Data Management

All subjects completed a demographic questionnaire. Demographic information included gender, profession, professional clinical degree, years of clinical practice, years of SM service provision, number of SCI patients per year, type of AT training, diagnoses commonly treated, and professional development activities. Professional clinical degree was defined as a clinicians' highest degree acquired to practice physical or occupational therapy (i.e., entry level associates, bachelors, masters, or clinical doctorate versus advanced level masters, clinical doctorate or PhD).

Subjects then completed a 13-item pretest, prior to the start of the educational program. The pretest was a subset of items from the 67-item SMSCT selected from the best available items that covered important content defined in the learning objectives for the educational program. All subjects recorded their answers on a machine-scored answer sheet. Following the completion of the 8-hour educational program, subjects completed an identical 13-item posttest. Each test took approximately 20 minutes to complete.

All demographic data were entered into a Microsoft Access® database, coded and verified for accuracy. SMSCT data were processed by the Office of Measurement and Testing at the University of Pittsburgh and supplied to the research team as electronic data that was used for scoring and further analysis.

4. Educational Program

The primary purpose of the specially designed educational program was to present state-of-the-art research and development conducted in the area of manual wheelchair mobility for individuals with spinal cord injuries. The aim was to facilitate and translate research activities to AT clinical practice. The 8-hour course consisted of lecture, demonstration, group discussion and

a pretest-posttest. All participants received a course packet including handouts and reference materials and a certificate of attendance upon completion of the course posttest. Course learning objectives were for participants to: 1) explain the prevalence, cause and means of prevention of upper extremity overuse injuries in manual wheelchair users 2) explain the prevalence, cause and means of prevention of neck and low back injuries in manual wheelchair users 3) appropriately order, set up, and train manual wheelchair users to maximize function and minimize the risk of injury 4) describe manual wheelchair Medicare classes and components that can effect seating including selection of wheels, cushions, back supports, suspension systems, and pushrims and 5) explain special considerations when prescribing manual wheelchairs for individuals with multiple sclerosis or other progressive disorders.

5. Procedures for Obtaining Validity Evidence

Initial analyses of data were completed to look at data normalcy, outliers and summary statistics. Descriptive statistics were used to describe group demographics. Frequency counts were used with nominal data, and measures of central tendency were used with continuous data. For all analyses, parametric statistics were used for normally distributed variables, homogeneity of group variances were estimated using the Levenes' test, nonparametric statistics were used to analyze data not normally distributed and significance levels were set at $p < 0.05$. To explore individual differences between pretest and posttest mean scores a paired samples t-test was conducted. A stepwise multiple linear regression was conducted to explore associations between postscores and proxy measures of expertise after controlling for prescores. The predictor variables (proxy measures of clinical expertise) are years of clinical practice, years of SM provision, hours/week of SM, number of SCI/year, and professional clinical degree. The prescore was first forced into the model and then the 5 proxy measures of expertise were entered in a

stepwise method. For the linear multiple regression analyses, a stepping method criterion for entry was set at 0.05 and removal was set at 0.10.

E. RESULTS

1. Demographics of Sample

A total of 61 subjects were enrolled to participate in the study. Fifty subjects completed the study. Eleven subjects did not complete the study: five withdrew, four completed the pretest only and two were ineligible to participate due to their previous involvement in a different SMSCT development study. Table 2 provides descriptive summary statistics for study participants.

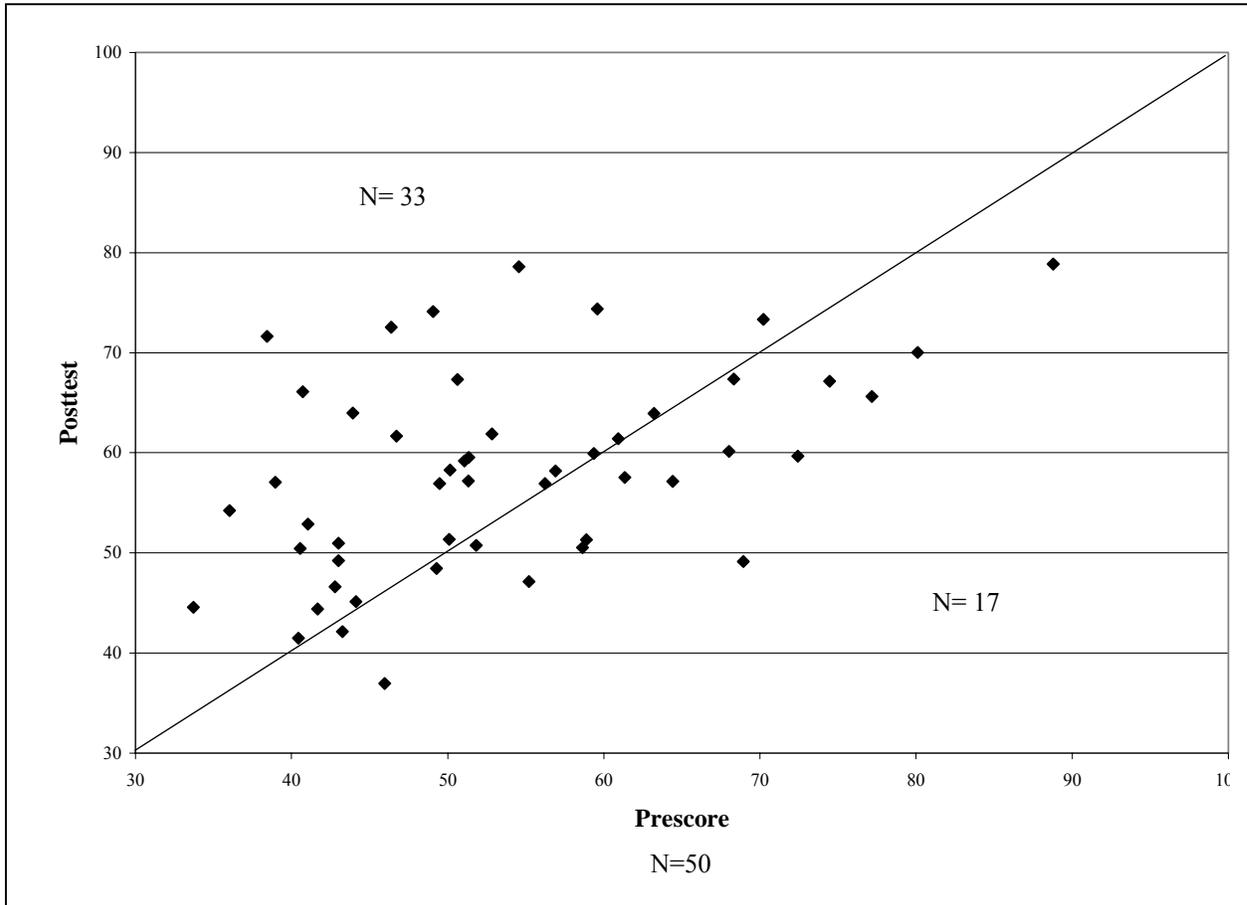
Table IV-2 Sample demographics

Variable	Mean	SD	Range
Age	39.2	24.4	24.4-69.5
Gender	21 males 29 females		
Years of clinical practice	12.4	8.4	2.0-30.0
SM service provision	8.8	7.3	0.0-31.0
Hours/week SM	16.8	14.4	0.0-50.0
SCI/year	72.7	161.7	0.0-1040.00
Professional clinical degree	5 no degree 37 entry level 8 advanced level		

2. Validity Evidence

A significant change in mean scores was found ($t(49) = -2.7, p = 0.01$) before and after an educational program. The SMSCT pretest scores ranged from 34-89 (53.7 ± 12.4) and posttest scores ranged from 37-79 (58.1 ± 10.1). One subject had a high pretest score of 89. Omitting this outlying score, the posttest score range was otherwise comparable to the pretest score range. Figure 2 is a bivariate plot of individual SMSCT scores obtained at pretest and posttest. The x-axis represents the SMSCT pretest score and the y-axis represents the posttest score. The diagonal line represents equal SMSCT scores for both the pretest and the posttest. Data points plotted above the line show subjects with greater posttest scores and data below the line show subjects with greater pretest scores. The majority of subjects showed improvement in their posttest score following the educational program. There was no apparent pattern between test scores for subjects that scored lower on the posttest than the pretest. The scores noted below the line ranged from 43-89. Low scorers (i.e. <50) did not score lower on the posttest more frequently than high scorers (i.e. >50). The stepwise multiple regression analysis identified one factor as a predictor of posttest score after controlling for pretest score. That factor, professional clinical degree, accounted for 9 % of the variability of the intervention score ($F = 5.0, r^2 = .09, p = 0.03$).

Figure IV-2 Scatterplot of pretest and posttest scores



F. DISCUSSION

In this exploratory pilot study we expected to recruit up to 100 subjects however only 50 subjects completed the study. Despite the inherent limitation of a small cohort of subjects some noteworthy findings were detected. The results revealed that the SMSCT as a measure of educational effectiveness has preliminary evidence to support its validity. The SMSCT was able to detect differences in test scores before and after an educational program.

Different sources of evidence are needed to support the meaning and interpretation of a test score (i.e. its validity). To provide evidence that the SMSCT is a measure of educational

effectiveness we hypothesized that test scores would change after an educational program. We expected postscores to be higher than prescores. Results of the first analysis partially supported our hypothesis. The majority of subjects (66%) showed improvement in their posttest scores following the educational program. A closer inspection of the data exploring the subjects that scored lower on the posttest than the pretest, revealed no apparent pattern; scores were distributed across the range. One explanation is that the actual items may not have reflected the unique knowledge and skills included in the educational program; another is that the educational program was ineffective. An alternative explanation may be that subjects were fatigued following the 8-hour educational program and were not motivated to complete the posttest. Conversely, subjects may have had improved scores from practice or recall. These preliminary results suggest that additional studies could be done. Future studies should incorporate a control group that does not participate in the educational program in order to determine the extent change in score was due to participation in the educational program. A third administration of the test might be considered at a later date (i.e. 4-6 months) to determine if the test-retest time interval affected scores. Follow-up test administrations may provide additional information about the stability of these changes over time following an educational program.

The interpretation of test scores relies heavily on the intrinsic structure of the test and consistency of the individual items. The test administered in this study consisted of a subset of the 67-item SMSCT, selected from the *best* available items that covered important content defined in the learning objectives for the educational program. Prior work by Cohen et al (Cohen et al., 2003b) suggests that the technical quality of the SMSCT may include evidence of a number of poorly functioning items. The initial pool of 21-pre and posttest items, selected from the SMSCT as matching the content of the educational program, had only a reliability coefficient

of .21 for the assessment subtest and negative .40 for the intervention subtest. Formally obtained internal structure evidence for the 67-item SMSCT, identified several poorly functioning items. These items were therefore removed from the pretest-posttest pool resulting in the 13-item test used. Test reliability, however, only minimally improved resulting in reliability coefficients of .23 and .31 respectively. Since reliability is a measure of item consistency, it is understood that low reliability indicates item inconsistency. Further work in improving individual items and the SMSCT as a whole is recommended and would extend to the subset of items used for this study. Less than optimally performing test items may be another contributing factor explaining why some subjects had lower postscores than prescores.

Construct representation refers to the degree to which a test captures important aspects of the construct it purports to measure (American Education Research Association et al., 1999; Nitko, 2001). Associated validity evidence obtained for the 67-item SMSCT indicates that the test measures two unique constructs: assessment knowledge and intervention knowledge (Cohen et al., 2003b). By design, the subset of items used for the pre-posttest was comprised of 33% assessment items and 67% intervention items. After removing items identified as poorly functioning, content coverage by subtest remained essentially unchanged; however the tradeoff was decreased coverage of content covered in the educational program (Cohen et al., 2003a). The breadth and scope of content tested was therefore narrowed.

The SMSCT was designed to measure the extent clinicians incorporate new learning into existing structures of knowledge or scripts and then utilize this knowledge when making specialized clinical decisions about SM needs, not specifically as an outcome measure for this specific educational program. Therefore, information presented in the educational program may not have incorporated knowledge specific to the items represented in the pre-posttest items

administered. We attempted to maximize content representativeness when selecting the subset of items administered by carefully reviewing the educational program learning objectives, materials and teaching methods. It is, however, possible that the items selected were not the strongest performing items to reflect the content of the course. In practice, we must include test items with less than ideal statistical properties so the test can match important subject matter content. A subset of SMSCT items found to have adequate consistency, functioning, and content, relevant to the educational program would be preferred for future studies.

Finally, to explore which proxy measures of clinical expertise can predict posttest scores controlling for pretest scores, we studied characteristics that we hypothesized might affect clinical expertise. In the field no clinical specialist recognition, specific to SM exists. We were therefore pressed to rely on less precise alternative indicators of expertise of unknown accuracy. We hypothesized that clinicians that had many years of clinical practice, worked more years providing SM services, provided more hours of SM services, saw many patients with SCI/year, and had advanced clinical degrees would have higher SMSCT scores on a test specific to the content domain of SM for SCI. The stepwise multiple linear regression results suggest that when controlling for prescores, clinicians with advanced clinical degrees are more likely to have higher postscores following an educational program. However, although significant, professional clinical degree only made a small contribution accounting for 9% of the variance in posttest score. These results differ from previous SMSCT validity evidence that showed SM hours/week made a small contribution to the variance in SMSCT scores (Cohen et al., 2003b). This difference, nonetheless, could be due to several alternate reasons: the use of different linear regression models, varying subject samples or the significance of the predictor variable.

G. CONCLUSION

There is concordance in the results from this pilot study and previous SMSCT validity studies. Pilot results suggest that the SMSCT can detect changes before and after an educational program and may be a promising measure of educational effectiveness. Future studies of educational effectiveness are recommended. Additional research should consider an experimental design using a control group to explore the extent to which the educational program contributes to change in score. A follow-up administration several months following the educational program could explore the stability of scores over time. Data obtained from this suggested work may also provide valuable evidence to support the conceptualization of the SMSCT by verifying that the acquisition of expertise in a content area can be characterized by 1) the development of scripts that can be learned, 2) organized in memory, 3) accessed later to solve problems and 4) changed with experience (Charlin et al., 2000; Tardif et al., 2000; Schmidt et al., 1990). Future exploration of the SMSCT as a measure of educational effectiveness should be delayed until SMSCT item revision, trial, and appraisal of internal structure evidence is complete. Once this is completed, future work is planned for the development of similar tests in other content domains.

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V. CONCLUSIONS

The primary purpose of this dissertation was two-fold; first to develop and validate a measurement tool that will evaluate the impact of educational experiences or clinical practice on clinicians' ability to make specialized decisions about seating and mobility (SM) needs for individuals with spinal cord injury (SCI). The second was to obtain and appraise validity evidence to support how scores for the measure are interpreted. The product of this dissertation is the Seating and Mobility Script Concordance Test (SMSCT), a performance-based measure of clinical expertise designed to assess clinicians by examining the organization of their knowledge, associations between items of their knowledge, and the adequacy of their clinical decisions, as compared to expert consensus. This dissertation was comprised of a series of three, inter-related studies.

The first study described the conceptual foundation, item generation process and content validity evidence obtained to result in the SMSCT. The SMSCT was constructed to distinguish between individuals with novice, intermediate and expert knowledge; examine the results of pre and post-service educational programs, and determine the level of competency for student and novice therapists. Content validity evidence describes the extent to which test items are representative and relevant to an instruments' domain of important content. We obtained content validity evidence throughout the SMSCT development phase. The appraisal of this evidence assisted in identifying content areas that were not satisfactorily represented and allowed development of additional items to provide adequate content coverage. This evidence also helped us to identify issues with test format, vignettes, and items; permitting us to make changes and revisions.

A process comprised of three components was employed in the development of the SMSCT; interviews, test development and content/item review. The interviews helped us to

identify similarities and themes describing standards of practice for professionals recommending SM technologies to individuals with SCI. These interviews also enabled us to: identify unique skills of SM experts, knowledge and skills that differentiate SCI experts from other SM clinicians and novice clinicians, and common misconceptions in clinical practice. Two other documents developed by work groups of stakeholders in the service delivery process to reflect content specific knowledge were used to verify the data obtained during the interviews (RESNA, 1996; RESNA, 1997). These data were triangulated to confirm the thoroughness of our findings and to ensure that no important aspects of SM clinical practice were overlooked.

SMSCT items were reviewed for content and clarity on two separate occasions. This was done initially to aid test developers in item writing and revision and secondly to verify that test revisions did not create unintended problems. Feedback from content and item reviewers resulted in several modifications to SMSCT item format, vignettes and items. Original subtest dimensions were modified to better represent clinical practice in the domain of SM resulting in assessment and intervention subtests. The response option scales for each subtest were modified to provide softer endpoints to maximize the use of the entire range of the response scale. Instruction sheets with sample items were added to allow test takers an opportunity to *warm-up* to the test response format. Modifications were made to individual items and vignettes to clarify terminology or provide additional information. Supplemental items and vignettes were developed to improve content coverage.

Results of this first study established that the 67-item SMSCT reflects adequate representation of the dimensions of assessment and intervention knowledge for SM for SCI. The resultant version of the SMSCT was comprised of 33 assessment knowledge items (49%) and 34

intervention knowledge items (51%). This version of the SMSCT was used for preliminary test administration and psychometric testing in subsequent dissertation studies.

The second study describes the development of the SMSCT scoring system and appraises the internal structure of the SMSCT items as well as the external structure evidence to support how the test is interpreted. First the technical quality of the test was examined. Reliability analyses showed reasonable item performance, with some items performing better than others. The initial pool of 67 SMSCT items had low reliability that was improved to satisfactory levels by removing 27 poorly performing items. Although item reliability was increased to satisfactory levels in removing poorly performing items the tradeoff was decreased coverage of content identified as key to representing the population of individuals with SCI served by SM clinicians (Cohen, Fitzgerald, Lane, & Boninger, 2003a).

In combination with content validity evidence obtained in the first study other corroborating support that the SMSCT measures two unique constructs: knowledge and intervention was found. We anticipated high correlations for items within a subtest and lower correlations for items across subtests (assessment and intervention). The results indicated that on the whole this was the case.

In addition to the technical quality of the test, different sources of evidence were needed to support the meaning and interpretation of test scores. To provide evidence that the SMSCT was a measure of SM clinical expertise we investigated the hypothesis that SM experts would receive higher test scores than Ortho experts. Merely because a clinician was an expert and was knowledgeable about assessment and intervention, we would not expect their SMSCT scores to be as high if their knowledge was not specific to SM for SCI. Results from this work partially supported this hypothesis. No difference between groups was found on the assessment subtest

whereas a significant difference was found between groups on the intervention subtest. One explanation for this finding may be that assessment knowledge is not unique to expert group therefore resulting in the inability to demonstrate the hypothesized relationships. Another possible reason is that the *best* remaining assessment items were not reflective of unique knowledge and skills specific to SM for SCI.

Due to the removal of more than a few poorly performing items (40%) it is quite possible that the resultant 40-item test had content underrepresentation. The test potentially no longer contained sufficient variety of skills and knowledge specific to SM for SCI including the spectrum of clinical vignettes, hypotheses and common misconceptions. The revision and addition of items previously removed, due to poor functioning, will increase content coverage to correspond with the original test blueprint and defined test content. Follow-up studies utilizing focus groups of SM experts are recommended to aid in revision of existing items and vignettes, as well as to assist in the development of supplemental items. A trial test administration is suggested. The purpose would be to obtain preliminary internal structure evidence prior to administering the test to a larger sample for additional psychometric testing.

To further support the meaning and interpretation of test scores we investigated which proxy measures of clinical expertise could predict SMSCT scores. Significance was found for only one variable. Results indicated that clinicians that work more hours per week providing SM services are more likely to have higher intervention subscores. These results although significant only made a small contribution to the variability of the intervention score suggesting that perhaps there are alternate factors that may be stronger indicators of clinical expertise. It is evident from the results that the proxy measures of expertise selected were lacking. It is recommended that additional external validity evidence be obtained using comparison groups with known

differences (i.e., ATP, therapy interns and therapy students). Therefore the investigation of score convergence and divergence with comparison groups with known dissimilarities could be explored versus relying on less precise measures of association (i.e., proxy measures of expertise). Given that this study was conducted with a convenience sample of clinicians attending a continuing education conference specializing in SM, it is probable that there was a sampling bias. It is likely that this bias influenced the ability to detect significant differences in SMSCT scores since it is quite likely that our sample was missing subjects from the lower end of the spectrum and was not representative of an adequate diversity and range of expertise. Future studies should include samples that will tap into subjects with a larger range of SM exposure.

Also, a separate but related line of research is needed to identify accurate correlates of SM clinical expertise. External validity evidence can be obtained by comparing test scores to a criterion test of known quality. Given that there are no valid and reliable measures of expertise in the area of SM an alternate option would be to compare the performance on the SMSCT to that of a measure of minimal clinical competency for AT, the RESNA Assistive Technology Practitioner certification examination. Though, the RESNA ATP exam has undergone limited psychometric testing, external validity evidence has not been appraised; therefore this exam may not prove to be a strong correlate of clinical expertise for AT or SM (RESNA, 2000).

The third study explores the use of the SMSCT as a measure of educational effectiveness. The purpose of this study was to determine if the test is capable of differentiating subjects by background and ability before and after an educational program.

Results showed that changes in SMSCT scores could be detected before and after an educational program with the majority of subjects showing an improvement in scores following the educational program. No apparent pattern in scores was detected for subjects that scored

lower on the posttest than the pretest. One possible explanation for this is that the administered items may not have reflected the knowledge and skills included in the educational program. Alternatively, improvement in scores may have been for a reason other than the benefits of the educational program such as a practice or recall effect. Results may also be attributed to the small item pool used for the study; conceivably negatively impacting test reliability and content representation.

The findings of this third study suggest that additional research might be done to: determine the extent that change in scores could be attributed to the educational program; if the test-retest time interval affected scores; and to obtain additional information about the stability of scores over time following an educational program. It is recommended that these follow-up studies be delayed until SMSCT item revision, trial and appraisal of internal structure evidence is complete. The proxy measure of clinical expertise, professional clinical degree was found to account for only a small amount of the variance in posttest scores; a different finding than that in Study 2 (Cohen, Fitzgerald, Lane, & Boninger, 2003b). This most certainly was influenced by the small sample size and probable sampling bias. Investigations to identify stronger correlates of clinical expertise are still needed.

Initial psychometric testing maintains that the SMSCT is a promising new measure of clinical expertise. Additional SMSCT revision and validation is required. To begin with, items identified, as poorly functioning and/or removed from the SMSCT-67 should be closely examined. Responses from the different groups (SCI experts, SM experts and validation subjects) should be compared, and individual items classified based on the distance in range of responses among the SCI experts. Items with strong agreement between the experts within one or two response options should be classified as *good items*, three options as *adequate*, and *poor* for

items with greater than a three-option distance between responses. The range of response options should also be examined for the other groups (SM experts and validation subjects) to determine if there is dissimilarity in the manner items were answered. Items with no disparity in responses between groups should be examined and included in the item pool for further revision or improvement, since these items may not be differentiating groups as expected.

A focus group made up of 4-5 expert SCI experts is recommended for item revision and the creation of supplemental items and vignettes. Discussion and interaction amongst the SCI experts will be essential to identify causes and potential explanations why some items may be of inferior quality than others. SCI experts can comment and offer recommendations to improve items. Suggestions may be in the form of providing additional information in the clinical vignette, alternate plausible hypotheses, clinical finding or supplier recommendation. In order to adequately represent the test blueprint new items may need to be created to better represent common misconceptions and the variety of skills and knowledge specific to SCI.

Once items are revised and rewritten a trial test administration is suggested using a unique sample of SCI experts. The purpose of this trial test would be to obtain preliminary internal structure evidence and determine if item functioning has reached an adequate level prior to administering the test to a larger sample for additional psychometric testing. This iterative process should be repeated until the SMSCT item pool has attained satisfactory item reliability.

Nevertheless, I genuinely believe in the SMSCT item format and conceptual theory underlying the test design. Future work is planned for the SMSCT for SCI as well as the development of similar tests in other content domains.

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APPENDIX A

RESNA

GUIDELINES for Knowledge and Skills for Provision of Assistive Technology Products and Services

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GUIDELINES
for Knowledge and Skills for
Provision of Assistive Technology
Products and Services

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PREFACE

This document presents the *Guidelines for Knowledge and Skills for Provision of Assistive Technology Products and Services*, 1st Edition, implemented by Assistive Technology Practitioners (ATP) (which includes Rehabilitation Engineers), and Assistive Technology Suppliers (ATS) relative to their respective roles in assistive technology service provision. The knowledge outlined is the identified knowledge with which a provider will need to be familiar; not be an expert in all areas, but have a sufficient understanding to seek the assistance of a collaborator and be able to have a conversation with the other professional. No one person will have "Analysis and Synthesis" level of understanding for each of these knowledge areas, but everyone will need identification and recall level of understanding to ensure effective team communications. This document was created assuming that each role of the service provider would include extensive collaboration with other professionals, family members, significant others, and most importantly, the consumer. Collaboration with other professionals and significant others not regularly participating in the technology team, but important in the consumer's life, is recommended. Interwoven throughout the specific roles are General Skills described in page one of this document. This is the first edition of this document. As technology continues to evolve, so will the knowledge, tasks and skills necessary in the provision of that assistive technology. RESNA asks for your input. Please use the form at the end of this edition to send us your comments.

The *Guidelines* define five critical interactive roles for individuals involved in assistive technology service provision. Each role is described by a set of tasks, which are supported by the skills and knowledge that the person must learn or know in order to complete the tasks. An appendix for each role provides detailed knowledge necessary for each task and skill.

Role number one (1) describes the necessary technology background. Role two (2) through four (4) focus on how to apply that technology background to benefit a consumer -- first through an evaluation, and then by planning and implementing the appropriate intervention for the consumer. Finally, role five (5) describes how the provider must conduct follow-up and make appropriate changes.

Expected General Skills

The attached guidelines are based on the fact that any professional involved in the provision of assistive technology services possess the outlined fundamental skills which will be used throughout the process. The following are general skills all these professionals are expected to possess.

The ability to:

1. Recognize own skills and knowledge and limit individual practice accordingly.
2. Operate within RESNA's Code of Ethics and Standard of Practice.
3. Communicate effectively including listening, speaking, and writing.
4. Understand appropriate terminology.
5. Collaborate with consumer and other team members in planning and implementation of service delivery.
6. Support advocacy as appropriate.
7. Provide timely, well-organized case management.
8. Recognize the need (how, when, and where) to refer a consumer to another professional.
9. Access information available through a wide variety of sources and formats.
10. Remain current on best practices and emerging technology through ongoing continuing education.
11. Respond to inquiries regarding assistive technology issues.

1.0.0. ROLE: Get to know the consumer, their needs and environments. Evaluate the consumers, tasks, and environment.

1.1.0. TASKS

- 1.1.1. Assist the consumer in clarifying and prioritizing their goals.
- 1.1.2. Account for consumer's possible future needs.
- 1.1.3. Interpret the results of various evaluations to determine how abilities relate to the use of assistive technology.
- 1.1.4. Evaluate existing and past use of technology.
- 1.1.5. Evaluate abilities and functional deficits as they relate to the use of specific assistive technology.
- 1.1.6. Assess the environmental impact, both physical and social as related to the potential use of the assistive technology.
- 1.1.7. Evaluate the tasks, functional demands and resources within the environments.
- 1.1.8. Refer to and work with other professionals when appropriate.

1.2.0. SKILLS

- 1.2.1. Interview the consumer, family, caregivers, and other team members.
- 1.2.2. Recognize the need for and acquire information necessary for evaluation, e.g., medical, educational, vocational records and plans.
- 1.2.3. Present evaluation findings to assist consumer in clarifying their goals.
- 1.2.4. Perform a task analysis.
- 1.2.5. Evaluate the consumer's abilities and functional deficits.
- 1.2.6. Assess all environments in which the technology is intended to be used.
- 1.2.7. Recognize the need for further evaluation by other professionals and initiate referral process.
- 1.2.8. Understand and synthesize acquired information.

1.3.0. KNOWLEDGE

Assistive Technology Specific Studies

- 1.3.1. Human Performance - Technology Evaluation I
(Posture, Mobility, Communication, Sensory Impairments)
- Describe assistive technology evaluation process.
 - Interview, objective evaluation of consumer, environmental assessment, goal setting.
 - Identify and perform objective evaluation using measurement tools.
 - Analysis of function and standard techniques of measuring physical condition and functional capacity.
 - Posture: Range of motion, strength, motor control, sensation.
 - Mobility: ROM, strength, motor control, perception, cognition.
 - Communication: Cognition, language, motor control, articulation
 - Sensory Impairment: Vision, auditory, sensation
 - Describe team process.
 - Skills of training of other disciplines.
 - Referral Process - when, where, and how.
 - Describe objective measures to evaluate current use of technology.
 - Sitting tolerance, skin integrity
 - Rate of communication
 - W/C Mobility Skills
 - # of communication partners
- 1.3.2. Human Performance - Technology Evaluation II
(Home [ADL, homemaking], Education, Vocation, Leisure, Transportation)
- Analysis of Tasks performed by Consumers
 - Identification of Critical Functional Abilities and Deficits
 - Objective Measurement of Ability and Environment
 - Tasks in Home Environment (ADL, Cooking, Child Rearing, Cleaning, etc.)
 - Tasks in School Environment (note taking, exam taking, computer, access)
 - Tasks in Vocational Environment (job specific tasks, telephone)
 - Tasks for Leisure (consumer specific interests)
 - Tasks for Transportation/Driving

- Public transportation
- Private passenger
- Driver

1.3.3. Environmental Assessment
(Home, School, Work, Leisure, Transportation)

- Accessibility (Codes)
- “Technology Tolerance” of Environment

1.3.4. Options in Funding A.T.

- Describe sources of 3rd party payment (medical, education, vocational resources)
- Describe procedures and documentation required for each type of funding
- Describe underlying legislation or regulation for each.
- Describe appeal process for each.
- Describe how to identify and locate available funding sources for individual consumers.
- Describe the role of the funding source as it relates to the assistive technology team.
- Describe services and facilities that may be helpful to users and how to locate them.

Basic Background Knowledge:

1.3.5. Psychology

- Cognition, perception, attention span, memory, depression, peer/family pressure.
- Learning styles, learning performance.

1.3.6. Sociology

- Value systems, cultural values (norms and mores), interpersonal relations, social supports.

1.3.7. Normal and Abnormal Development through the lifespan.

- Motor Development
- Language Development
- Cognitive Development
- Sensory Development
- Normal Aging Process

1.3.8. Human Anatomy & Physiology

- Musculoskeletal system common to specific functional movement
 - Identify muscle groups, joints, sensory elements
- Central and Peripheral Nervous System
 - Identify vestibular, visual, oculomotor, auditory and sensory systems; main areas of brain and functional importance
- Oral Motor/Respiratory Systems
 - Describe coordination of respiratory, phonatory, articulatory systems
 - Describe coordination of respiratory and swallowing systems
- Cardio-Pulmonary Systems
 - Describe cardiovascular and respiratory capacities, components of systems and methods of measuring exertion
- Skin and Soft Tissue
 - Physiology and Effect of pressure and shear; Effects of moisture and hygiene in skin care.

1.3.9. Kinesiology and Biomechanics

- Mechanical terminology related to human posture, movement and function.

1.3.10. Disability Studies

- Common etiologies and pathologies leading to disabilities (congenital, traumatic,

disease)

- Physical, sensory, cognitive, and learning disabilities.
 - Functional prognosis for a given disability
 - Effect of disability on development
 - Aging with a disability

2.0.0. ROLE: Develop an Intervention Strategy with the consumer and other team members.

2.1.0. TASKS

- 2.1.1. Integrate and discuss all evaluation information and formulate proposed action plans and/or recommendations.
- 2.1.2. Evaluate and interpret technical differences among various solutions for consumers to make final selection.
- 2.1.3. Explain pros and cons of different solutions for consumers to make final selection.
- 2.1.4. Evaluate possible technology solutions during appropriate equipment trials.
- 2.1.5. Identify training and technology support needs.
- 2.1.6. Document technology and related services specifications and determine costs.
- 2.1.7. Direct consumer to appropriate funding sources.
- 2.1.8. Develop a follow-up plan.

2.2.0. Skills

- 2.2.1. Define potential intervention strategies and generic technology features which could facilitate achieving the goal.
- 2.2.2. Develop an action plan.
- 2.2.3. Define measurable objectives by which to compare potential solutions.
- 2.2.4. Measure and evaluate effectiveness of potential solutions.
- 2.2.5. Seek and integrate consumer feedback during trial opportunity.
- 2.2.6. Organize information and communicate pros and cons of each solution.
- 2.2.7. Recognize when training is appropriate.
- 2.2.8. Organize information in written form to communicate needs, solutions and justifications.
- 2.2.9. Participate in conflict resolution and consensus building.

- 2.2.10. Write clear specifications and/or drawings for a cost estimate.
- 2.2.11. Distinguish the appropriateness of technical and non-technical, off-the-shelf, modified or custom solutions.
- 2.2.12. Develop knowledge base of funding sources and distinguish appropriate sources for specific interventions.
- 2.2.13. Confirm consumer's goals.
- 2.2.14. Identify measurable outcomes to monitor progress toward achieving stated goals.
- 2.2.15. Compare existing and/or past use of technology to new technology being considered.

2.3.0. KNOWLEDGE

Assistive Technology Specific Studies:

- 2.3.1. Human Performance - Technology Evaluation I
(Posture, Mobility, Communication, Sensory Impairments)
 - Describe A.T. evaluation process
 - Interview, objective evaluation of consumer, environmental assessment, goal setting.
 - Identify and perform objective evaluation using measurement tools.
 - Analysis of function and standard techniques of measuring physical condition and functional capacity
 - Posture: Range of motion, strength, motor control, sensation.
 - Mobility: ROM, strength, motor control, perception, cognition.
 - Communication: Cognition, language, motor control, articulation
 - Sensory Impairment: vision, auditory, sensation
 - Describe team process
 - Skills of training of other disciplines
 - Referral process - when, where, and how
 - Describe objective measures to evaluate current use of technology
 - Sitting tolerance, skin integrity
 - Rate of communication
 - W/C mobility skills
 - # of communication partners
- 2.3.2. Human Performance - Technology Evaluation II

(Home (ADL, homemaking), Education, Vocation, Leisure, Transportation)

- Analysis of Tasks performed by Consumers
- Identification of Critical Functional Abilities and Deficits
- Objective Measurement of Ability and Environment
 - Tasks in Home Environment (ADL, cooking, child rearing, cleaning, etc.)
 - Tasks in School Environment (note taking, exam taking, computer, access)
 - Tasks in Vocational Environment (job specific tasks, telephone)
 - Tasks for Leisure (consumer specific interests)
 - Tasks for Transportation/Driving
 - Public transportation
 - Private passenger
 - Driver

2.3.2. Assistive Technology Intervention I (Posture, Mobility, Communication, Sensory Impairments)

- Describe the hierarchy of assistive technology for each need (posture, mobility, communication, sensory impairments)
- Describe available technology solutions for broad functional disability issues.
- Identify the key features of a product (expressed and implied) as they relate to “target” or specific users.
- Describe how choice of material and design relates to function..
- Evaluate/analyze how well the key features of a product meet the need of the target group.
- Describe the factors related to cost of a device: custom versus mass produced, size of market, liability, warranty.
- Describe the key environmental considerations for safe, effective use of the technology.
- Describe when and how to access product information; including product-development information.
- Describe basic operating functions for each device.

2.3.3. Assistive Technology Intervention II (Home, Education, Work, Leisure, Transportation)

- Describe the hierarchy of assistive technology for each need (home, education, work, leisure, transportation).
- Describe available technology solutions for broad functional disability issues.
- Identify the key features of a product (expressed and implied) as they relate to “target” or specific users.
- Describe how choice of material and design relates to function..
- Evaluate/analyze how well the key features of a product meet the need of the target group.
- Describe the factors related to cost of a device: custom versus mass produced, size of market, liability, warranty.
- Describe the key environmental considerations for safe, effective use of the technology.
- Describe when and how to access product information; including product-development information.
- Describe basic operating functions for each device.

2.3.4. Human Device Interface

- Integrate functional and technical information.
 - List and describe possible outcomes such as the ability to communicate, remain seated, return to work, access education, be independent in activities of daily living or no change.
 - Identify the solutions that may help accomplish the desired outcomes: Device selection, training, local resources.
 - Identify potential access methods to operate appropriate devices.
 - Identify extrinsic constraints and limitations which impact potential solutions.
Environmental Factors;
Cost
Available Funding
 - Identify the characteristics of technology in relationship to users.
 - Identify and verify the need for custom technology solutions.
 - Describe the functional outcomes expected from use of the solution.
 - Describe the technology set-up (device, access method, programming, adjustments, etc.) used during equipment trials.
 - Describe the functional milestones to be demonstrated when using the technology.
- Describe the interdependence of various interventions.

- Define the range of appropriate interventions from technology, training, medications, surgery, therapy, education, or counseling.
- Describe the relationship between therapy and assistive technology interventions.
- Describe the intervention among various technologies in meeting needs of the consumer.
- Describe the trade-offs and constraints in formulating an optimal solution.
- Describe the characteristics of the technology in relationship to the user.
 - Translate a set of recommendations for technology into a set of specifications to be ordered.
- Describe the process of re-evaluation after procurement to determine impact of intervention.
 - Describe the criteria to be used to judge the consensus success or failure on a continuum.
 - Describe objective outcomes to be used to measure consumer's performance.

2.3.5. Options in Funding A.T.

- Describe sources of 3rd party payment (medical, education, vocational resources)
- Describe procedures and documentation required for each type of funding
- Describe underlying legislation or regulation for each.
- Describe appeal process for each.
- Describe how to identify and locate available funding sources for individual consumers.
- Describe the role of the funding source as it relates to the assistive technology team.
- Describe services and facilities that may be helpful to users and how to locate them.

2.3.6. Service Delivery Administration

- Describe the most common service delivery systems.
 - Describe different strategies for service delivery.
 - Describe follow-up, training, etc., available with each option.

- Describe the roles, constraints, and perspectives of primary therapists and physicians.
 - Describe different categories of therapists, clinicians, and prescribers.
- Describe the roles, constraints, and perspectives of distributors and suppliers.
 - Describe what to look for in a responsible supplier or distributor.
 - Define the roles of supplier, distributor, manufacturer's representative, and manufacturer.
- Describe the roles, constraints, and perspectives of designers, fabricators, and manufacturers.
 - Define the roles of designers, fabricators, and manufacturers.
- Describe the roles, constraints, and perspectives of payors.
 - Describe how to communicate with different funding sources.
 - Describe different types of procurement systems of various payors, for example, prior authorization, bid system, co-payment, etc.
- Demonstrate the ability to justify technology and service to a variety of funding sources.
- Describe the components of a quality assurance program.
 - Define the differences between an individual consumer's outcome and a program evaluation.
- Describe strategies for conflict resolution and consensus building.
- Describe the steps in the procurement process.
 - For each step, explain each team member's role and responsibility.

Basic Background Knowledge:

2.3.7. Principles of Design and Product Development

- Describe Universal Design concepts
- Define: Design Process
 - Design Criteria (target population or function), investigative, mainstream technologies (solutions), drawings, prototype, testing.
- Define the major components that contribute to the cost of custom products
- Demonstrate technical drawing and recording specifications.

2.3.8. Computer Literacy

- Define P.C. components (CPU, monitor, mouse, key)
- Define operating systems (DOS,MAC)
- Define applications (word process, spreadsheet database, graphics, on-line)

3.0.0. ROLE: Implement the intervention to assist the consumer in achieving their goals.

3.1.0. TASKS

- 3.1.1. Initiate and monitor the order process.
- 3.1.2. Communicate schedule of responsibilities to team and end user.
- 3.1.3. Design, fabricate and install the technology solution at a defensible level of competence.
- 3.1.4. Check out product for safety and quality, verify that it works as intended.
- 3.1.5. Prepare for delivery.
- 3.1.6. Deliver and install, fit and adjust the technology to the end user requirements.
- 3.1.7. Train end user and other team members in device operation, adjustment and troubleshooting. Initiate training program if indicated.
- 3.1.8. Confirm consumer's and team members understanding of safety and practical use of the equipment.
- 3.1.9. Provide information on device care, warranty and scheduled maintenance.

3.2.0. SKILLS

- 3.2.1. Understand proper mechanical and electrical safety practices or direct their use in the assembly and integration of the technology at a defensible level of competence.
- 3.2.2. Make adjustments or modifications to achieve expected outcomes.
- 3.2.3. Instruct others in the operation of the technology, maintenance and troubleshooting techniques which may be needed.

3.3.0. KNOWLEDGE

Assistive Technology Specific Studies:

- 3.3.1. Service Delivery Administration
 - Describe the most common service delivery systems.
 - Describe different strategies for service delivery.
 - Describe follow-up, training, etc., available with each option.

- Describe the roles, constraints, and perspectives of primary therapists and physicians.
 - Describe different categories of therapists, clinicians, and prescribers.
- Describe the roles, constraints, and perspectives of distributors and suppliers.
 - Describe what to look for in a responsible supplier or distributor.
 - Define the roles of supplier, distributor, manufacturer's representative, and manufacturer.
- Describe the roles, constraints, and perspectives of designers, fabricators, and manufacturers.
 - Define the roles of designers, fabricators, and manufacturers.
- Describe the roles, constraints, and perspectives of payors.
 - Describe how to communicate with different funding sources.
 - Describe different types of procurement systems of various payors, for example, prior authorization, bid system, co-payment, etc.
- Demonstrate the ability to justify technology and service to a variety of funding sources.
- Describe the components of a quality assurance program.
 - Define the differences between an individual consumer's outcome and a program evaluation.
- Describe strategies for conflict resolution and consensus building.
- Describe the steps in the procurement process.
 - For each step, explain each team member's role and responsibility.

3.3.2. Assistive Technology Intervention I (Posture, Mobility, Communication, Sensory Impairments)

- Describe the hierarchy of assistive technology for each need (posture, mobility, communication, sensory impairments)
- Describe available technology solutions for broad functional disability issues.
- Identify the key features of a product (expressed and implied) as they relate to "target" or specific users.
- Describe how choice of material and design relates to function..
- Evaluate/analyze how well the key features of a product meet the need of the target group.
- Describe the factors related to cost of a device: custom versus mass produced,

size of market, liability, warranty.

- Describe the key environmental considerations for safe, effective use of the technology.
- Describe when and how to access product information; including product-development information.
- Describe basic operating functions for each device.
- Describe adjustable functions for each device.

3.3.3. Assistive Technology Intervention II (Home, Education, Work, Leisure, Transportation)

- Describe the hierarchy of assistive technology for each need (home, education, work, leisure, transportation).
- Describe available technology solutions for broad functional disability issues.
- Identify the key features of a product (expressed and implied) as they relate to “target” or specific users.
- Describe how choice of material and design relates to function..
- Evaluate/analyze how well the key features of a product meet the need of the target group.
- Describe the factors related to cost of a device: custom versus mass produced, size of market, liability, warranty.
- Describe the key environmental considerations for safe, effective use of the technology.
- Describe when and how to access product information; including product-development information.
- Describe basic operating functions for each device.
- Describe adjustable functions for each device.

3.3.4. Human Device Interface

- Integrate functional and technical information.
 - List and describe possible outcomes such as the ability to communicate, remain seated, return to work, access education, be independent in

- activities of daily living or no change.
 - Identify the solutions that may help accomplish the desired outcomes:
 - Device selection, training, local resources.
 - Identify potential access methods to operate appropriate devices.
 - Identify extrinsic constraints and limitations which impact potential solutions.
 - Environmental Factors;
 - Cost
 - Available Funding
 - Identify the characteristics of technology in relationship to users.
 - Identify and verify the need for custom technology solutions.
 - Describe the functional outcomes expected from use of the solution.
 - Describe the technology set-up (device, access method, programming, adjustments, etc.) used during equipment trials.
 - Describe the functional milestones to be demonstrated when using the technology.
- Describe the interdependence of various interventions.
 - Define the range of appropriate interventions from technology, training, medications, surgery, therapy, education, or counseling.
 - Describe the relationship between therapy and assistive technology interventions.
 - Describe the intervention among various technologies in meeting needs of the consumer.
 - Describe the trade-offs and constraints in formulating an optimal solution.
 - Describe the characteristics of the technology in relationship to the user.
 - Translate a set of recommendations for technology into a set of specifications to be ordered.
 - Describe the process of re-evaluation after procurement to determine impact of intervention.
 - Describe the criteria to be used to judge the consensus success or failure on a continuum.
 - Describe objective outcomes to be used to measure consumer's performance.

3.3.5. Technology Training and Device Mastery

- Describe learning styles and differences in learning performance.
- Describe the functional characteristics of motivation.
- Describe training sequences and hierarchy of task mastery.

- Describe how measurements can be used to establish progress in training.
- Describe methods by which training is indicated or no longer indicated.

Basic Background Knowledge:

3.3.6. Principles of Design & Product Development

- Describe Universal Design concepts
- Define: Design Process
 - Design Criteria (target population or function), investigative, mainstream technologies (solutions), drawings, prototype, testing.
- Define the major components that contribute to the cost of custom products
- Demonstrate technical drawing and recording specifications.

3.3.7. Small Tool, Basic Machine Shop and Electronics

- Describe safe operation of small hand tools; wrench, hammer, screwdriver, etc.
- Describe safe operation of routine hand shop machines, including band saw, sander, drill press, and table saw.
- Describe safe operation of soldering gun.
- Describe proper grounding techniques when working with electronics.

3.3.8. Mechanical Principles

- List and Describe Mechanical Principles:
 - Define stress, strain, torque, inertia, momentum, levers, rotational & angular movements, power, etc.
- Describe Safety Functions of Mechanical Systems.
 - Technical Solutions for Common Failures
 - Common Hazards- Mechanical
 - Flammability

3.3.9. Electrical Principles

- Define Electrical Parameters
 - Define voltage, current, power, frequency, amplitude, and resistance.

- Describe Safety Functions of Electrical Systems
 - Technical Solutions for Common Failures
 - Common Electrical Hazards
 - Flammability
 - Unsafe Installation

4.0.0. ROLE: To be an expert source of information on assistive technologies and their applications.

4.1.0. TASKS

- 4.1.1. Characterize and group assistive technologies by features.
- 4.1.2. Correlate features of assistive technologies with potential applications.
- 4.1.3. Identify compatibility requirements needed to integrate technologies.
- 4.1.4. Maintain knowledge of emerging technologies.

4.2.0. SKILLS

- 4.2.1. Recognize defining features of a technology.
- 4.2.2. Compare, evaluate and catalog technologies by feature including: accessibility, durability, reliability, adjustability, maintenance, repairs and cost.
- 4.2.3. Access and interpret product literature and comparative testing, including standards and safety testing if applicable and available.
- 4.2.4. Solicit accurate feedback from end-users and others having experience with technology.
- 4.2.5. Analyze technology as it relates to the functional abilities of potential users.
- 4.2.6. Acquire the information necessary to operate the technology.
- 4.2.7. Identify, recognize, evaluate and test compatibility issues.
- 4.2.8. Access/interpret product research and development, medical and technical information.

4.3.0. KNOWLEDGE

Assistive Technology Specific Background:

- 4.3.1. Assistive Technology Intervention I
(Posture, Mobility, Communication, Sensory, Cognitive Impairments)
 - Describe the hierarchy of assistive technology for each need (posture, mobility, communication, sensory, cognitive impairments)

- Describe available technology solutions for broad functional disability issues.
- Identify the key features of a product (expressed and implied) as they relate to “target” or specific users.
- Describe how choice of material and design relates to function.
- Evaluate/analyze how well the key features of a product meet the need of the target group.
- Describe the factors related to cost of a device: custom versus mass produced, size of market, liability, warranty.
- Describe the key environmental considerations for safe, effective use of the technology.
- Describe when and how to access product information; including product-development information.
- Describe basic operating functions for each device.

4.3.2. Assistive Technology Intervention II (Home, Education, Work, Leisure, Transportation)

- Describe the hierarchy of assistive technology for each need (home, education, work, leisure, transportation).
- Describe available technology solutions for broad functional disability issues.
- Identify the key features of a product (expressed and implied) as they relate to “target” or specific users.
- Describe how choice of material and design relates to function..
- Evaluate/analyze how well the key features of a product meet the need of the target group.
- Describe the factors related to cost of a device: custom versus mass produced, size of market, liability, warranty.
- Describe the key environmental considerations for safe, effective use of the technology.
- Describe when and how to access product information; including product-development information.

- Describe basic operating functions for each device.

**Basic Background Knowledge:
Science/Technical Background**

4.3.3. Mechanical Terminology

- List and Describe Mechanical Terminology:
 - Define stress, strain, torque, inertia, momentum, levers, rotational & angular movements, power, etc.
- Describe Safety Functions of Mechanical Systems.
 - Technical Solutions for Common Failures
 - Common Hazards- Mechanical
 - Flammability

4.3.4. Electrical Terminology

- Define Electrical Parameters
 - Define voltage, current, power, frequency, amplitude, and resistance.
- Describe Safety Functions of Electrical Systems
 - Technical Solutions for Common Failures
 - Common Electrical Hazards
 - Flammability
 - Unsafe Installation

4.3.5. Introduction to Electronics

- Describe basic electronic components
 - Define transmitters, receivers, connectors, chargers.
- Describe Safety Functions of Electronic Systems
 - Define grounding, surge protection
 - Technical Solutions for Common Failures
 - Common Electrical Hazards
 - Flammability
 - Maintenance and Use

4.3.6. Material Science

- Describe properties of materials
 - Metals, Plastics, Composites
- Describe effects of temperature, humidity

- Describe material compatibility
- Describe application trade-offs inherent in material's properties

4.3.7. Design & Product Development

- Describe Universal Design concepts
- Define: Design Process
 - Design Criteria (target population or function), investigative, mainstream technologies (solutions), drawings, prototype, testing.
- Define the major components that contribute to the cost of custom products
- Demonstrate technical drawing and recording specifications.

4.3.7. Computer Literacy

- Define P.C. components (CPU, monitor, mouse, key)
- Define operating systems (DOS, MAC)
- Define applications (word process, spreadsheet database, graphics, on-line)

5.0.0. ROLE: Determining whether consumer goals have been met.

5.1.0. TASKS

5.1.1. Evaluate, measure and report outcomes.

5.1.2. Compare actual outcomes with goals in intervention plan .

5.1.3. Determine and initiate actions necessary to achieve consumer goals.

5.1.4. Re-evaluate and re-initiate process, if needed.

5.1.5. Participate in program evaluation to optimize the service delivery process.

5.2.0. SKILLS

5.2.1. Interview the consumer, family and caregivers to determine if the solution meets their needs.

5.2.2. Observe and measure, or get feedback about the consumer's performance with the technology.

5.2.3. Compare actual performance with anticipated performance.

5.2.4. Provide or direct any additional training that may be needed to improve outcomes.

5.2.5. Recognize poor outcome and offer re-evaluation to consumer.

5.2.6. Recognize equipment failure, troubleshoot and initiate repair and/or warranty process.

5.3.0. KNOWLEDGE

Assistive Technology Specific Studies:

5.3.1. Human Device Interface

- Integrate functional and technical information.
 - List and describe possible outcomes such as the ability to communicate, remain seated, return to work, access education, be independent in activities of daily living or no change.
 - Identify the solutions that may help accomplish the desired outcomes: Device selection, training, local resources.
 - Identify potential access methods to operate appropriate devices.
 - Identify extrinsic constraints and limitations which impact potential solutions.

* Environmental Factors

* Cost

* Available Funding

- Identify the characteristics of technology in relationship to users.
- Identify and verify the need for custom technology solutions.
- Describe the functional outcomes expected from use of the solution.

- Describe the technology set-up (device, access method, programming, adjustments, etc.) used during equipment trials.*

- Describe the functional milestones to be demonstrated when using the technology.*

- Describe the interdependence of various interventions.
 - Define the range of appropriate interventions from technology, training, medications, surgery, therapy, education, or counseling.
 - Describe the relationship between therapy and assistive technology interventions.
 - Describe the intervention among various technologies in meeting needs of the consumer.
 - Describe the trade-offs and constraints in formulating an optimal solution.

- Describe the characteristics of the technology in relationship to the user.
 - Translate a set of recommendations for technology into a set of specifications to be ordered.

- Describe the process of re-evaluation after procurement to determine impact of intervention.

- Describe the criteria to be used to judge the consensus success or failure on a continuum.
 - Describe objective outcomes to be used to measure consumer's performance.

5.3.2. Service Delivery Administration

- Describe the most common service delivery systems.
 - Describe different strategies for service delivery.
 - Describe follow-up, training, etc., available with each option.

- Describe the roles, constraints, and perspectives of primary therapists and physicians.
 - Describe different categories of therapists, clinicians, and prescribers.

- Describe the roles, constraints, and perspectives of distributors and suppliers.
 - Describe what to look for in a responsible supplier or distributor.

- Define the roles of supplier, distributor, manufacturer's representative, and manufacturer.
- Describe the roles, constraints, and perspectives of designers, fabricators, and manufacturers.
 - Define the roles of designers, fabricators, and manufacturers.
- Describe the roles, constraints, and perspectives of payors.
 - Describe how to communicate with different funding sources.
 - Describe different types of procurement systems of various payors, for example, prior authorization, bid system, co-payment, etc.
- Demonstrate the ability to justify technology and service to a variety of funding sources.
- Describe the components of a quality assurance program.
 - Define the differences between an individual consumer's outcome and a program evaluation.
- Describe strategies for conflict resolution and consensus building.
- Describe the steps in the procurement process.
 - For each step, explain each team member's role and responsibility.

5.3.3. Outcome Measures Methodology

- Define efficiency and effectiveness
- Define WHO classification of impairment, disability
- Define level of impact of technology intervention
- Define objective measurement tools applied to technological intervention.

Basic Background Knowledge:

5.3.4. Statistics

APPENDIX B

RESNA

Guidelines for Knowledge and Skills for Provision of the Specialty Technology:

Seating and Mobility

Acknowledgment

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PREFACE

Introduction

Seating and mobility concerns underlie many activities. For persons with a physical disability poor seating and mobility can jeopardize vocational and learning pursuits, independent living, computer access, health, productivity, and more. Often a medical or productivity problem appears to resolve itself after the seating and mobility is improved. For example, optimal computer access depends on trunk stability which in turn requires adequate trunk support. When sitting support is provided, either by improving the body's internal biomechanics or by additional external support devices the arm and shoulder complex has a more stable base from which to work. Computer access thus improves.

Purpose

The purpose of this document is (1) to provide guidelines for educational programs in Seating and Mobility Assistive Technology (SMAT) and (2) to form a preliminary basis for continuous quality improvement in SMAT.

This document describes the tasks, skills, and knowledge required to provide the best possible SMAT services, of the highest quality, utilizing the most advanced techniques and technologies available by providers of excellence. In order to provide services at this advanced or "specialist" level, there are particular skills and knowledge that are needed beyond the basic skills of an Assistive Technology Practitioner or Assistive Technology Supplier (The basic ATP and ATS are defined in *Guidelines for Knowledge and Skills for Provision of Assistive Technology Products and Services*, RESNA, 1996).

This document does not seek to address the issue of "who" should provide the services, but rather "what" services should be provided. The breadth and depth of knowledge spans several disciplines and will require input from several disciplines working together. The document contains a composite of the skills and knowledge, not of a single person, but of a group of people representing several different disciplines. No one person could, or should attempt to, perform all these tasks independent of others. Collectively, a team of "Providers" working together, must perform the roles and tasks outlined here. Most of these team members will commonly fall into one of three categories: "Practitioners", "Suppliers" and "Rehabilitation Engineers", as defined by RESNA.

As well, this document does not seek to address the issue of "how" to provide these services, but rather "what" services should be provided. Geographic, cultural, political, and financial differences will dictate the setting in which the services are provided. An on-site team of multiple disciplines may not be practical or easy to construct. Admittedly, this challenge is not addressed here and indeed will require creativity to overcome. Nonetheless, to provide the best possible services in the provision of Seating and Mobility, the knowledge and skills of several disciplines is required. The present educational system does not produce an individual

professional with this mixed bag of knowledge. Perhaps someday it will. In the meantime, some form of teamwork will be required, whether it is a loose network of consultants assisting a single “lead” provider, or a dedicated team who address each client in a roundtable discussion, or something else yet to be conceived.

A primary role of the SMAT Provider (SMATP) that is implicit in all the roles discussed is that of coordinating and managing the team effort in order for the consumer to achieve maximal functional seating and/or mobility. Interwoven throughout the five specific roles, are these General Tasks:

- 1) Recognize skills and knowledge, and limit a practice accordingly.
 - Adhere to the scope of practice defined in the other credentials or licenses held (e.g., PT, OT, MD, Engineer, Teacher, RTS, etc.), and limit individual practice accordingly.
 - Recognize the need (e.g., why, how, when, and where) to refer a consumer to another professional.
- 2) Operate within RESNA’s Code of Ethics and Standard of Practice.
- 3) Communicate effectively, including listening, speaking, reading and writing.
 - Understand appropriate terminology.
 - Collaborate with the consumer and other team members in planning and implementation of the intervention.
 - Respond to inquiries regarding assistive technology issues.
- 4) Recognize appropriate candidates for SMAT.
- 5) Support advocacy as appropriate.
- 6) Remain current on best practices and emerging technology
 - Participate in ongoing continuing education.
 - Access information available through a wide variety of sources and formats.
- 7) Provide timely, well-organized case management.

SMATPs must be alert to any information which may impact the technological intervention. If the SMATP is unable to perform any of the tests, data retrieval, or analysis, he/she is still responsible for acquiring that information from an appropriate source. The SMATP needs to:

- 1) Recognize the need for additional information or tests
- 2) Obtain accurate information from a qualified expert or source
- 3) Interpret the data or test results, and
- 4) Apply this information to the SMAT intervention

Design

This document is divided into five roles. Each role is supported by tasks, skills, and knowledge required to perform the role. It is assumed that all these roles and tasks will be provided regardless of the order of placement in this document.

Role 1 describes the necessary technology background. Roles 2, 3, and 4 focus on how to apply that technology background to benefit a consumer -- first through an evaluation, and then by planning and implementing the appropriate intervention for the consumer. Role 5 describes how the provider must conduct follow-up and make appropriate changes to ensure quality.

SMAT uses a spectrum of materials, methods, and technologies that are rapidly advancing. Therefore the provider must be prepared to re-evaluate the usefulness. New competencies will emerge as new technological techniques and components reach the consumer marketplace. Consequently, SMAT providers need to continually expand the knowledge base to include new information that becomes available through scientific research, providers' experience, and technological advances.

Role 1: INFORM—Be an expert source of information on Seating and Mobility Assistive Technologies, the applications, and related services.

1.1.0 TASKS

- 1.1.1 Increase public awareness and knowledge of SMAT products and services.
- 1.1.2 Inform individuals or a group/type of consumers, when and if SMAT intervention, products or services are appropriate based on consumer abilities, needs, environment, funding, and support system(s).
- 1.1.3 Recommend features of different SMATs that maximize functional performance, the most effective process for the assessment, and the most effective model for the delivery system.
- 1.1.4 Inform individuals or a group/type of consumers of related services (e.g., education or training, preventative maintenance, ongoing (open-ended) follow up, and related medical services).
- 1.1.5 Advocate for holistic solutions, interventions, strategies, and goals.
- 1.1.6 Provide information about specific SMAT products, devices, and interventions, based on a full analysis, characterization, and comparison of the products (See Appendix A).
- 1.1.7 Provide information related to AT integration.
- 1.1.8 Utilize and maintain open and active communication with others.
- 1.1.9 Be a source of information on funding.
- 1.1.10 Increase personal knowledge of SMAT techniques, devices, and service delivery.

1.2.0**SKILLS**

- 1.2.1 Disseminate information to a variety of persons including (e.g., the community, the educational system, the legal system, medical and allied health systems).
- 1.2.2 Conduct workshops, lectures, seminars, and in-services.
- 1.2.3 Develop educational and awareness products.
- 1.2.4 Advocate for increased public awareness and attention to the seating and mobility needs of all persons.
- 1.2.5 Provide information and testimony to various community, government, legal, and education agencies.
- 1.2.6 Analyze the inter-relationship of the person, the task, and the environment.
- 1.2.7 Identify the consumer's functional abilities, limitations, potential, needs, and goals.
- 1.2.8 Analyze the technology of the SMAT interventions as related to the consumer's functional abilities, limitations, potential, needs, and goals.
- 1.2.9 Describe the full spectrum of SMAT interventions, and the ramifications of each.
- 1.2.10 Inform consumers and others of all potential interventions.
- 1.2.11 Provide a range of options for each solution (e.g., minimum to maximum approach).
- 1.2.12 Advise consumers and others of emerging SMAT, new techniques, related research, and related technologies.
- 1.2.13 Search for, and find obscure products and manufacturers.
- 1.2.14 Explain the compatibility of multiple components.
- 1.2.15 Explain the structural, mechanical, electrical, computer-base, safety, and physical considerations of SMAT.

- 1.2.16 Document, in a manner that is thorough and clear, regarding specific cases, interventions, and individuals being served.
- 1.2.17 Maintain up to date information and referral exchange with a network of support persons, advisors, colleagues and professionals in the field.
- 1.2.18 Participate as teacher, advisor, and/or author in continuing education programs, mentoring projects, and publications.
- 1.2.19 Actively participate in professional associations related to SMAT.
- 1.2.20 Provide cost benefit analysis for SMAT interventions.
- 1.2.21 Advise consumers of funding sources and options.
- 1.2.22 Match appropriate funding sources to specific interventions and the individual needs of specific consumers.
- 1.2.23 Assist funding sources to develop prudent, reasonable, and effective policies regarding payment for services and for equipment.
- 1.2.24 Utilize available continuing education resources.
- 1.2.25 Utilize information sources.
- 1.2.26 Seek knowledge of emerging SMAT and new techniques.
- 1.2.27 Search out and apply related research and technologies.

1.3.0**KNOWLEDGE**

- 1.3.1 List and give examples of the benefits and risks of seating, positioning, and mobility interventions, as well as the risks of NOT intervening (e.g., direct and indirect, long and short term benefits and risks).
- 1.3.2 Demonstrate a thorough knowledge of available and emerging SMAT products, devices, and equipment (See Appendix A for details).
- 1.3.3 Describe the issues to consider before integrating multiple technologies, such as interfacing a computer or AAC, ECU, and power wc.
- 1.3.4 Describe the requirements, process, risks, and benefits of integrating products.
- 1.3.5 Describe the types of information available, and how to access the following sources of information:
- a) Computer-based information sources (See Appendix B).
 - b) Professional/colleague networking, peer consultation.
 - c) Feedback and experiences of consumers, caregivers, technicians, and professionals.
 - d) Printed material, catalogues, technical data sheets, and other publications from manufacturing, scientific, rehabilitation, medical, and disability communities.
 - e) SMAT related educational resources (e.g., videos, publications, workshops, conferences, exhibits, seminars).
 - f) Public and community officials and service departments.
 - g) Medical, engineering, and educational facilities and libraries.
 - h) SMAT research and development, testing, and manufacturing facilities.
- 1.3.6 Describe how the computer can improve business practices (See Appendix B).
- 1.3.7 Demonstrate a thorough knowledge of the SMAT Team.
- a) Describe the pros and cons of using different types of teams (e.g.,

multidisciplinary, interdisciplinary).

- b) Defend the need for and value of using a SMAT team.
- c) Describe the role of various disciplines and members who compose AT teams, including direct and indirect participants, such as:
 - Consumer, advocate, caregivers, family, friends, guardian, significant other
 - Case manager
 - Funding agent (e.g., third party payer, fiduciary, funding specialist)
 - Educational staff (e.g., class teacher, special educator, school therapists)
 - Medical staff: Medical Doctor (MD), Physical Therapist(PT), Occupational Therapist(OT), Nurse(RN), Speech and Language Pathologist(SLP), Orthotist, Prosthetist, Respiratory Therapist, Recreational Therapist
 - Rehabilitation Engineering (RE), technical staff, and fabricators
 - Supply & Manufacturing staff: Assistive Technology Supplier (ATS), Durable Medical Equipment provider (DME), technologist, distributor, manufacturer's rep, designer, engineer, fabricator, and
 - Others
- d) Describe the training, skills, and background of each discipline and team member.
- e) Describe the roles, rights, constraints/limitations, perspective, and responsibilities of each discipline and team member.
- f) Describe the relationships and interactions of the team members including group/team dynamics, strategies for conflict resolution, problem solving techniques, negotiation, compromise, trade-offs, and consensus building in the team process.
- g) Describe the liability and legal responsibility of each discipline and team member.
- h) Define the terminology that is unique to each discipline.
- i) Describe the moral and ethical responsibilities of each discipline and team member.
- j) Describe why, when, how, and where to make referrals to another discipline.

- k) Describe what to look for in selecting team members (e.g., educational background, license, certification, registration, opinions of satisfied customers', and colleagues' opinions).

1.3.8 Describe the full range of options for obtaining commercially available equipment in seating and wheeled mobility.

- a) Define the role, responsibilities, and services of manufacturers, manufacturer representatives, Research and Development (R&D) specialists.
- b) Identify acquisition processes including needs, intervention required, funding, and support system.

1.3.9 Describe the service delivery systems that provide SMAT

- a) Describe the full range of service delivery models for SMAT products and services.
- b) Compare and contrast the requirements, availability, costs, range of services available, the approach to intervention, the strategies of each system, including assessment process, follow-up, training, repairs, and other pertinent issues. Common service delivery models may include:
- Therapeutic intervention at a rehabilitation hospital, clinic, mobile unit, home health, or other medical facility
 - Special Education departments of the public school system, special schools, or other educational institutes
 - Community-based
 - Residential/institutional based
 - Vocational Rehabilitation or re-training programs
 - Durable Medical Equipment (DME) storefront or catalogue
 - Assistive Technology Suppliers (ATS), Rehabilitation Technology Suppliers (RTS)
 - Mail order /catalogue
 - Resale of used equipment (exchange groups, private parties)
 - Charity
 - Providers of free, used and/or recycled equipment
- c) Describe the different procurement options, including, no-charge rental, loaner, rental, rent-to-own, institutional loaners, trial, shared, and purchase options.
- d) Describe the different steps in the service delivery process of different service

delivery systems. (e.g., explain each team member's possible role and responsibility, identify the aspects that contribute to a cost effective delivery system).

- e) Describe the timelines and legalities of the total service delivery process.
- f) Describe when and how to refer to other SMAT service providers, and how these related services are coordinated.
- g) Describe the related services and facilities that may be helpful to users, as well as how to locate and coordinate these services.
- h) Describe the impact of consumer driven, client centered, advocacy driven, funding driven, and other "driving" forces and approaches

1.3.10 Describe the full range of funding options for SMAT.

1.3.11 Describe the terminology, regulations, and standards that apply to SMAT, used by the following organizations:

- a) World Health Organization (WHO)
- b) American Occupational Therapy Association (AOTA)
- c) International Standards Organization (ISO)
- d) American National Standards Information (ANSI)
- e) Canadian Standard Association (CSA)
- f) RESNA
- g) Other local, National, International and governmental agencies, as appropriate

1.3.12 Describe the general purpose, benefits, and goals achieved by SMAT intervention.

1.3.13 Describe the characteristics and the progression of specific impairments, diagnoses, and disabilities.

1.3.14 Describe the impact SMAT can have on function and health (See Appendix B for list of diagnoses).

1.3.15 Describe the different training options available to SMAT users from the practitioner, the supplier, the manufacturers, and others.

1.3.16 Describe the factors that contribute to abandonment, misuse of equipment, and non-compliance.

- 1.3.17 Describe the legal, advocacy and regulatory policies and procedures which apply to persons with disabilities, or to SMAT products or services .
- 1.3.18 Describe SMAT-related resources, including audio-visual materials, publications, speakers, and others.

Role 2: ASSESS—Acquire the necessary information to evaluate, analyze, and assess the consumer, the tasks, the assistive technologies, and the environments.

2.1.0 TASKS

- 2.1.1 Maintain the consumer as the central focus throughout the assessment process.
- 2.1.2 Determine the reason for referral, the initial statement of the problem, and the need for SMAT intervention.
- 2.1.3 Gather comprehensive assessment information regarding the consumer, tasks, technologies, and environments.
- 2.1.4 Analyze, interpret, integrate, and apply assessment information to determine and clarify the problems, needs, causes, and effects.
- 2.1.5 Produce a hierarchy of goals, objectives, and desired outcomes that reflect the consumer's needs and preferences.
- 2.1.6 Support the funding process.
- 2.1.7 Demonstrate good business practices, professional behavior, and safety.

2.2.0 SKILLS

- 2.2.1. Construct an atmosphere that encourages communication with the consumer.
- 2.2.2 Develop a sense of partnership with the consumer.
- 2.2.3 Demonstrate effective receptive communication (listening skills), effective expressive communication (verbal), awareness of body language, keen observation skills, sensitivity to lifestyle differences, and sensitivity to cultural differences.
- 2.2.4 Translate clinical and technical jargon into words the consumer can understand.

- 2.2.5 Differentiate among the consumer's needs, desires, concerns, abilities, function, potential, limitations, risks, and precautions.
- 2.2.6 Validate the consumer's need for SMAT intervention.
- 2.2.7 Appraise the consumer's potential for improved function or health using SMAT.
- 2.2.8 Clarify and state the preliminary problem(s) as the focus of the SMAT assessment.
- 2.2.9 Perform the SMAT assessment process with accuracy, completeness and efficiency.
- 2.2.10 Recognize the types of information needed, and identify the most appropriate sources.
 - a) Determine the particular information, evaluations, tests, and measurements needed for a specific consumer's assessment.
 - b) Discriminate among sources of information, including performing tests or assessments, referral to other professionals, networking, searching records, and other sources.
 - c) Select the best source from the available qualified resources or candidates.
- 2.2.11 Acquire specific information that is needed.
 - a) Use appropriate tools for information gathering.
 - b) Demonstrate proper protocol for record retrieval and Release Authorization procedures.
 - c) Refer to and work with other professionals, as appropriate.
 - d) Examine the background of the consumer including personal, medical, psychological, social, educational, vocational, and other aspects.
 - e) Conduct interviews of the consumer, family, caregivers, and other team members.
 - f) Perform a site visit and evaluation to observe and examine the consumer in the context of the environment, and to determine environmental factors which will impact the assessment.

- g) Acquire quantitative objective information by applying measurable evaluations, tests, measurements, and other quantification tools.
- h) Acquire qualitative subjective information by observing the consumer at rest, during activities, and in appropriate environments.
- i) Perform specific, measurable, objective, and comprehensive evaluations or tests with thoroughness, accuracy, efficiency, and attention to detail. Evaluate the:
 - physical condition of the consumer.
 - function, skills, and task performance during activities that reflect the demands of the consumer's lifestyle.
 - environments of the consumer
 - existing and past use of technology, resources, and equipment.
- j) Demonstrate safe, appropriate, and effective use of diagnostic equipment, seating simulators, pressure and force measuring systems, goniometer, and others assessment or measurement tools.

2.2.12 Assure that the assessment information is comprehensive and complete.

- a) Recognize when there is a need for additional information.
- b) Define additional resources needed.
- c) Perform, re-do, or acquire further tests and evaluations as needed.

2.2.13 Assure that all required assessment information is acquired and compiled in a manner that demonstrates accuracy, thoroughness, organization, and efficiency.

2.2.14 Demonstrate the ability to read, to interpret or solicit interpretation from another, to understand, to analyze, to integrate, and to apply test results, records, reports, and evaluation findings.

2.2.15 Extract critical information from the total findings of the interview, testing, evaluations, and other sources.

2.2.16 Integrate and analyze the acquired findings to determine and clarify the problems and concerns, as well as, the causes and effects.

2.2.17 Identify, categorize and list the consumer's needs, desires, concerns, abilities, functions, potential, barriers, limitations, risks, hazards, and precautions.

- 2.2.18 Integrate the problems and needs to determine the impact on various technology options and intervention strategies, considering past, present, and future conditions.
- 2.2.19 Apply sound engineering and therapeutic principles to determine appropriate seating, positioning, posture, and mobility intervention options and strategies.
- 2.2.20 Compare the options of using versus not using SMAT intervention as it effects the consumer's abilities, limitations, function, potential, and risks in relation to accomplishing the goals and objectives.
- 2.2.21 Appraise the potential environmental and lifestyle impact, both physical and social, of using or changing SMAT intervention.
- 2.2.22 Present evaluation findings to the consumer to assist individuals in clarifying goals and objectives.
- 2.2.23 Formulate, with the consumer and team, a hierarchy of the consumer's critical functional abilities in order to prioritize goals.
- 2.2.24 Produce a list of goals, objectives, and desired outcomes that reflect the consumer's needs and preferences.
- 2.2.25 Incorporate the consumer's possible future needs, in terms of equipment, modifications, training, and other goals.
- 2.2.26 Determine how goals, objectives, and desired outcomes will be measured and what level of performance will be acceptable to each member of the team.
- 2.2.27 Quantify and record accurate baseline measures that will substantiate the goals and objectives, and be useful in determining outcomes.
- 2.2.28 Obtain or formulate a cost estimate(s) for assessment services, for intervention(s), and for training or follow-up.
- 2.2.29 Identify available funding source(s).
- 2.2.30 Assist the consumer in selecting the most appropriate funding source.
- 2.2.31 Provide support to obtain funding.

- 2.2.32 Maintain documentation that is relevant, appropriate, accurate, timely, and thorough.
- 2.2.33 Include up-to-date reports of progress toward goals.
- 2.2.34 Assure that records are accurate and secure.
- 2.2.35 Preserve consumer: team, and patient:therapist confidentiality.
- 2.2.36 Abide by institutional privacy regulations, including permission to photograph.
- 2.2.37 Effectively communicate findings and progress to the consumer, and all team members.
- 2.2.38 Use appropriate language and terminology.
- 2.2.39 Create and disseminate progress reports and information updates to the consumer and other team members.
- 2.2.40 Throughout the process, consider the information needs of all team members, whether or not they are active participants in the assessment process.
- 2.2.41 Work only within your scope of practice and expertise.
- 2.2.42 Observe health and safety rules, recommendations, and precautions.
- 2.2.43 Demonstrate universal infection control practices.
- 2.2.44 Maintain a safe physical environment.

2.3.0 KNOWLEDGE

- 2.3.1 Describe the steps, and the purpose of each step, of the SMAT assessment process including:
 - a) Preliminary needs identification.
 - b) Comprehensive information and data gathering.
 - c) Interviews.

- d) Subjective observations.
- e) Objective evaluations.
- f) Measurements using quantification techniques and tools.
- g) Consolidate pertinent information.
- h) Establish desired outcomes.
- i) Define goals and objectives.
- j) Plan the intervention strategy.
- k) Follow-through with intervention.
- l) Follow-up to assure goals were met.

2.3.2 Demonstrate how information about the consumer is collected using tools such as:

- a) Pre-assessment questionnaires.
- b) Record retrieval and review including medical, psychological, educational, vocational and others.
- c) Telephone interview.
- d) Consumer (face-to-face) interview.
- e) Consultations with or referral to other professionals.
- f) Site visits to determine environmental issues related to the SMAT integration within the user's environments.
- g) Other tools, as appropriate.

2.3.3 Demonstrate how to locate relevant information about the consumer, including indications, contraindications, and precautions such as:

- a) Clinical, medical, and surgical records / charts, and precautions.
- b) General medical history.

- c) Pharmacology reports.
- d) Clinical reports, including x-ray, bone density, Magnetic Resonance Imaging (MRI), CAT scan, imaging studies, Electroencephalopathy (EEG), and others.
- e) Cardiopulmonary records, including Electrocardiogram (EKG), vital capacity, pulmonary function, stress tests, exercise endurance, and others.
- f) Neuromuscular records, including Nerve Conduction Studies, Electromyography (EMG), and others.
- g) Physical and Occupational Therapy reports, including strength, range of motion, joint laxity, spasticity, perception, sensation, ambulation, posture, balance, Activities of Daily Living (ADL), occupational functions, pain, wound healing, and others.
- h) Communication, speech and language reports.
- i) Biomechanical reports.
- j) Educational reports, including Individual Education Plan (IEP) , MFE, and IFSP.
- k) Vocational records, Worksite evaluations, Job Task Analysis, Job Descriptions.
- l) Lifestyle reports.
- m) Sociological, psychological, cognitive tests.
- n) Neuropsychological reports.
- o) Biomechanical reports, including kinesthetic forces, compression, loads, joint reaction and forces, joint and bone decomposition, stress, muscle force reactions, endurance, task efficiency, and others.
- p) Engineering reports and documents.
- q) Design specifications.
- r) Safety data sheets, technical data sheets.

s) Facility safety regulations.

2.3.4 Describe the components, and the purpose of the medical background check, including:

a) Medical records and other pertinent issues in health history.

b) General physical exam.

c) Neuromuscular and orthopedic exams.

d) Functional vision and acuity.

e) Static body measurements.

f) Cardiopulmonary exams.

g) Sensory and perceptual exams.

h) Psychological and neuropsychological exams.

2.3.5 Describe the components and issues addressed in a Physical Evaluation, how each is assessed or measured, and the impact on the SMAT assessment and selection process.

a) Neuromusculoskeletal

- Muscle strength, flexibility, spasticity, tone, rigidity, tremor
- Joint laxity, flexibility, range of motion, joint end feel
- Posture, balance, motor control, coordination, reaction time
- Bone and joint disorders, scoliosis, pelvic asymmetry, subluxation, dislocation
- Biomechanical issues
- Kinesiological issues

b) Sensory

- Vision, hearing, touch, pain
- Perception
- Proprioception
- Kinesthetic sense, body position in space (relative to gravity or x-y axes)

c) Skin and Connective tissue

- Soft tissue palpation, edema, color, blanching and erythema

- Ulcer condition, size, recurrence, stages, wound healing process
- d) Cardiopulmonary
- Respiratory rate, oxygen consumption, respiratory capacity
 - Functional capacity, vital capacity
 - Blood pressure, heart rate, oxygen saturation of blood (oximetry)
 - Endurance, fatigue
- e) Communication
- Speech and language
 - Oral motor control, articulation
- f) Cognition
- Cognitive and behavioral skills / abilities
 - Ability to learn, attention, judgment
 - Academic / educational status
- g) Psychosocial
- Psychological, social, and cultural information
 - Consumers background, living situation, history and future plans
 - Lifestyle, support system, family dynamics
 - Motivation, attitude, personality traits
 - Tolerance for technology, attitude toward use of SMAT
 - Ability and potential to use SMAT appropriately

2.3.6

Describe the components and issues addressed in a Function, Skills, and Task Performance Evaluation, how each is assessed or measured, and the impact on the SMAT assessment and selection process.

a) Mobility Skills and Function

- Functional ability, stability, balance, endurance, exertion, strength, speed, assistance needed, in home, in community
- During ambulation, stairs, ramps, curbs, transfers, bed mobility, wheelchair skills, propulsion (manual or power), vehicle access, transportation
- Use of assistive devices -- cane, crutches, walker, orthoses, prostheses

b) Sitting Skills and Function

- Stability, balance & recovery, support or assistance needed, compensatory strategies
- Exertion, endurance, strength
- Postural alignment, flexibility, postural tone

- Unsupported and supported sitting, on soft and firm surfaces
 - Effects of gravity, fatigue, and irritability
 - Hands-on support required to optimize seating function
 - In a simulation set-up, during trials in mock-up equipment
 - Positioning and postural support needs in terms of forces, pressure, contour, profile, size, response to interfaces, and other parameters.
 - Reach, one or two hand, range, distance, functional strength to grasp and retrieve items
 - Functional ability during sitting, with and without support
 - Sitting skills in various functional settings such as in a desk chair, working at tabletop, sitting on a mat edge, sitting for eating, office sitting, at a work station, and other positions, as needed.
- c) Daily Living Functional Skills
- Eating, dressing, bathing, hygiene
 - Cooking, child rearing, cleaning, laundry and others, as needed
- d) Special Activity Functions, Skills, and Tasks
- Vocational or Occupational skills -- transportation to work, entering the building, lunchroom access, toilet access, work station arrangement, job tasks, telephone, computer, and others as needed
 - Educational skills -- written expression, note taking, exam taking, tasks associated with science experiments, library tasks, homework, computer access, desk size and height, participation in lunch, Physical Education, and recess, transport to school, access to building, class to class transitions, toilet access and use, and others tasks as needed
 - Recreational skills -- consumer specific interests and leisure activities
- e) Describe the importance of evaluating the consumer in various functional positions (e.g., supine, standing, sitting in a chair, sitting on a firm surface, working at tabletop or workplace).
- f) Relate the demands of the task and/or environment to the deficits, limitations, and potential of the consumer.
- g) Identify problems, potential solution options, and precautions.

2.3.7

Describe the components and issues addressed in an Environmental Evaluation, how each is assessed or measured, and the impact on the SMAT assessment and selection process.

- a) Different environmental demands

- Home, school, work, community, recreation
- Various terrains -- streets, sidewalks, curbs, ramps, rough surface, gravel, grass, hills, snow, sand, indoors, carpet
- Environmental hazards that might cause falls, trips, collisions, loss of control

b) Accessibility within and between environments

c) Community access and Transportation -- public transportation, watercraft, aircraft, personal vehicle, vehicle access, device storage, lifts, wheelchair tie-downs, passenger or driver, car seats, occupant restraint system, primary and secondary driving controls

d) Technology tolerance of the environments, such as,

- In extended care or group homes
- Sharing equipment in schools
- When postural support components are viewed as restraining devices

e) Ability to re-structure specific environments to make them accessible while complying with regulations, codes, and standards.

f) On site visit to evaluate, as needed.

2.3.8

Describe the components and issues addressed in an Equipment Evaluation, how each is assessed or measured, and the impact on the SMAT assessment and selection process.

a) Specifications of the equipment, including canes, crutches, walkers, orthoses, prostheses, scooters, wheelchairs, seating systems, school seats, office seats, vehicle seats, farm or work equipment seats, leisure seats, recreational equipment, and others.

b) Equipment use (e.g., past, present and future), including specifications, success/failure, and features contributing to success/failure.

c) Equipment requests, including current needs, desires, goals, preferences, and future needs.

d) Accurate measurements, including relevant static and dynamic body measurements, equipment measurements and specifications.

2.3.9

Explain Therapeutic Principles and the relevance or application to seating, positioning, posture, and mobility:

- a) On the hierarchy of therapeutic goals for SMAT intervention function and health should be higher than normalizing posture.
- b) Use SMAT equipment only as is needed to achieve the postural control or support needed for function.
- c) When positioning the pelvis, back, neck, head and limbs use therapeutic and healthful positions / postures which promote normalization.
- d) The angles of seating or positioning surfaces will impact many neurologic and orthopedic physiological functions.
- e) The surface characteristics (i.e. firmness, contour, texture, etc.) of seating or positioning surfaces and the interface to the body will impact many neurologic, orthopedic, and Biomechanical functions.
- f) Posture and position in space relative to gravity will influence and be influenced by neurological reflexes and reactions.
- g) Proximal stability provides a base for distal movement.
- h) The use of dynamic rather than static components in seating, positioning, tilt, recline, and other postures, can produce different effects for different people and conditions.
- i) Before restricting a movement consider the impact on function, psychological effect, effect of the support or restraint interface, and the potentially damaging forces being applied.
- j) SMAT interventions should be free of hazardous conditions, such as encouraging orthopedic deformities, inducing ulcers or abrasions, allowing tip over during normal use, etc.
- k) Head, trunk, and upper extremity motor control for better function and performance can be enhanced with appropriate SMAT.
- l) SMAT is useful to assist in managing spasticity, hypertonicity, and abnormal tone and reflexes.
- m) SMAT is useful to assist in managing both non-flexible and flexible orthopedic deformities with safely applied forces, loading, and bending moments which can correct, retard, or accommodate the deformity.

- n) SMAT is useful to assist in managing soft tissue/muscle tightness and shortening, especially in the posterior thigh, posterior calf, lumbopelvic, and thoracic regions.
- o) SMAT is useful to assist in managing skin integrity.
- p) SMAT is useful to enhance speech, swallow, oral motor, digestive, and respiratory functions.
- q) SMAT is not always an appropriate way to apply active and passive positioning, stretching, and exercise.
- r) SMAT is useful to assist in managing fatigue, repetitive stress, and some effects of aging.

2.3.10

Describe the influence that each of the following statements has on the quality and effectiveness of goals, objectives and desired outcomes.

- a) Maintain the consumer as the central focus when establishing goals, objectives, and desired outcomes.
- b) Differentiate goals and objectives from desires and needs.
- c) Establish goals and objectives that reflect the consumer's needs, desires, and interests regarding:
 - Seating and positioning
 - Mobility
 - Compatibility with other technology
 - Various environments (e.g., physical, Psycho-social, educational, cultural, vocational, leisure and recreation)
 - Training and support
 - Need for adaptability and change
- d) Consider the concerns and goals of the other team members.
- e) Use a consumer driven process to set the goals, but gain the consensus of the entire team and all members of the team.
- f) Differentiate among goals that are Medically Necessary (Basic and Essential, will enhance quantity of life), Medically Appropriate (will enhance quality of life), Educationally Appropriate (will enhance learning), and Vocationally Appropriate (will enhance productivity and job opportunities).

- g) Establish goals that are realistic, reasonable, and potentially attainable.
- h) Establish goals that reflect short and long term issues.
- i) Specify goals clearly, with specific desired outcomes that can be measured and quantified in objective terms.
- j) Clarify how goals conflict and/or enhance each other.
- k) Resolve conflicts before deciding goals.
- l) Provide the consumer with more information/education, additional choices, and the professional's rationale in terms the consumer can understand.
- m) Assist the consumer in prioritizing the goals and make choices when trade-offs are necessary.

2.3.11 Define commonly used terminology and abbreviations of multiple disciplines (e.g., SMAT, other Assistive Technology fields, Engineering, medicine and therapeutic fields).

2.3.12 Describe how each issue applies to SMAT, and the impact on making a value judgment (wise versus poor decision) during the assessment and provision process. (See the Appendix B)

- a) Human Anatomy & Physiology
- b) Normal and Abnormal Growth, Development, and Aging
- c) Psychology, Sociology, and Cultural Studies
- d) Pathology, Impairment, and Disability Studies
- e) Biomechanics and Kinesiology
- f) Mechanical Engineering
- g) Electrical Engineering and Electronics
- h) Materials Engineering

2.3.13 Describe the wide range of funding options and sources of third party payment. Include information about:

- a) Role of the funding source as a member of the assistive technology team.
- b) How to identify and locate available funding sources for individual consumers, specific needs, and specific interventions.
- c) Funding sources available in specific regions of the country, such as:

- Federal and State (Provincial) Medical insurance programs
 - Private medical Insurance
 - Veterans Administration
 - Vocational programs
 - Educational programs
 - Worker's compensation
 - Private funding
 - Community, religious, and philanthropic organizations
 - Disability societies and organizations
- d) Underlying legislation or regulations that pertain to each funding source.
- e) The constraints, responsibilities, and perspective of each funding source.
- f) Coverage provided by each source, the rationale for payment, and funding limitations. Include:
- Funding for evaluation and assessment
 - Funding for equipment rental or purchase
 - Funding for fittings, modifications, follow-up, and re-assessment
 - Standard allowables (inclusion and exclusion criteria)
 - Criteria and process for gaining exceptions/exemptions to the regular allowables
 - Appeal process
- g) Effectively communicating with each funding source.
- How to tailor the communication to suit a variety of funding sources.
 - Write a Letter of Medical Necessity and /or Letter of Justification to solicit funds for the evaluation, the intervention, the technology, the fitting and adjustments, the training, the follow-up, and other services.
- h) Various Policies and Procedures of each type of funding, including:
- The population served
 - Process and requirements for requesting funding
 - Documentation (e.g., forms, content required, deadlines, signatures required)
 - Use of supplemental information (e.g., photos or video, live demonstration)
 - Filing requirements, processing timeline, contact person(s)
 - Process for appeal
- i) The different funding processes, including:

- Prior authorization
- Bid system
- Co-payment
- Purchase prior to reimbursement
- Sole source
- Contract
- Cash on delivery (COD)
- Bill in advance
- Charge after delivery
- Installment payments

2.3.14 Describe the use of safety techniques and precautions applied to the provision of SMAT. Include:

- a) Universal infection control precautions and hygienic practices.
- b) Emergency medical techniques, such as first aid and CPR.

Role 3: STRATEGIZE—Develop an intervention strategy and plan with the consumer and other team members.

3.1.0 TASKS:

- 3.1.1 Identify and describe the desired generic attributes of the intervention.
- 3.1.2 Consider different intervention strategies and solution options.
- 3.1.3 Explore multiple strategies and solutions for SMAT intervention.
- 3.1.4 Discriminate among, and appraise the value of using, equipment in different levels of a complexity hierarchy (e.g., non-technical or “low tech”, technical, commercial off-the-shelf, eclectic combinations, modified, or custom designed equipment solutions).
- 3.1.5 Recognize the improper use of equipment, and provide recommendations as appropriate.
- 3.1.6 Develop, examine, and assess potential intervention strategies.
- 3.1.7 Assist the consumer to resolve trade-offs and to prioritize intervention options.
- 3.1.8 Perform simulations of possible interventions and solutions strategies (See Glossary).
- 3.1.9 Select an intervention strategy.
- 3.1.10 Evaluate the effectiveness of the intervention of choice.
- 3.1.11 Design a plan to implement the intervention of choice.
- 3.1.12 Support the funding process.
- 3.1.13 Demonstrate good business practices, professional behavior, and safety.

3.2.0**SKILLS**

- 3.2.1 Confirm that the agreed-upon goals and objectives continue to reflect the consumer's needs and preferences.
- 3.2.2 Recognize and categorize broad generic attributes of SMAT products and intervention strategies (e.g., useful features, structural components, functional parameters, appearance, ease of use).
- 3.2.3 Translate clinical information into technical and engineering specifications.
- 3.2.4 Match the consumer's needs and objectives to broad generic attributes of SMAT products and intervention strategies.
- 3.2.5 Prioritize and list the desired generic technology features in clear and specific terms.
- 3.2.6 Define measurable objectives by which to compare potential interventions.
- 3.2.7 Share information with the consumer and team using effective communication tools including verbal, written, photography, drawing, or other modalities.
- 3.2.8 Gain consensus and buy-in from the consumer and team.
- 3.2.9 Apply creative, broad thinking and critical problem solving techniques.
- 3.2.10 Use group problem solving whenever possible.
- 3.2.11 Select out critical information to apply to problem solving.
- 3.2.12 Use experience based analysis, extrapolation, judgment, and common sense.
- 3.2.13 Use a variety of information sources (See Role 1 Knowledge).
- 3.2.14 Locate and obtain information regarding effective strategies utilizing peer queries, literature review, conferences, workshops, manufacturers, and other sources of information.

- 3.2.15 Locate and obtain information regarding the full range of SMAT technologies and solutions (e.g., market search, peer queries, technical literature, equipment exhibits, databanks, manufacturers, and other sources of information).
- 3.2.16 Use quantitative and qualitative measures to determine performance and effectiveness of each intervention in producing the desired goals, objectives and functional outcomes.
- 3.2.17 Compare and contrast the effectiveness of the intervention options.
- 3.2.18 Appraise the value of each strategy considering the pros and cons.
- 3.2.19 Compare and contrast new interventions being considered to past use of technology and interventions.
- 3.2.20 Ascertain the potential of interventions to meet the consumer's future needs.
- 3.2.21 Recognize, identify, evaluate, and test for compatibility, ability to integrate, and interface potential of existing and potential equipment.
- 3.2.22 Identify the demands of the access system (e.g., cognitive, sensory, and motor skills), and other abilities required to effectively utilize the intervention.
- 3.2.23 Assure that the applied therapeutic and engineering principles are sound, compatible, properly interfaced, and safe.
- 3.2.24 Collect and record data and measurements that are accurate, complete, and will support the outcome measures for each strategy considered.
- 3.2.25 Analyze the funding available for each intervention option.
- 3.2.26 Consider direct and indirect costs and the benefits of each intervention option.
- 3.2.27 Select the most desirable simulation methodology and techniques.
- 3.2.28 Demonstrate safe and effective use of simulation equipment.
- 3.2.29 Formulate and produce accurate the simulation parameters (e.g., angles, dimensions, textures).
- 3.2.30 Perform simulation.

- 3.2.31 Analyze, assess and appraise the results of simulation.
- 3.2.32 Distinguish between faulty simulation technique versus faulty intervention strategy.
- 3.2.33 Compare results to other intervention options.
- 3.2.34 Refine, revise, and redo the simulation, as necessary.
- 3.2.35 Select an intervention with consensus from the consumer and team.
- a) Identify and communicate the preferred interventions to the consumer and team, detailing pros and cons.
 - b) Assist consumer to rank and prioritize the solution options in order to determine the best choice.
 - c) Solicit, analyze, integrate and apply feedback from the consumer and team.
 - d) Participate in conflict resolution and consensus building.
 - e) Define selection criteria.
- 3.2.36 Identify specific products and services that match the generic attributes of the intervention of choice, including specifications such as:
- a) Dimension, texture, and shape specifications.
 - b) Static strength, impact strength, stress and fatigue specifications.
 - c) Obstacle climbing ability, coefficient of friction specification.
 - d) Energy consumption specification on a power wheelchair.
 - e) Dynamic and static stability specifications.
 - f) Wheel lock holding strength specifications.
 - g) Battery power and life specification, re-charge requirements.
- 3.2.37 Select and define the specific product(s) needed for the intervention of choice.
- a) Document clearly and accurately using technical specifications, technology drawings, and other appropriate tools.
 - b) For commercially available products:
 - Locate, appraise, and analyze a wide range of SMAT products.
 - Select and define the product specifications, minor modifications, and personal adjustments required for the intervention of choice.
 - Select and define any modifications required for issues such as growth, progressive weakness, incontinence, orthopedic deformity, etc.

- Identify the manufacturer and model preferred, if applicable.
- c) For modular and eclectic equipment combinations:
- Analyze and justify the cost effectiveness of integrating and /or modifying products.
 - Select and define the interface, integration, minor modifications, and personal adjustments required.
 - Analyze effects of integration, such as, safety, stability, performance, etc.
 - Design and construct new interfaces and/or linkages as needed.
- d) For custom-modified, semi-custom, and fully-custom designed equipment:
- Analyze and justify the cost effectiveness of custom design.
 - Identify the benefits and limitations of modified or custom technology interventions.
 - Compare modified and custom devices to available commercial devices.
 - Apply engineering principles of design.
 - Design, modify, and construct equipment.
- 3.2.38 Select and define the specific service(s) needed for the intervention of choice (e.g., providing, fitting, adjusting, modifying, trouble shooting, repairing).
- 3.2.39 Select and define the training needed for the intervention.
- 3.2.40 Select and define the follow-up needed for the intervention.
- 3.2.41 Test the intervention of choice for its effectiveness in meeting the specified goals and desired outcomes by applying additional simulation, measurements, quantitative tests, and qualitative assessment.
- 3.2.42 Confirm that both therapeutic and engineering principles have been successfully applied and integrated, and resolve any conflicts without sacrificing goals.
- 3.2.43 Affirm that the intervention will not compromise performance, function, or safety.
- 3.2.44 Confirm the appropriateness and accuracy of selected equipment features, dimensions, and parameters.
- 3.2.45 Refine the chosen intervention by trying other options, as appropriate.
- 3.2.46 Design the plan to achieve the stated goals in the most efficient, effective and economical manner.

- 3.2.47 Develop an action plan with timelines, deadlines, and consequences of non-compliance.
- 3.2.48 Determine the most appropriate service delivery model for providing the intervention.
- 3.2.49 Determine the team members required to carry out the plan, specifying the role of each in providing services (e.g., accountability, deadlines for tasks).
- 3.2.50 Establish stages for gradual phasing in of changes or new equipment, progressive regimens, training steps, trial or probationary phases, and others.
- 3.2.51 Develop a plan to supply technology support services, and to evaluate the effectiveness.
- 3.2.52 Assess the consumer's ability to access support services, now and in the future.
- 3.2.53 Develop a plan to supply training, as appropriate, and to evaluate its effectiveness.
- 3.2.54 Obtain or formulate a cost estimate for the different intervention strategies being considered, including costs for products, services, training, and follow-up.
- 3.2.55 Identify the available funding source(s) from a wide range of possibilities. (See Role 1 Knowledge).
- 3.2.56 Assist the consumer in selecting the most appropriate funding source.
- 3.2.57 Explore provider options with the consumer and team.
- 3.2.58 Provide support and justification to obtain funding.
- 3.2.59 Prepare a Letter of Medical Necessity and supportive documentation.
- 3.2.60 Prepare a Letter of Justification and supportive documentation, as needed.
- 3.2.61 Prepare a Letter of Appeal and supportive documentation, as needed.
- 3.2.62 Prepare various Request for Funding forms and supportive documentation.
- 3.2.63 Verify that appropriate funding has been or will be successful obtained.

- 3.2.64 Advocate for thoroughness in considering all possible strategies, and in planning the implementation.
- 3.2.65 Document the process in an appropriate, accurate, timely, and thorough manner. Include documentation of:
- a) up-to-date progress toward the goals.
 - b) the strategies considered, with the rationale for accepting or rejecting each, and the pros and cons of each.
 - c) the rationale of selecting the intervention of choice.
 - d) the details of the intervention plan including time line, person responsible for each step, and measures being taken to assure quality.
- 3.2.66 Utilize appropriate documentation tools (e.g., written forms, narratives, computer generated reports and graphics, video, photos, charts, and other media).
- 3.2.67 Assure that measurements and technology specifications are accurate.
- 3.2.68 Effectively communicate progress to the consumer and all team members, including the funding source.
- 3.2.69 Work only within your scope of practice and expertise.
- 3.2.70 Observe health and safety rules, recommendations, and precautions.
- 3.2.71 Demonstrate universal infection control practices.
- 3.2.72 Maintain a safe physical environment.
- 3.2.73 Demonstrate safe use of simulator and mock-up.

3.3.0

KNOWLEDGE

- 3.3.1 Identify and define the consumer's physical and functional needs and goals effecting equipment selection.
- 3.3.2 Describe when and how to locate and access information:
 - a) about successful intervention strategies.
 - b) about product information, technological specifications, product-development, research and design.
 - c) using a variety of information sources (See Role 1 Knowledge).
- 3.3.3 List and defend the benefits of improved seating, posture, positioning, and mobility.
- 3.3.4 Describe the full range of SMAT interventions (e.g., technology, training, therapy, education, counseling, or referral for medications and/or surgery).
- 3.3.5 Demonstrate knowledge of the full range of SMAT products and the applications (See Appendix A for details).
- 3.3.6 Describe the full range of supplier types, delivery models, and service delivery systems.
- 3.3.7 Compare and contrast the requirements, availability, services, costs, and other pertinent issues (See Role 1- Knowledge).
- 3.3.8 Describe the usefulness and application concerns for SMAT interventions on each level of the complexity hierarchy (e.g., from non-technological (low tech), to technological (high tech), to custom designed and integrated interventions).
- 3.3.9 Describe issues that determine effective and ineffective matchmaking of the consumer's physical and functional abilities, and the product's technical features.
- 3.3.10 Identify and describe typical trade-offs and constraints in formulating an optimal intervention solution.
- 3.3.11 Compare and contrast funding sources (See Role 2--Knowledge).
- 3.3.12 Identify extrinsic constraints and limitations which impact potential interventions.
- 3.3.13 Apply basic principles of Sciences to SMAT interventions. (See Appendix B).
 - a) Biomechanics and Kinesiology
 - b) Mechanical Engineering
 - c) Electrical Engineering and Electronics

- d) Materials Engineering
- e) Engineering Design

Role 4: IMPLEMENT - Provide appropriate and timely implementation of the intervention to enable the consumer to achieve the seating and mobility goals.

4.1.0 TASKS

- 4.1.1 Acquire commercially available products, materials, components and/or full systems.
- 4.1.2 Design custom products, modifications, materials, components and/or systems when no commercially available solution meets the consumer's needs.
- 4.1.3 Fabricate and/or modify the SMAT.
- 4.1.4 Assure that the SMAT intervention achieves the stated goals and objectives.
- 4.1.5 Provide training for the consumer and team.
- 4.1.6 Support the funding process.
- 4.1.7 Demonstrate good business practices, professional behavior, and safety.

4.2.0 SKILLS

- 4.2.1 Order and purchase all components required.
- 4.2.2 Monitor the purchasing process.
- 4.2.3 Assure acquisition, and receipt of products.
- 4.2.4 Check goods for damage, missing parts, and an accurate reflection of the order.
- 4.2.5 Assemble product(s).

- 4.2.6 Integrate and interface the product(s) with other products (e.g., wheelchair, vehicle, environmental control unit, computer, and communication device).
- 4.2.7 Resolve confounding variables in integrated devices.
- 4.2.8 Adjust and modify the product.
- 4.2.9 Prepare the product for delivery.
- 4.2.10 Install and fit the SMAT to the consumer's requirements.
- 4.2.11 Apply principles of engineering design and product development to custom SMATs.
- 4.2.12 Apply universal design concepts.
- 4.2.13 Analyze cost effectiveness of custom design and fabrication.
- 4.2.14 Demonstrate skill in technical drawing (e.g., CAD-CAM), and specifications recording accurate in detail and concept.
- 4.2.15 Recognize design liability issues, and ethical responsibilities.
- 4.2.16 Comply with requirements for information disclosure, documentation, and labeling.
- 4.2.17 Assure that custom products meet or exceed manufacturing and safety regulations and standards.
- 4.2.18 Demonstrate safe and efficient construction and fabrication techniques.
- 4.2.19 Demonstrate proper tool use and material handling.
- 4.2.20 Demonstrate the ability to properly assemble the SMAT product.
- 4.2.21 Demonstrate the ability to form, build, construct, sew, and finish the product.
- 4.2.22 Properly install, integrate, and link interfaces.
- 4.2.23 Perform structural, mechanical, and/or electrical tests to ensure compliance with design parameters.

- 4.2.24 Perform adjustments, modifications, or alterations to designs to achieve expected outcomes.
- 4.2.25 Perform measurements, tests, and data collection to determine outcomes.
- 4.2.26 Compare actual results to desired outcomes and goals.
- 4.2.27 Revise and/or redesign any intervention until goals are met.
- 4.2.28 Design a thorough training curriculum that reflects the consumer's needs and goals.
- 4.2.29 Utilize effective training methods that are appropriate for the consumer.
- 4.2.30 Evaluate the effectiveness of the training.
- 4.2.31 Apply objective measures to demonstrate quantifiable progress in training.
- 4.2.32 Confirm that the consumer and/or a designated caregiver understands the safe and practical use of the equipment.
- 4.2.33 Initiate additional training, if indicated.
- 4.2.34 Explore provider options with the consumer and team.
- 4.2.35 Provide support and justification to obtain funding.
- 4.2.36 Obtain prior approval, if necessary.
- 4.2.37 Verify that appropriate funding has been, or will be, successfully obtained.
- 4.2.38 Advocate for thoroughness and timeliness in providing an intervention.
- 4.2.39 Document the process and effectively communicate progress to the consumer and all team members, including the funding source.
- 4.2.40 Confirm that measurements and technology specifications are accurate.
- 4.2.41 Work only within your scope of practice and expertise.
- 4.2.42 Observe health and safety rules, recommendations, and precautions.

4.3.0**KNOWLEDGE**

- 4.3.1 Mechanical Sciences -- see Appendix B Knowledge of Basic Sciences.
- 4.3.2 Material Sciences -- see Appendix B Knowledge of Basic Sciences.
- 4.3.3 Electrical Sciences -- see Appendix B Knowledge of Basic Sciences.
- 4.3.4 Electronic Sciences -- see Appendix B Knowledge of Basic Sciences.
- 4.3.5 Computer Sciences -- see Appendix B Knowledge of Basic Sciences.
- 4.3.6 Design & Product Development
- a) Describe and justify major contributors to the cost of custom and modified SMAT products.
 - b) Describe manufacturing standards and regulations, related to SMAT products.
 - c) Describe the engineering design process in both theory and practice, including:
 - Review goals and objectives.
 - Identify and define needs and problems.
 - Appraise cost-effectiveness.
 - Gather as much information as possible about the problem, including past attempts to solve it.
 - Identify the design criteria (target population or function).
 - Identify the design parameters and constraints, essentials, and bonus features.
 - Generate ideas utilizing conceptualization, creative thinking, brainstorming, forced connections, attributes, trigger words.
 - Develop design specifications.
 - Utilize modeling, Computer Assisted Design (CAD).
 - Specify and evaluate design alternatives.
 - Apply failure mode and effects analysis (FMEA).
 - Choose best alternative.
 - Perform an engineering analysis.
 - Construct a conceptual model or prototype of the chosen alternative.

- Test, refine, and retest the prototype.
- Perform structural, mechanical, and/or electrical tests to ensure compliance with design parameters, regulations, and standards.
- Test the parameters/constraints against the consumer's goals and objectives.
- Refine, alter, revise, and re-design, as needed.
- Re-evaluate the cost effectiveness.
- Fabricate or finish the product.

4.3.7

Installation and Fabrication.

- a) Identify different hand tools, describe the pros and cons of each, the basic use or operation, and the application to SMAT.
 - Wrenches- socket, ring, adjustable, ratchet, allen, hex
 - Hammers- ballpeen, rawhide, rubber, claw, mallet
 - Screwdrivers- phillips, flathead, torex
 - Knives- exacto, electric
 - Saws- jigsaw, hacksaw, bandsaw
 - Pliers, wirecutters, and others
 - Power hand tools

- b) Identify different machine shop tools and equipment, describe the pros and cons of each, the basic use, safe operation, and the application to SMAT.
 - Band saw
 - Table saw
 - Drill press
 - Sander
 - Grinder

- c) Identify other common SMAT tools and equipment, describe the pros and cons of each, the basic use, safe operation, and the application to SMAT.
 - Soldering gun
 - Sewing machine
 - Glue gun
 - Velcro - proper application and attachment

- d) Describe common safety practices.

- e) Recognize and eliminate hazards.

4.3.8

Warranty and Liability issues

- a) Describe components of a manufacturer's warranty (e.g., limits, exceptions,

causes for voiding of warranty).

- b) Define and apply professional liability terms (e.g., role and function of a professional, ethics and responsibilities, scope of practice, reasonable and customary practice, and negligence).
- c) Define and apply product liability issues including:
 - Injury to user
 - Injury to others
 - Commercial products versus components
 - Limits of Modifications to commercial products and components
 - Design and fabrication of custom products

4.3.9

Training and Instruction Techniques.

- a) Describe the contents of an appropriate SMAT training curriculum, including:
 - Use and operation of the equipment and all accessories
 - Set-up, adjustment, fit, and modification of equipment
 - Safety, care, maintenance, and repair of equipment
 - Troubleshooting techniques
 - Warranty coverage
 - When, What and How to obtain support services
 - Storage and transport of equipment
 - Proper posture and/or positioning
 - Ambulatory mobility skills
 - Wheelchair mobility skills, foot or manual propulsion, power driving
 - Pressure relief and risk reduction skills
 - Transfer skills
 - Access skills
- b) Describe how different training methods will effect the learning process.
 - Compare and contrast learning styles, and design appropriate training methods for each.
 - Describe the functional characteristics of motivation, and the effect on learning to use SMAT.
 - Use a hierarchy of task mastery to formulate a training sequence.
 - List objective measures that quantify the effectiveness of the training.

Role 5: ASSURE —Determine whether consumer goals and desired outcomes have been met.

5.1.0 TASKS

- 5.1.1 Assess the efficacy of the SMAT intervention to achieve the desired goals.
- 5.1.2 Evaluate the effectiveness of the assessment and recommendation process.
- 5.1.3 Evaluate the effectiveness of the SMAT service delivery process.
- 5.1.4 Recognize consumer dissatisfaction, equipment failure, and other poor outcomes, and take appropriate action to improve and optimize the SMAT intervention.
- 5.1.5 Assure effective follow-through, and follow-up.
- 5.1.6 Support the funding process.
- 5.1.7 Demonstrate good business practices, professional behavior, and safety.

5.2.0 SKILLS

- 5.2.1 Compare actual outcomes with anticipated outcomes (e.g., goals).
- 5.2.2 Develop and apply outcome measurements that subjective and objective, using appropriate qualitative tools. Assess the:
 - a) sitting/postural stability, position, dynamics, comfort, and tolerance.
 - b) skin integrity, pathological risks, trauma/accident risks.
 - c) functional skills involving arm, hand, leg, head, part or full body.
 - d) wheeled mobility skills such as speed, directional control, environmental challenges, endurance, joystick control, switch use, etc.

- e) ambulation and transfer skills.
 - f) Assess the head control, eye-hand function, visual control, oral-motor function, and respiratory function.
- 5.2.3 Solicit, analyze and integrate feedback about the consumer's:
- a) perceived satisfaction with the technology.
 - b) use of, and performance with the technology.
 - c) functional benefits achieved, in quantitative and qualitative terms.
- 5.2.4 Assess the effects of the intervention on life style (e.g., vocational plans and opportunities, social skill and interaction, independence, education, mobility, and motivation).
- 5.2.5 Determine criteria to be used to judge the success or failure of an intervention.
- 5.2.6 Perform, analyze, and share the results of a program evaluation on the assessment and recommendation, follow-through, and follow-up processes.
- 5.2.7 Develop and implement procedures that encourage continuous monitoring, measuring, and analyzing of program outcome measurements.
- 5.2.8 Provide corrective actions required to improve the assessment and recommendation process.
- 5.2.9 Conduct studies to compare assessment process models and techniques.
- 5.2.10 Conduct studies to compare service delivery models and procedures.
- 5.2.11 Analyze and appraise the appropriateness of the recommendations.
- 5.2.12 Analyze and appraise the effectiveness of the evaluation personnel, the techniques, and the dynamics as a team member.
- 5.2.13 Appraise the communication and documentation.
- 5.2.14 Assess the coordination of the service delivery system (e.g., assessment, training).
- 5.2.15 Solicit, analyze, and integrate feedback regarding the consumer's and the other team member's perceived satisfaction with the:

- a) assessment team members, the knowledge, skills and dynamics.
- b) assessment process, efficiency, thoroughness, timeliness.
- c) established recommendations.
- d) delivery and service team members, the knowledge, skills and dynamics.
- e) delivery and service process, efficiency, thoroughness, timeliness.
- f) training and/or instructions.

- 5.2.16 Perform, analyze, and share the results of a program evaluation on the service delivery process.
- 5.2.17 Determine the accuracy of the delivered product / intervention compared to that which was requested.
- 5.2.18 Utilize outcome results to identify and analyze the strengths and weaknesses of the interventions, assessment techniques, and the service delivery system.
- 5.2.19 Determine the problem and need(s) for:
- a) revisions or modifications.
 - b) alternative intervention.
 - c) additional information, instruction, or training.
 - d) other available options.
- 5.2.20 Plan a new strategy, as needed.
- 5.2.21 Provide the specific corrective action required, including:
- a) troubleshooting, exchange, adjust, repair, or modify the technology.
 - b) warranty processes.
 - c) additional training.
 - d) re-assessment.
- 5.2.22 Initiate global improvements or corrections to the assessment process and techniques, and the service delivery process.
- 5.2.23 Communicate to the consumer and the funding agent the need for, benefits of, and cost of follow-through and follow-up services.

- 5.2.24 Instruct the consumer in the available range of follow-up and maintenance plans, and how to obtain these services.
- 5.2.25 Communicate the value of good outcomes, including direct and indirect benefits, long and short term benefits, and relative costs involved.
- 5.2.26 Communicate the causes and consequences of poor versus good outcomes.
- 5.2.27 Communicate the value of funding complete and proper assessments, follow-through and follow-up services.
- 5.2.28 Advocate for thoroughness and timeliness in evaluating the intervention's efficacy.
- 5.2.29 Continue to document the process and effectively communicate progress, follow-up, and follow-through to the consumer and all team members, including the funding source.
- 5.2.30 Work only within your scope of practice and expertise.
- 5.2.31 Observe health and safety rules, recommendations, and precautions.

5.3.0	KNOWLEDGE
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- 5.3.1 Describe the need for, the process of, and the methods of conducting outcome measurements, program evaluations, quality assurance programs, and other efficacy studies.
- 5.3.2 Compare and contrast tests for efficacy of an individual consumer's intervention outcome versus a program's outcome.
- 5.3.3 Describe the importance of evaluating the efficacy of a particular SMAT intervention in meeting that consumer's goals, including both objective and subjective tests, or measures.
- 5.3.4 Describe the statistical methods commonly used for SMAT outcome measurements, program evaluations, and efficacy studies; such as:
 - a) Correlation studies
 - b) Significance

- c) T test
- d) P test
- e) Null hypothesis
- f) Curve fitting
- g) Gain over time
- h) Bell curve
- i) Normal distribution
- j) Tests of reliability, efficacy, validity

5.3.5 Describe scientific research and information management methods used to analyze the efficacy of SMAT interventions, such as:

- a) Survey methods
- b) Comparative analysis
- c) Test efficiency
- d) Cost benefit analysis
- e) Program evaluations
- f) Data collection and storage

5.3.6 Describe the principles of Continuous Quality Improvement (CQI) and Total Quality Management (TQM), as related to SMAT.

Appendix A

Knowledge of SMAT Products

Knowledge of Product Specifications for the full range of SMAT products.

- a) Describe the key features (attributes and descriptors of the product) and components (special parts of the device).
 - Match the key features or components with the consumer's functional ability or disability that it was designed to address.
 - Distinguish between expressed and implied features.
 - Describe the accessories available.
 - Compare and contrast similar product features from different manufacturers and brands.
- b) Describe the appropriate use of the product and its operating functions.
 - Describe the intended consumer or the functional ability the product was designed to enhance.
 - Differentiate among products designed specifically for pediatric, adult, and geriatric use.
 - Describe the product's appropriate use, designed use, any unique uses, and the safe limits for "above & beyond" use.
 - Recognize product limitations and whether the original design parameters include the application being considered.
 - Describe the appropriate environment(s) for use.
 - Describe the product's environmental accessibility, transportability, and storage required for the product.
 - Compare and contrast the ease of use and "user friendliness" of similar products.
 - Describe the training required for effective operation.

- c) Compare and contrast the versatility of similar products.
- Describe the areas of adjustability, and fixed vs. removable parts.
 - Describe the method, tools required, or procedure to adjust.
 - To what extent can the product be adapted to other uses?
 - Describe modifications available. Who is intended to do them, the consumer, the service provider, or the manufacturer?
 - Describe the ability to integrate it with other devices or components.
 - Describe the interface required, compatibility, and potential for symbiotic function.
 - Define the consumer skills required to operate the device.
- d) Compare products for the ability to meet specific selection criteria.
- Describe the advantages and disadvantages.
 - Describe the benefits, risks and limitations.
 - Describe the proper fitting process, including how to make adjustments for improving fit.
 - Describe the safety features.
- e) Compare and contrast the design and construction of similar products.
- Describe the equipment's technical specifications.
 - Compare the materials used and basic fabrication process of similar products.
 - Describe the material characteristics, such as, durability, strength, density, weight, washable, and others.

- Describe each product's performance characteristics and other qualities, such as, stability, adjustability, rollability, speed, compact, and others.
 - Relate each product's materials, design, and construction to that product's use, performance, and other qualities.
 - Describe the mechanics of the equipment and the related biomechanics of its user.
 - Describe the aesthetic features of the product.
 - Assess how well each product meets universal design, human factors, ergonomic principles, and ease of use considering the intended consumer or functional ability for which it was design.
 - For mobility devices, describe the propelling structure and mechanism, including it's movement forces and power source.
- f) Compare and contrast a product's compliance with Standards.
- Appraise each product's ability to meet local, national, and international standards and regulations.
 - Create a hierarchy of commercially available products based on the performance ratings and ability to meet or exceed the standards.
- g) Compare and contrast maintenance and repairs for similar products.
- Describe the standard maintenance requirements .
 - Describe the recommended cleaning process.
 - Describe the reliability, repair history and expected lifetime of the product.
 - Describe the warranty and availability of replacement, parts and service.
- h) Compare and contrast the value of similar products.
- Describe the direct, indirect, and hidden costs of a product.

- Describe the sources and availability of the product.
- Produce a cost:benefit analysis for each product.
- Describe how the following factors might effect the cost and availability of a product: custom versus mass produced, size of market, liability, warranty, materials, fabrication techniques, workmanship

Knowledge of the full range of Seating Systems and seating products.

- a) Categorize and describe the types of seating systems by location, including:
 - Wheelchair seating
 - Scooter seating
 - Vehicle seating
 - Office seating
 - Industrial seating
 - School and classroom seating
 - Recreational equipment seating
 - High chair and feeder chair seating
 - Leisure, recreational, and home seating

- b) Categorize and describe the types of seating systems by surface style, including:
 - Sling seating systems
 - Planar seating systems
 - Generic contour seating systems
 - Custom contour (molded) seating systems, such as, hand shaped foam, injection foam, vacuum consolidation, modified orthotic, shapable matrix, and others
 - Commercial prefabricated seating systems
 - Modular seating systems
 - Custom fabricated seating systems
 - Hybrid or eclectic seating systems

- c) Categorize and describe the standard components of seating systems including:
 - Seat or Seat base
 - ◇ Sling, flexible, adjustable tension, firm, padded,
 - ◇ Planar, Generic Contour, Custom Contour
 - ◇ Contact surface, texture, firmness,

- ◇ Static, dynamic
- ◇ Seat angle, “dump”, forward tilt
- ◇ Seat height, dropped, raised
- ◇ Seat size, width, “squeeze”, depth, asymmetrical, cutouts
- ◇ Seat pan on office chairs
- ◇ Hardware for attachment and adjustability
- Cushions
 - ◇ Materials: foam, gel, air, fluids, and others
 - ◇ Pressure relief, cushioning properties: viscosity, stiffness, verometry, visco-elastic, time dependent, heat dependent, Indention Load Deflection (ILD),
 - ◇ Shearing, friction, elastics, $F=Kx$
 - ◇ Contact surface, size, contour
 - ◇ Surface material, interface with body, effect on cushioning property
 - ◇ Mechanism for attachment, removable
- Back Rest
 - ◇ Fixed, flexible, folding, adjustable
 - ◇ Sling backs, adjustable tension, strap backs
 - ◇ Planar, Generic Contour, Custom Contour
 - ◇ Size, shape, height, width, cut-outs
 - ◇ Contact surface, size, texture, firmness, angle, contour
 - ◇ Seat to back angle, static, dynamic
 - ◇ Back uprights, bent, straight, angled
 - ◇ Push handle mounts, wrap around, extensions, stroller handles, attachment to base
 - ◇ Hardware for attachment and adjustability
- Trunk supports
 - ◇ Flexible Straps, Rigid bars, vests, padding
 - ◇ Anterior, lateral, superior, and posterior supports
 - ◇ Contact surface, size, texture, firmness, angle, contour
 - ◇ Static, dynamic
 - ◇ Hardware for attachment and adjustability
- Arm supports
 - ◇ Frame, Single or two point mounts
 - ◇ Conventional, swingaway, wrap around, cantilever
 - ◇ Height adjustable, fixed, removable
 - ◇ Forearm supports, pads, full or desk length, waterfall
 - ◇ Side guards, firm, flexible
 - ◇ Release mechanism, swing, lift, flip, quad release
 - ◇ Static, dynamic

- ◇ Contact surface, size, texture, firmness, angle, contour
- ◇ Hardware for attachment and adjustability
- Pelvic supports
 - ◇ Flexible Straps, Rigid bars, removable, release mechanism
 - ◇ Anterior, lateral, inferior, and posterior supports
 - ◇ Contact surface, size, texture, firmness, angle, contour
 - ◇ Static, dynamic
 - ◇ Hardware for attachment and adjustability
- Thigh supports
 - ◇ Built into seat contour, add-on
 - ◇ Medial, lateral supports
 - ◇ Flexible Straps, Rigid bars, padding
 - ◇ Contact surface, size, texture, firmness, angle
 - ◇ Static, dynamic, removable, release mechanism
 - ◇ Hardware for attachment and adjustability
- Calf supports
 - ◇ One piece, straight, tapered front ends
 - ◇ Elevating, swing away, fixed front ends, removable, release mechanism
 - ◇ Contact surface, size, texture, firmness, angle
 - ◇ Calf pads, stump supports
 - ◇ Static, dynamic
 - ◇ Hardware for attachment and adjustability
- Foot supports
 - ◇ Flexible straps, rigid guides, shoe holder, heel or toe cup,
 - ◇ Contact surface, size, texture, firmness, angle
 - ◇ Static, dynamic, removable, release mechanism
 - ◇ Hardware for attachment and adjustability
- Head supports
 - ◇ Flexible, rigid, padded, contour
 - ◇ Contact surface, size, texture, firmness, angle
 - ◇ Anterior, lateral, and posterior supports
 - ◇ Static, dynamic, removable, release mechanism
 - ◇ Hardware for attachment and adjustability
- Other components such as lap trays, device holders, AAC device or computer mounts
 - ◇ Removable, release mechanism
 - ◇ Hardware for attachment and adjustability

Knowledge of the full range of postural support and positioning products.

- a) Categorize and describe the types of standers, including
 - Prone standers
 - Mobile standers
 - Pediatric and adult standers

- b) Categorize and describe other types of positioners, including
 - Sidelyers
 - Prone positioners
 - Supine positioners

Knowledge of the full range of mobility products.

- a) Categorize and describe the types of walking aids, including
 - canes
 - walkers
 - crutches
 - Prostheses and orthoses

- b) Categorize and describe the types of scooters, play and recreational mobility products.

Knowledge of the full range of wheeled mobility products.

- a) Categorize and describe the types of dependent devices, including
 - strollers
 - geriatric chairs
 - transport wheelchairs

- b) Categorize and describe eclectic, integrated or unique mobility devices.

- c) Categorize and describe manual wheeled mobility devices, including:
 - Mobile standers
 - Manual wheelchairs
 - ◇ Describe Wheel features, such as mags, spokes, spoke guards, axle, axle mounting plates, amputee mounting plates, push rims.

- ◇ Describe caster features, such as caster pin locks, forks.
 - ◇ Describe tire features, such as pneumatic, flat-free, rubber, polyurethane, tread, sew-up, sports, recreational.
 - ◇ Describe braking and locking features, such as wheel locks, grade aides, hill holders, extension handles.
 - ◇ Describe frame features, such as rigid, folding, collapsing, anti-tipping levers, stretch frames, weight, side guards.
 - ◇ Describe the seating system and it's attachment to wheelbase.
 - ◇ Describe the theory and application of static vs dynamic components.
 - ◇ Describe the theory and application of fixed vs. adjustable components.
- d) Categorize and describe the specialty wheeled mobility devices, including:
- the theory and application of tilt features, such as the relation between the center of rotation and the center of gravity
 - the theory and application of recline features
 - the theory and application of standing features
 - the theory and application of combinations of tilt and recline
 - the theory and application of other specialty wheelchair features
- e) Categorize and describe powered wheeled mobility devices, including:
- Types:
 - ◇ Power wheelchair
 - ◇ Power base
 - ◇ Three wheel scooters
 - ◇ Portable power wheelchairs
 - ◇ Add-on or temporary power units
 - ◇ Power toys
 - ◇ Other eclectic and unique power mobility devices
 - Components
 - ◇ Wheels
 - ◇ Tires
 - ◇ Braking and locking features
 - ◇ Frame features

- ◇ Seating system and it's attachment to wheelbase
- Power sources
 - ◇ Batteries
 - ◇ Other
- Methods of control
 - ◇ Joysticks
 - ◇ Handle style
 - ◇ Remote, integral
 - ◇ Induction coil, micro-switch, proportional, latch, momentary
 - ◇ Heavy duty, sensitivity
 - ◇ Body part used to activate it
 - ◇ Modified and alternative joysticks
- Specialty electronics
- Drive controls and switches:
 - ◇ Breath, sip or puff, chin control, leaf, treadle
 - ◇ Pneumatic, pressure, infrared, thermal, sensitouch
 - ◇ Micro switch, proximity, direct and non-direct contact
 - ◇ Single throw, double throw, laser tri-switch
 - ◇ Momentary, proportional
 - ◇ Secondary, kill, back up, safety, reset, relax box
 - ◇ Magnetic field control, ultrasound, voice activated, scanning
 - ◇ Mechanical coupling, induction coils, digital, analog
 - ◇ Active, passive
- Person : Switch : Power Source interfaces
- Converting input to output

Appendix B

Knowledge of Basic Sciences

Human Anatomy & Physiology -

(as it relates to seating, posture, positioning, skin and soft tissue management, mobility, wheeled mobility, and SMAT intervention)

- a) Musculoskeletal system
 - Structural components, organization, and function of the:
 - ◇ Major muscles (including origin, insertion, innervation, vascular supply)
 - ◇ Major joints of the body (including shape, movement allowed, range)
 - ◇ Connective tissue (including skin, subcutaneous tissue, fibrosis, scar tissue, fascia)
 - ◇ Sensory and perceptual elements (including neural receptors and the pathways)
 - ◇ Bones (including specific bony landmarks)
 - Musculoskeletal and neural components involved in specific functional movements frequently associated with SMAT, including:
 - ◇ Manually stroking the wheels
 - ◇ Using feet to assist propulsion
 - ◇ Grasp, manipulation, and control of a joystick
 - ◇ Hand to mouth
 - ◇ Arm reach forward, to the side, to the floor, and overhead
 - ◇ Head and trunk erect, side bending, forward bending, and rotation
 - ◇ Transferring, sit to stand to sit
 - ◇ and others
 - Muscle fibers involved in stretch, static stretch, and rebound.
 - Neural control of normal muscles, both voluntary and involuntary
 - Describe the physiological mechanisms involved in co-contraction, synergy, reciprocity, stretch reflex, quick stretch, and static stretch
 - Describe the role of various types of muscle including skeletal, cardiac, and smooth
 - Describe the role of muscles in stabilizing, moving, fatigue, endurance, responsiveness, fine control, postural balance, etc
 - Compare and contrast muscle fatigue to cardiopulmonary fatigue
 - Role of bony structures in kinesiology, kinetics, and postural balance

- b) Central and Peripheral Nervous System
 - Central (brain and spinal cord) and peripheral nervous systems including structural components, organization, and functions
 - Sensory systems including structural components, organization, and function of the vestibular, visual, oculomotor, auditory, and sensorimotor systems
 - Autonomic nervous system including structural components, organization, and functions
 - Reflexes, associated reactions, righting responses, equilibrium responses, and other neurologic responses including the mechanism, normal and abnormal functions, and the influence on SMAT use and performance

 - c) Oral Motor/Respiratory Systems
 - Components, organization, and function of the respiratory, swallowing, phonatory, articulatory and gastrointestinal processes
 - Coordination and interaction of these systems
 - Inter-relation of mobility, trunk posture, and neck and head position to respiratory, swallow, and speech function
 - Methods of assessing and measuring the functioning of these systems

 - d) Cardio-Pulmonary (Cardio-Respiratory) Systems
 - Components, organization, and function of the cardiovascular and respiratory systems
 - Coordination of these two systems
 - Blood flow
 - ◇ Through the heart, lungs, vessels, and tissues
 - ◇ Factors affecting blood flow
 - ◇ Effects of impaired blood flow
 - ◇ Role of blood flow in temperature control, wound healing, skin integrity, muscle contraction, and brain function
 - Methods of assessing and measuring function:
 - ◇ Exercise Tolerance (exertion, endurance, exercise tolerance, fatigue)
 - ◇ Blood flow
 - ◇ Cardiac response
 - ◇ Pulmonary response
 - Relation of cardio-pulmonary function to posture and mobility

 - e) Skin and soft/connective tissue
 - Structure, function, and role of the skin and soft/connective tissues, including:
-

- ◇ Physiological effects of pressure, shear, stretch, elasticity, force, and tension on skin and soft/connective tissue
- ◇ Deformation properties of skin and soft tissues.
- Internal and external forces of various sitting and standing postures
- Effects of moisture (perspiration), hygiene (bacteria, urine and feces), autonomic nervous system, nutrition, sensory system, clothing, psychological state, and temperature on skin integrity
- Methods of assessing and measuring skin and soft/connective tissue pathologies and impairments.
- Normal and abnormal healing processes of soft/connective tissue and skin, including inflammatory response, edema, flare, reconstructive response, and ulcer stages
- Methods of assessing and measuring skin and soft/connective tissue integrity.
- Analyze, interpret, and assess the results of pressure and force sensing devices
- Role of prevention vs. healing of skin and soft/connective tissue breakdown
- Common skin and soft/connective tissue dysfunctions and the impact on SMAT use.
- Role of SMAT intervention for persons with these impairments.

f) Inter-relatedness of the body systems

- ◇ Inter-relationships of skin and soft/connective tissue, musculoskeletal system, central and peripheral nervous system, oral motor/respiratory system, and cardio-pulmonary systems with each other.
- ◇ Role of SMAT intervention(s) for persons with multiple impairments

Psychology

(as it relates to seating, posture, positioning, skin and soft tissue management, mobility, wheeled mobility, and SMAT intervention)

- a) Psychological impact of a disability on that person and on other persons in the environments; and it's management
- b) Cognition, perception, attention span, memory, emotional state, peer/family dynamics

- c) Learning styles, learning performance, learning strategies
- d) Attitudes, motivation, tolerance for change, effects of fatigue
- e) Influence of age (pediatrics, teens, geriatrics)
- f) Negotiation, team dynamics, consensus building, problem solving
- g) Technology tolerance and receptiveness to technology

Sociology

(as it relates to seating, posture, positioning, skin and soft tissue management, mobility, wheeled mobility, and SMAT intervention)

- a) Value systems
- b) Cultural values (norms and mores)
- c) Interpersonal relations
- d) Social supports
- e) Language barriers
- f) Lifestyle differences
- g) Socio-economic condition

Normal and Abnormal Growth, Development, and Aging

(throughout the lifespan, as it relates to seating, posture, positioning, skin and soft tissue management, mobility, wheeled mobility, and SMAT intervention)

- a) Motor and skeletal growth and development
- b) Language development
- c) Cognitive, intellectual, and psychological development
- d) Sensory, tactile, and perceptual development
- e) Growth and aging process
- f) Effects of various disabilities on the developmental and aging process
- g) Developmental reflexes, responses, and reactions; and the impact on SMAT use, including:
 - Reflexes including Assymetrical Toninc Neck Reflex (ATNR), Symetrical Tonic Neck Refles (STNR), Tonic Labyrinthian Reflex (TLR), and others
 - Responses and Reactions including Righting, Equilibrium, Startle, Protective Extension, and others
 - Oral-Motor reflexes

Pathology, Impairment, and Disability

(as it relates to seating, posture, positioning, skin and soft tissue management, mobility, wheeled mobility, and SMAT intervention)

- a) Define and distinguish among the terms impairment, disability, and handicap.
- b) Describe the use of SMAT as a tool to augment or compensate for a given impairment.
- c) Describe the populations that typically utilize SMATs. For each of these conditions listed below describe:
 - Anatomy and pathophysiology contributing to the impairment
 - Etiology and progression of the pathology
 - Common presentation of physical, sensory, cognitive, and learning dysfunctions
 - Impact of age, stress, fatigue, posture, position, comfort, and pain
 - Impact of aging with the impairment
 - Indications, contraindications, and precautions
 - Factors influencing functional prognosis and quantity of life expected
 - Impact of the condition on the person's:
 - ◇ Growth and development
 - ◇ Physiological functions, including bowel, bladder, sexual function, digestion, respiration, compensatory functioning
 - ◇ Neuromuscular performance, including speed, coordination, endurance, fine/gross motor control, tone, spasticity, athetosis, abnormal movement patterns
 - ◇ Functional activities, including bowel/bladder, swallowing, speech, digestion, functional movements, transfers
 - Common interactions of multiple pathologies and impairments
 - Common interventions, including:
 - ◇ Medical, surgical, pharmacological, and therapeutic
 - ◇ Educational, psychological, vocational, and social
 - ◇ Environmental and technological
 - Impact on use of SMAT, including appropriateness, SMAT as an augmentation, SMAT as a compensation, potential for success, special considerations, common interventions, and other issues
- d) Describe the populations that typically utilize SMATs.
 - Cardiac disorders
 - ◇ Atherosclerosis, coronary artery disease
 - ◇ Myocardial infarct, transient ischemic attacks
 - ◇ Congestive heart failure

- ◇ Cardiopulmonary disorders (hypertension, hypotension)
- Geriatric disorders
- Muscular disorders (muscular dystrophy, amyotrophic lateral sclerosis,)
- Skeletal and joint disorders (carpal tunnel syndrome, and repetitive stress syndromes)
 - ◇ Arthritis (osteoarthritis, rheumatoid), arthrogyrosis
 - ◇ Repetitive stress syndromes
 - ◇ Amputation, fractures, contractures
 - ◇ Congenital bony abnormalities, osteogenesis imperfecta, spina bifida
 - ◇ Osteoporosis, heterotopic ossification, calcification
 - ◇ Hyperlordosis, kyphosis, pelvic asymmetries, scoliosis
- Pain syndromes (acute, chronic, neck and back pain, whiplash)
- Cognitive disorders
 - ◇ Dementia, Alzheimers
 - ◇ Down syndrome, mental retardation, cognitively challenged
 - ◇ Developmentally delayed
 - ◇ Learning deficit, attention deficit disorder
- Pediatric disorders
- Neurological disorders
 - ◇ Autonomic nervous system disorders (dysreflexia)
 - ◇ Brain injury (traumatic, tumor, cerebral vascular, degenerative)
 - ◇ Cerebral Palsy (spastic, athetoid, hypotonic)
 - ◇ Coma (coma scales, emerging from coma, decerebrate posturing)
 - ◇ Huntington's chorea
 - ◇ Multiple sclerosis
 - ◇ Polio, post polio syndrome
 - ◇ Parkinsonism
 - ◇ Spinal Cord Injury (traumatic, quadriplegia, paraplegia)
 - ◇ Stroke
- Skin disorders (abrasion, contusion, edema, erythema, decubitus ulcers, pressure sores, wound healing)
- Respiratory disorders (emphysema, asthma, pulmonary insufficiency, pulmonary edema)
- Sensory impairments (vision, hearing, vestibular, somatosensory, tactile, proprioception)

e) Managing skin integrity:

- Ischemic ulcer (etiology, stages, measures, treatments)

- Factors influencing skin integrity, measures of skin integrity (color, blanching, texture, etc.)
 - Shearing, friction, pressure, abrasion
 - Scar tissue
 - Pressure relief
 - Principles of seating for pressure management
 - Use of SMAT equipment
 - Cushion properties & characteristics
 - Pressure measurement
 - Seated body surface measurement
- Recognize and refer for control of other potential causes of skin breakdown such as poor nutrition, cardiovascular issues, or poor hygiene.
- f) Managing pain and discomfort:
- Pathophysiology, etiology
 - Acute, chronic, progressive
 - Resulting impairment, limitations
 - Effect on human performance, function
 - Implications for SMAT use
 - Pain measurement tools and scales
- g) Impact and interaction of multiple impairments and/or disabilities.
- h) Pathophysiology of common impairments and conditions, and the impact on SMAT use; such as, paralysis, paresis, tremor, dystonia, dyscoordination, athetosis, spasticity, hypertonicity, rigidity, hypotonicity, flaccidity, bony anomalies, heterotopic ossification, skin abrasion, decubitus ulcers, and others.
- i) Common substitutions, compensations, and adaptations the body makes when poor muscle function is present and the consequences of these.
- j) Common pharmacological agents and the primary (intended effect) and secondary (side effect) impacts and interactions

Biomechanics, and Kinesiology

(as it relates to seating, posture, positioning, skin and soft tissue management, mobility, wheeled mobility, and SMAT intervention)

- a) Biomechanics
 - Planes of the body
 - Terms of movement
 - Anthropometry
 - Body models used in biomechanics
 - Soft tissue biomechanics
 - Propulsion biomechanics
 - Posture biomechanics
 - Functional activity biomechanics

- b) Kinesiology of Body Postures including:
 - Center of mass
 - ◇ “Line of gravity” v. the y axis
 - ◇ “Center of gravity” v. center of mass
 - ◇ Shifts in body position relative to x-y axes will alter the vertical forces on the body

 - Dynamics and kinesiology of standing, sitting, sitting in a wheelchair, sitting in office or school chair, sidelying, and reclined postures

 - Balance in sitting and standing; static and dynamic; challenge and recovery
 - Effects of sitting posture on tone and spasticity

 - Sitting symmetry v. asymmetry; consistent v. intermittent

 - Dynamics of functional activities, such as, pushing a walker, lifting, reaching, stroking the wheel, etc.

 - Principles of energy conservation

 - Factors contributing to stability in upright sitting postures, such as, biomechanics, kinesthetic forces, postural tone, skeletal construction, response to support surfaces, visual and cognitive system

 - Role of pelvic stabilization as contributor to erect sitting posture

 - Synergistic construction of muscles and bones as it relates to movement pattern efficiency and economy of motion

- Neural control and integration of patterned movements
 - Role of internal v. external support to control posture
 - Role of support features v. restraint
 - Changes in sitting posture mechanisms during relaxation and work
 - Sway and weight bearing patterns in normal and pathological sitting
- c) Kinesiology of Functional movements, specifically:
- Sit -to-stand, stand-to-sit
 - Reach, withdrawl, and retrieval
 - Transfers
 - Ambulation, gait analysis (with or without devices)
 - Manual wheelchair propelling (forwards, backwards, turns, inclines, for speed, for accuracy, for endurance)
 - Joystick control (by hand or other body parts)
 - Switch activation (by hand or other body parts)
 - Feeding and swallowing (digestion, tube feeding, catheters)
 - Breathing and vocalizing (tracheostomy)
 - Bowel and bladder function (catheters, voiding positions)
 - Vehicle driving (by hand or foot)
 - Weight shifting
- d) Interaction and impact of body posture, body position in space, limb position, movement, and sensory perception on:
- Nervous system, reflexes, reactions
 - Muscular/motor system, muscle tone, and muscle activity (bone and joint)
 - Gross and fine motor control
 - Vestibular, visual, oculomotor, auditory and sensory systems

- Autonomic function, such as, perspiring
- Energy consumption of activities and positions, such as, propelling, transfers, table top activities, leaning, reaching, upright, semi- recline, recline

Mechanical Engineering

(as it relates to seating, posture, positioning, skin and soft tissue management, mobility, wheeled mobility, and SMAT intervention)

a) Terminology and Fundamental Concepts

- Definitions
 - ◇ Units of measurement (e.g., International system of metric units (SI), United States customary units)
 - ◇ Scalar and vector quantities
 - ◇ Frame(s) of reference
 - ◇ Force, moment, torsion (torque), couple
 - ◇ Displacement, velocity, acceleration (e.g., linear, angular)
 - ◇ Mass, weight, gravity
 - ◇ Inertia, momentum
 - ◇ Work, energy (potential and kinetic)
 - ◇ Compression, tension, shear
 - ◇ Pressure, stress, strain
 - ◇ Resistive forces, friction
 - ◇ Absolute, relative motion
 - ◇ Shock, elasticity, viscosity
- General Laws
 - ◇ Basics of algebra, trigonometry, and calculus
 - ◇ Vector math and manipulation
 - ◇ Newton's three laws of motion
 - ◇ Conservation of Mass
 - ◇ Conservation of Momentum
 - ◇ Conservation of Energy
 - ◇ Law of mutual attraction (gravitation)
 - ◇ Spring force (elasticity) $F=kx$

◇ Dashpot (damper) force (viscosity) $F=c \, dx/dt$

b) Statics of Rigid Forms

- Free body diagram of forces
- System of forces (internal and external) in equilibrium
- Sum of forces (xyz axes) equal 0
- Sum of moments (xyz axes) equal 0
- Composition, resolution and equilibrium of forces

c) Mechanics of Materials

- Stress and strain - axial loading
- Stress and strain - torsion
- Stress and strain - pure bending
- Transverse loading
- Transformations of stress and strain
- Principal, minimum, and maximum stresses and strains
- Multiple stresses
- Deflection of non rigid supports (envelopment, deformation, indentation load deflection, density, stiffness, compression)
- Mechanical properties of materials commonly used in SMATs, including foam, viscoelastics, plastics, metals, gels, air, water, textiles, wood, and others

- Thermal characteristics of materials commonly used in SMATs

d) Dynamics of Particles

- Kinematics - the study of motion
 - ◇ Motion in two dimensions (e.g., Straight line (Rectilinear) motion, Curved (plane curvilinear and circular) motion, Rectangular coordinates, Normal and tangential coordinates, Polar coordinates, Three-dimensional motion, and Relative motion)
- Kinetics - the study of forces causing motion
 - ◇ Newton's second law (e.g., Rectilinear motion, Plane curvilinear and circular motion, and Three coordinate systems)
 - ◇ Work and Energy (e.g., Kinetic energy, Potential energy)
 - ◇ Impulse and momentum (e.g., Linear impulse and momentum, Angular impulse and momentum, Conservation of Momentum)
 - ◇ Impact (e.g., Direct central impact, and Oblique central impact)
 - ◇ Relative motion

- ◇ Vibration and time response (e.g., no damping, underdamped, and overdamped)
- e) Dynamics of Rigid Objects --Incorporating moments of inertia
- Proper use and application of Common Components of Machines
 - ◇ Gears
 - ◇ Clutches
 - ◇ Motors, brush, brushless
 - ◇ Bearings, throw-out bearings
 - ◇ Pulleys
 - ◇ Actuators
 - ◇ Torque converters
 - ◇ Belt drives, direct drives
 - ◇ Fasteners (velcro, screws, bolts, t-nuts, rivets, clips, pins, cotter pin)
 - ◇ Electronic control components
 - Strength of Materials
 - Typical Failure Modes
 - ◇ Excessive elastic deformation
 - ◇ Lack of strength (plastic deformation, crush, tensile tear)
 - ◇ Fast (catastrophic) fracture
 - ◇ Thermal expansion/contraction
 - ◇ Fatigue
 - ◇ Creep deformation (temperature-dependent behaviour)
 - ◇ Wear induced by friction and/or abrasion
 - ◇ Safety
 - ◇ Proper Design
 - ◇ Proper Testing
 - ◇ User Training
 - ◇ User's manual (proper operation, care, preventative maintenance)
 - ◇ Protective covers
 - ◇ Over-rides in the event of failure

Materials Science

(as it relates to seating, posture, positioning, skin and soft tissue management, mobility, wheeled mobility, and SMAT intervention)

- a) Classes of Materials : Metals and alloys, polymers, ceramics, glass, composites, wood

b) Properties of Materials

- Economic properties: Price, availability,
- Mechanical properties:
 - ◊ density
 - ◊ elasticity
 - ◊ stiffness
 - ◊ strength
 - ◊ toughness
 - ◊ fracture resistance
 - ◊ fatigue strength
 - ◊ creep strength
- Non-mechanical properties:
 - ◊ thermal
 - ◊ optical
 - ◊ magnetic
 - ◊ electrical
- Surface properties
 - ◊ oxidation, and corrosion
 - ◊ friction
 - ◊ abrasion
 - ◊ wear
- Production properties
 - ◊ ease of manufacturing
 - ◊ fabrication
 - ◊ shaping
 - ◊ joining
 - ◊ machining
 - ◊ finishing
 - ◊ brazing
 - ◊ welding
- Aesthetic properties
 - ◊ Appearance, texture, feel

c) Properties of Specific Materials

- Iron and steels
- Aluminum and its alloys
- Titanium and its alloys
- Polyethylene
- Polypropylene

- PVC
 - ABS
 - Foams
 - Woods
 - Fiberglass
 - Carbon fiber reinforced polymers
 - Kevlar fiber reinforced polymers
- d) Selection of Materials-- Matching design criteria to materials based upon material properties
- e) Altering (Improving/Degrading) Material Properties
- Machining
 - Shaping (deforming)
 - Heat treating
 - Joining

Electrical Engineering and Electronics

(as it relates to seating, posture, positioning, skin and soft tissue management, mobility, wheeled mobility, and SMAT intervention)

- a) Define Electrical Parameters as they relate to specific mobility parameters, including:
- Alternating and Direct Current (ac, dc)
 - Isolation
 - Latch
 - Potentiometer (variable resistance)
 - Power in/power out
 - Plugs and connectors
 - Open versus closed loop
 - Transformers
 - Fuses
 - Load testing
- b) Define voltage, current, power, frequency, amplitude, and resistance.
- c) Batteries: Gel cell, lead acid, sealed, chargers
- d) Describe Safety Functions of Electrical Systems
- Technical Solutions for Common Failures

- Common Electrical Hazards
 - Flammability
 - Fuses to protect circuitry
 - Self monitoring diagnostics
- e) Describe basic electronic components
- Transmitters
 - Receivers
 - Connectors
 - Digital chips
 - Filters
 - Transistors
 - Amplifiers
 - Oscilloscope
 - Multi-meters
 - Wave sources
 - Signal tracers
 - Potentiometer
 - Radio frequency generators
 - Circuit analysis
 - Bread board
 - Light Emitting Diode (LED)
 - Liquid crystal display (LCD)
 - Alternating current (AC)
 - Direct current (DC)
 - Analog logic
- f) Ensure safety functions of electronic systems
- Grounding, surge protection, calibration, resistance, amperage, voltage.
 - Technical Solutions for Common Failures
 - Common Electrical Hazards
 - Flammability
 - Maintenance and Use
 - Fundamentals of circuit design and analysis

Computer Engineering

(as it relates to seating, posture, positioning, skin and soft tissue management, mobility, wheeled mobility, and SMAT intervention)

- a) Use of the computer to acquire SMAT related information, information exchange, and access computer-based information sources;
 - On-line services and sources
 - Email
 - List Serv (a process of linking a group of users to share communication)
 - WWW (Wide World Web)
 - Web Browsers (assist in searching the web for information)
 - Home Page
 - HTTP (Hypertext Transfer Protocol; used to enter home pages on the WWW)
 - FTP (File Transfer Protocol; a method of accessing information on the WWW, locates the address and transfers the file)
 - NARIC and similar online databases

- b) Use of the computer as a design, analysis, and research tool
 - Databases
 - Digitizing data
 - Engineering modeling
 - CAD-CAM design
 - Digital imaging
 - Engineering analysis
 - Pressure mapping devices
 - Data manipulation and analysis

- c) Use of the computer to improve business practices:
 - Personal computer components, such as, CPU, monitor, mouse, keys
 - Operating systems, such as, DOS, MAC, Windows
 - Software Applications, such as, word processing, spreadsheets, databases, and graphics.

GLOSSARY

Assessment Team	The consumer and all others who have a vested interest in providing the best intervention to meet the goals and needs of the consumer in order to improve function, safety, or performance. Members may be active or not, and might include the consumer, family, caregivers, physician, therapists, nurse, therapeutic recreation specialist, product supplier, vendor, rehabilitation engineer, funding agent, case manager, rehab technologist, special educator, vocational evaluator, employer, and others.
Assistive Technology (AT)	(1) Any device, product, or methodology used to enable individuals to perform tasks that would typically not be possible due to the disabilities. (2) Also used to refer to the field or area of the development and provision of such devices.
Consumer	The person who has been or will be using the technology; often referred to as the end user, user, customer or client.
Evaluation	The process of gathering, synthesizing, and analyzing pertinent information on a specific issue, such as physical condition or functional vision, in order to clarify the person's status and make recommendations. It is performed by a qualified professional with advanced knowledge in that particular field.
Funding Source	The person or agency responsible for paying for the intervention. It may pay for purchase or rental of just the SMAT product(s) or it may cover additional services including the assessment, fitting the equipment to the consumer, modifications, adjustments, interfacing, training, product maintenance and follow-up services.

Seating and Mobility Assistive Technology (SMAT)

Any device, product, or methodology used to enable individuals with varying degrees of disability to improve the functional ability to be seated and mobile. The range of products includes postural support devices, ambulation aides, walkers, standers, scooters, mobility devices, wheelchairs, and of course, seats, cushions, and seating systems for classrooms, worksites, factories, highchairs, carseats, vehicles, and wheel bases.

Simulation

Use of hands or a device to imitate the actual equipment recommended. This includes use of manual hands-on positioning, seating simulators, mock-ups, and demonstration or trial equipment.

SMAT Assessment

A comprehensive problem-solving process of gathering, synthesizing, and analyzing pertinent information and data related to the consumer, the task(s), and the environment(s) in order to identify the SMAT intervention, products, and/or services most suited to meet the consumer's goals, desires, and needs. It often includes information from several disciplines provided via records, evaluations, tests, and reports.

SMAT Intervention

Any change to improve the functional ability to be seated and mobile. The range of interventions includes not just new products and devices, but also education or training, modifications or adjustments to existing equipment, maintenance or repairs, ongoing follow up, and referral to other services, such as surgical, pharmaceutical, behavioral consultation.

SMAT Provider (SMATP)

An expert with advanced knowledge, skills, abilities, and considerable experience which uniquely enables them to provide exceptional service and high quality performance during the process of informing, assessing, strategizing, implementing and assuring successful seating and mobility assistive technology intervention.

SMAT Service Delivery

A complete multi-step process whereby comprehensive SMAT intervention is provided to an individual. Steps in the service delivery process include, but are not limited to: acceptance of referral, pre-assessment screening, assessment, evaluations, plan development, acquisition of equipment, fitting, training, follow up, follow-through, and preventative maintenance.

APPENDIX C

Demographic Information

Demographic Information

1. Date of birth (mm/dd/yr): _____
2. Gender: ___Male ___Female
3. Professional Designation (select all that apply)
 - Physical Therapist
 - Occupational Therapist
 - Physical Therapist Assistant
 - Occupational Therapist Assistant
 - Other (please specify) _____

4. Please complete all that apply:

Check all that apply	Degree	Year of graduation
<input type="checkbox"/>	Bachelors (entry level)	_____
<input type="checkbox"/>	Masters (entry level)	_____
<input type="checkbox"/>	Advanced level Masters (degree) _____	_____
<input type="checkbox"/>	Clinical Doctorate (entry level)	_____
<input type="checkbox"/>	Clinical Doctorate (advanced level)	_____
<input type="checkbox"/>	PhD (degree) _____	_____
<input type="checkbox"/>	Other (degree) _____	_____

5. Years of clinical practice _____ (years)
6. Years of seating and mobility service provision _____ (years)
7. How many hours per week do you work? _____ (hrs/wk_____)
8. How many hours per week do you work providing seating and wheeled mobility services? _____ (hrs/wk_____)
9. On average, how many individuals with traumatic spinal cord injuries do you see for seating and mobility services? Estimate the **one** that is most appropriate for you.

_____/ week
 _____/ month
 _____/ year

Please continue on the next page!

Investigator Use Only			
Study: Val.	Int.		
Level: SCI	Ortho	Disc	X

10. Do you provide any *preservice* professional training about seating and wheeled mobility to student PT's and /or OT's? Yes No

If yes, what is your level of involvement? (check all that apply)

Type of training	# of hrs/year
— Teach course with seating and mobility content	_____hrs/year
— Teach lecture about seating and mobility	_____hrs/year
— Clinical instructor for internship in seating and mobility	_____hrs/year
— Other (Please describe)	_____hrs/year

11. Do you provide any *postservice* professional training about seating and wheeled mobility to professional PT's and /or OT's? Yes No

If yes, what is your level of involvement? (check all that apply)

Type of training	# of hrs/year
— Teach continuing education course about seating and mobility	_____hrs/year
— Teach lecture about seating and mobility at a professional conference	_____hrs/year
— Provide inservice training about seating and mobility to PT /OT colleagues	_____hrs/year
— Provide inservice training to others about seating and mobility (i.e.; third party payors, nursing, teachers, suppliers, etc.)	_____hrs/year
— Other (please describe)	_____hrs/year

12. Describe your preservice exposure and training (training received during PT or OT school) to seating and wheeled mobility prescription.

13. How many hours of professional development per year do you complete in the area of seating and wheeled mobility? _____ (hours/year)

Please continue on the next page!

14. What types of professional development activities **in the area of seating and wheeled mobility service provision** do you participate?

Activity	Participation <i>(check all that apply)</i>
Continuing education conference (i.e RESNA, ISS, CSUN, etc.)	
Inservice (supplier, manufacturer, colleague)	
Formal self study program	
Higher education course	
Teaching (professionals, students, etc.)	
Other (List)	

For each of the following 3 items:

Draw a vertical line to mark your response along the scale (Novice to Expert). A **novice** is an individual who has the prerequisite *generic* knowledge (basic, common, general) in the area of seating and wheeled mobility prescription for individuals with spinal cord injury. An **expert** is an individual with *specialized* knowledge (specific, thorough, proficient, skilled, practiced) in the area of seating and wheeled mobility prescription for individuals with spinal cord injury.

(Ex.) Novice _____  _____ Expert

15. **I would rate** my abilities as a seating and mobility clinician as....

Novice _____ Expert

16. **My colleagues would rate** my abilities as a seating and mobility clinician as....

Novice _____ Expert

17. **My supervisor would rate** my abilities as a seating and mobility clinician as....

Novice _____ Expert

Thank you for your participation!

APPENDIX D

**Seating and Mobility
Script Concordance Test: Spinal Cord Injury
(SMSCT-SCI)**

Assessment Knowledge

Introduction – How to answer these questions:

The following clinical vignettes provide basic background information about a clinical situation. Think of yourself performing an evaluation, generating a hypothesis and then finding out more information. How would your original hypothesis change based on this new information? Use the scale below. Consider each item separately. Each item is unique and does not build on the previous one.

Do not skip any questions. There is **no** one correct answer. Use your professional judgment to select the **best** choice based on the information provided to you.

Please answer each question by circling the appropriate number on the test sheet. Next, darken your response on the answer sheet using a number 2 pencil. Be sure to check that the item number corresponds between the test and answer sheet. The entire test should take approximately 60-75 minutes to complete. This first test section should take approximately 30 minutes to complete. All data will be kept strictly confidential.

Answer Scale

Use the information provided in the clinical vignette and the hypothesis in column one. (If you were to find out new information listed in column two, to what extent would the original hypothesis change?)

- 1 becomes almost eliminated
- 2 becomes less probable
- 3 is not affected by the new information
- 4 becomes more probable
- 5 becomes most likely probable

Ex.

1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Example

A 42- year old female with T10 paraplegia presents with a complaint of pain when she lifts her right arm overhead.

<i>If you were thinking of (a hypothesis)</i>	<i>And then you find</i>	<i>This hypothesis</i>
Partial rotator cuff tear	No longer able to transfer to her tub seat without assistance	1 2 3 (4) 5

For assessment knowledge

A 32-year-old male with a diagnosis of T10 spinal cord injury arrives in your clinic sitting in his manual wheelchair in a slumped kyphotic posture with a left ischial pressure ulcer.

	<i>If you were thinking of (a hypothesis)</i>	<i>And then you find</i>	<i>This hypothesis</i>				
1.	Fixed posterior pelvic tilt	Supine mat assessment reveals increased lumbar lordosis	1	2	3	4	5
2.	Fixed pelvic obliquity with right ASIS (anterior superior iliac spine) higher than the left	Supine mat assessment reveals full lower trunk mobility with left lateral flexion to create right lateral trunk extension	1	2	3	4	5
3.	Flexible pelvic obliquity with right ASIS higher than the left	Right hip flexion range of motion 15 from neutral to 75 degrees	1	2	3	4	5
4.	Fixed pelvic obliquity with right ASIS higher than the left	Left hip flexion range of motion 10 from neutral to 95 degrees	1	2	3	4	5

- 1 becomes almost eliminated
- 2 becomes less probable
- 3 is not affected by the new information
- 4 becomes more probable
- 5 becomes most likely probable

A 45-year-old male with a diagnosis of T10 spinal cord injury arrives in your clinic, sitting in his manual wheelchair, in a slumped kyphotic posture with complaints of sliding forward.

	<i>If you were thinking of (a hypothesis)</i>	<i>And then you find</i>	<i>This hypothesis</i>				
5.	Impaired sitting balance	Upon request to lift upper extremities off mat, you observe a weight shift to the left and increased thoracic kyphosis	1	2	3	4	5
6.	Bilateral hip flexion less than 90 degrees	Following a pushup and repositioning, he sits with hips 3" in front of sling back and complains of constantly sliding forward on seat	1	2	3	4	5
7.	Impaired sitting balance	Upon lifting arms, you observe an elongation of thoracic spine with symmetrical weightbearing on both ischial tuberosities	1	2	3	4	5
8.	Tight hamstrings	When supine on mat with hips flexed to 85, you measure 110 degree popliteal angle	1	2	3	4	5
9.	Decreased lumbar extension	He moves off sacrum onto ischial tuberosities with thoracic extension	1	2	3	4	5
10.	Tight hamstrings	75 degree popliteal angle in sitting	1	2	3	4	5
11.	Bilateral hip flexion less than 90 degrees	Patient sitting with a posterior pelvic tilt but is able to passively achieve a neutral pelvic position when allowing the shoulders to move slightly posterior to hips	1	2	3	4	5

- 1 becomes almost eliminated
- 2 becomes less probable
- 3 is not affected by the new information
- 4 becomes more probable
- 5 becomes most likely probable

For assessment knowledge

A 42-year-old female with T10 paraplegia presents with complaints of right shoulder pain. She comes into the clinic with a prescription from her orthopaedic doctor stating, "Please evaluate wheelchair seating and mobility, diagnosis right shoulder pain".

	<i>If you were thinking of (a hypothesis)</i>	<i>And then you find</i>	<i>This hypothesis</i>				
12.	Wheelchair not fitting properly	Her hip width measures 16" and her wheelchair seat width measures 18"	1	2	3	4	5
13.	Anterior/posterior rear wheel axle position not optimal	The rear wheelchair axle position is set in the most posterior position and 50% of her body weight is over the rear wheels	1	2	3	4	5
14.	Rear wheel camber not optimal	There is 0 degrees of camber	1	2	3	4	5
15.	Rear wheel alignment causes uneven tracking during rolling	She complains that the wheelchair pulls to the left when she is propelling on flat terrain	1	2	3	4	5
16.	Excessive stress is placed on right shoulder during wheelchair transfers	She recently switched from a "popover" or "depression" transfer to a sliding board transfer. She transfers to her right whenever possible. She states that the majority of her transfers are to level surfaces.	1	2	3	4	5
17.	Anterior/posterior rear wheel axle position not optimal	At initial wheel contact during propulsion her shoulders are in 60 degrees of extension with 80 degrees of elbow flexion and 15 degrees of wrist extension	1	2	3	4	5
18.	Unequal wheelchair rolling resistance	Both wheelchair tires are inflated to an equal pressure	1	2	3	4	5

- 1 becomes almost eliminated
- 2 becomes less probable
- 3 is not affected by the new information
- 4 becomes more probable
- 5 becomes most likely probable

A young man with a diagnosis of T4 paraplegia reports new onset of Grade 1, sacral / coccygeal skin redness

	<i>If you were thinking of (a hypothesis)</i>	<i>And then you find</i>	<i>This hypothesis</i>				
19.	Posterior pelvic tilt that is causing excessive sacral weightbearing	He sits in his wheelchair with the posterior superior iliac spine lower than the anterior superior iliac spine	1	2	3	4	5
20.	The seat cushion is not providing adequate pressure distribution	He sits on a five year old fluid filled cushion	1	2	3	4	5
21.	Posterior pelvic tilt that is causing excessive sacral weightbearing	A supine mat assessment reveals full lumbar spine extension	1	2	3	4	5
22.	Posterior pelvic tilt that is causing excessive sacral weightbearing	Wheelchair back upholstery is old and appears stretched and worn	1	2	3	4	5
23.	Unequal sitting pressure distribution	He reports that he wears sneakers some of the time and cowboy boots some of the time	1	2	3	4	5
24.	Skin redness is due to moisture	He performs intermittent catheterization and reports infrequent (less than weekly) incontinence of urine	1	2	3	4	5
25.	Infrequent or inadequate weight reliefs	He is constantly moving around and leaning. During the interview he does not perform a pushup but leans forward on the table.	1	2	3	4	5
26.	Excessive sitting pressures on boney structures	He underwent Baclofen pump placement for tone management 6 months ago	1	2	3	4	5

- 1 becomes almost eliminated
- 2 becomes less probable
- 3 is not affected by the new information
- 4 becomes more probable
- 5 becomes most likely probable

A 65-year-old male with a diagnosis of C6 tetraplegia is referred to your clinic because he is having trouble self-propelling his manual wheelchair. He falls to the right side and is unable to propel with both arms at the same time.

	<i>If you were thinking of (a hypothesis)</i>	<i>And then you find</i>	<i>This hypothesis</i>				
27.	Inadequate trunk control resulting in loss of balance to the right side	When seated on the mat, he falls to the right side when he attempts to lift his right hand off the mat	1	2	3	4	5
28.	Pelvic obliquity left side higher than the right causing loss of balance to the right side	When sitting on the mat, palpation reveals that he has equal weightbearing on his left and right ischial tuberosity	1	2	3	4	5
29.	Inadequate back support when sitting in his wheelchair causing him to fall to the right	His wheelchair seat to back angle is 95 degrees and the top of the back upholstery comes to the level of the scapular spine	1	2	3	4	5
30.	Excessive thoracic kyphosis	When seated on the mat with external trunk support, he is able to lift his arms to shoulder height with shoulder elevation and cervical hyperextension	1	2	3	4	5
31.	An S-curve thoracolumbar scoliosis (thoracolumbar convexity to the left, cervicothoraco convexity to the right) causing him to fall to the right	When seated on the mat a visual inspection reveals the left shoulder higher than the right and his head is slightly tilted to the left	1	2	3	4	5
32.	Poor position in wheelchair with hips shifted to the left	Upon assisted repositioning in his chair he falls to his right	1	2	3	4	5
33.	He is sitting too upright in his wheelchair causing him to lose his balance	In his wheelchair his shoulders are positioned in vertical alignment with his hips	1	2	3	4	5

- 1 becomes almost eliminated
- 2 becomes less probable
- 3 is not affected by the new information
- 4 becomes more probable
- 5 becomes most likely probable

Intervention Knowledge

Introduction – How to answer these questions:

The following clinical vignettes provide basic background information about a clinical situation including a reason for referral to the clinic. When considering the proposed intervention consider the degree of confidence with which you could justify that recommendation to address the complaint(s) in the vignette in light of the findings listed in the first column. Use the scale below. Consider each item separately. Each item is unique and does not build on the previous one. The recommendation is not intended to solve all the problems presented in the vignette.

Do not skip any questions. There is **no** one correct answer. Use your professional judgment to select the **best** choice, based on the information provided to you. Please answer each question by circling the appropriate number on the test sheet. Next, darken your response on the answer sheet using a number 2 pencil. Be sure to check that the item number corresponds between the test and answer sheet. This test section should take approximately 30 minutes to complete. All data will be kept strictly confidential.

Answer Scale

Use the information provided in the clinical vignette plus the finding in column one. If the supplier on your team makes the recommendation in column two, select the degree of confidence with which you could justify that recommendation to address the complaint(s) in the vignette.

- 1 with very little confidence
- 2 with little confidence
- 3 neither favor nor oppose the recommendation
- 4 with partial confidence
- 5 with a high degree of confidence

Ex.

1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Example

An 18 year old newly injured man with C5 complete tetraplegia

<i>If you find (Column 1)</i>	<i>And then the supplier recommends the following (Column 2)</i>	<i>To what degree of confidence could you justify this recommendation?</i>
He has strong biceps but no finger flexion strength	Projection hand rims	1 2 3 4 (5)

Definitions

These definitions (Cooper, 2001) are intended to clarify the use of the following terms.

UW- Ultralight wheelchairs weigh less than 30 lbs, are moderately adjustable or selectable manual wheelchairs intended for individual use [K0005]

LW- Lightweight wheelchairs weigh less than 35 lbs, and are minimally adjustable or nonadjustable manual wheelchairs intended for individual or institutional use [K0004]

DW- Depot wheelchairs weigh 35 lbs or more, and are minimally adjustable (i.e. hemi or standard height) or nonadjustable manual wheelchairs intended for institutional or commercial use [K0001, K0002, K0003]

For intervention knowledge

A 45- year old man 20 years status post C6-7 spinal cord injury is referred to your clinic for a replacement wheelchair. He is an experienced manual wheelchair user and is currently using a 10 year old, folding frame, depot manual wheelchair with a fixed seat to back angle and no rear wheel axle adjustability. This chair presents with vinyl upholstery that is overstretched and results in his body being positioned between the back posts. He has removed the armrests for easier wheel access. He sits with a slumped posture with rounded shoulders and forward head position. His main complaint is neck and shoulder pain of recent slow onset (less than 4 months). He reports an active lifestyle including driving a car, independently loading/unloading his folding wheelchair, and employment as an architect. He lives in an accessible home environment with his wife and two children 5 and 7 years old. He states he is interested in trying new things that may alleviate his current problems or improve his pain.

	<i>If you find</i>	<i>And then the supplier recommends the following</i>	<i>To what degree of confidence could you justify this recommendation?</i>
34.	He reports that his neck and shoulder pain is less severe when propelling his wheelchair	Duplicating features of current wheelchair with a lightweight wheelchair	1 2 3 4 5
35.	When sitting on the mat he falls forward and he puts his hands on the mat in order to stop himself	Adjustable tension back upholstery	1 2 3 4 5
36.	When repositioned in his current wheelchair so that his hips are beneath his shoulders he is unable to lift his arms without falling forward	Ultralight folding manual wheelchair with rear wheel axle adjustability with axle plate positioned 1” higher than the standard setting. Solid back insert to replace the sling upholstery	1 2 3 4 5
37.	Complaints of pain with shoulder extension, abduction and internal rotation	Ultralight manual wheelchair with rear axle adjustability positioned in a mid to forward position	1 2 3 4 5
38.	When repositioned in his current wheelchair so that his hips are beneath his shoulders he is unable to lift his arms without falling forward	Solid back insert to replace the sling upholstery	1 2 3 4 5
39.	When sitting in his current wheelchair with properly adjusted arm supports he has a level shoulder position but no change in neck and shoulder pain	Recommend that he use his armrests	1 2 3 4 5
40.	He drives a 2 door sedan	Ultralight rigid manual wheelchair frame	1 2 3 4 5

- 1 with very little confidence
- 2 with little confidence
- 3 neither favor nor oppose the recommendation
- 4 with partial confidence
- 5 with a high degree of confidence

For intervention knowledge

A newly injured 18-year-old male with a diagnosis of complete T10 paraplegia is about to be discharged from the rehab unit. He is referred to your clinic for an evaluation for his first wheelchair and seating system. He graduated from high school and was injured during a “pick-up” football game. He is being discharged home with his parents and 16-year-old sister. He has plans on attending college “out of state”. He owns his own car and is in the process of having hand controls installed. He has had no incidence of skin problems. He has done well in rehab and is independent with high-level wheelchair skills and can independently negotiate ramps and curbs.

	<i>If you find</i>	<i>And then the supplier recommends the following</i>	<i>To what degree of confidence could you justify this recommendation?</i>
41.	He has funding for only one wheelchair. He wants to explore and participate in wheelchair sports. He does not know what the accessibility situation will be in university housing.	Rigid frame ultralight manual wheelchair with adjustable seat to back angle, camber, axle position and “squeeze” or “dump”	1 2 3 4 5
42.	He initially will be travelling in cars with multiple individuals until his own two-door car is ready.	Lightweight folding frame manual wheelchair with height adjustable axle position, swing away footrests and adjustable back height	1 2 3 4 5
43.	He has funding for only one wheelchair and he reports that he would like to stand on a daily basis in preparation for walking	Manual standing wheelchair	1 2 3 4 5
44.	He has been working on gait training with KAFO’s as an inpatient and intends to continue gait training upon discharge	Rigid manual wheelchair with swing away footrests	1 2 3 4 5
45.	He has been working on gait training with KAFO’s as an inpatient and intends to continue gait training upon discharge	Rigid manual wheelchair with rigid front end	1 2 3 4 5
46.	When in school, he anticipates needing to travel across a large campus. He will need to carry multiple personal items including catheter supplies, wallet, books etc. estimated to weigh 10 lbs.	Luggage carrier and net	1 2 3 4 5
47.	He has good wheelchair propulsion skills. He independently manages ramps and curbs	Manual wheel locks with grade aids (also known as “hill holders”)	1 2 3 4 5

- 1 with very little confidence
- 2 with little confidence
- 3 neither favor nor oppose the recommendation
- 4 with partial confidence
- 5 with a high degree of confidence

For intervention knowledge

A 50-year-old male with a diagnosis of C6 tetraplegia onset 20 years ago has done very well in his current manual wheelchair. He presents to your clinic for a new wheelchair recommendation. He works in an office environment 8 hours per day. He drives a van from his manual wheelchair and accesses the van via a ramp. He lives in Florida with his wife and two cats in a one level accessible home. His hobbies include web page design, geneology and community groups (i.e. Rotary club, garden club, bridge club). He is currently using a 10-year-old folding frame lightweight manual wheelchair with 8” casters and very few adjustable features (armrests, back rest height and rear axle height). He uses a fluid floatation cushion for pressure management and a lumbar support insert. He only recently has been having problems with pressure resulting in Grade 1 redness on his sacrum. He presents with a slumped posture.

	<i>If you find</i>	<i>And then the supplier recommends the following</i>	<i>To what degree of confidence could you justify this recommendation?</i>
48.	He does not perform high level wheelchair skills such as wheelies	Rigid frame ultralight titanium wheelchair	1 2 3 4 5
49.	He reports difficulty rolling his current wheelchair over door thresholds and deep pile carpet	Suspension forks for casters	1 2 3 4 5
50.	He reports getting stuck in his gravel driveway when exiting his van	8” front wheel caster	1 2 3 4 5
51.	He has difficulty pushing up the ramp into his van because the chair tips backwards on inclines	Adjustable rear wheel axle in mid (anterior/posterior) position and one notch superior to standard setting	1 2 3 4 5
52.	He is happy in his existing chair even though he has previously trialed new wheelchair and seating technologies with a vendor.	Duplicate existing wheelchair and seating system	1 2 3 4 5
53.	A neutral or slight anterior pelvic tilt can be passively achieved in sitting	Biangular back support	1 2 3 4 5
54.	He performs an incomplete weight relief because he gets spinal extension during the pushup with no lift off.	CADCAM (computer aided design/computer aided manufacturing) foam seat and back cushions	1 2 3 4 5

- 1 with very little confidence
- 2 with little confidence
- 3 neither favor nor oppose the recommendation
- 4 with partial confidence
- 5 with a high degree of confidence

For intervention knowledge

A 60-year-old female with new C7-8 tetraplegia currently in rehab is referred to your clinic for a first wheelchair and seating system. She currently is 6 weeks post surgery for a cervical fusion and is wearing a cervical collar. She plans on initially being discharged home to her daughter and son in law but plans on returning to her accessible condominium independently when she is able. She lives in an urban setting with accessible bus transportation. She does not anticipate returning to her job as a real estate agent. She is currently able to propel a loaner reclining back manual wheelchair 100 feet. It is necessary to order her definitive wheelchair now due to funding issues.

	<i>If you find</i>	<i>And then the supplier recommends the following</i>	<i>To what degree of confidence could you justify this recommendation?</i>
55.	Full upper extremity range of motion and an efficient wheelchair stroke	Rigid ultralight manual wheelchair with an adjustable height back support	1 2 3 4 5
56.	Both her daughter’s home and her condominium have hardwood floors throughout. The rooms in her condominium are small	Rigid ultralight manual wheelchair with solid back support with scapular cut outs, adjustable seat to back angle, adjustable rear axle position and 5” casters	1 2 3 4 5
57.	She has degenerative arthritis in her shoulders that resulted in pain and activity limitation prior to her accident	Ultralight manual wheelchair with power assist wheels	1 2 3 4 5
58.	She can propel her wheelchair 100 feet on level indoor surfaces, and has an efficient wheelchair stroke. She anticipates encountering various ramps to access public buildings	Grade aides (also known as “hill holders”)	1 2 3 4 5
59.	She experienced a right shoulder dislocation during her accident and she is unable to perform an effective weight relief via a pushup due to inadequate shoulder depression	A power wheelchair and modify method of weight relief by leaning forward onto her knees.	1 2 3 4 5
60.	She has a shortened wheelchair stroke due to limited shoulder extension from a right traumatic soft tissue shoulder injury at the time of her accident	A programmable power wheelchair	1 2 3 4 5

- 1 with very little confidence
- 2 with little confidence
- 3 neither favor nor oppose the recommendation
- 4 with partial confidence
- 5 with a high degree of confidence

For intervention knowledge

29-year-old T8 paraplegic, 8 years post injury presents to your clinic for a replacement wheelchair and seating system. She is self-employed in her own business with her husband. She is very active and travels often for her business. She reports being unhappy with the performance of her existing ultralight rigid frame manual wheelchair.

	<i>If you find</i>	<i>And then the supplier recommends the following</i>	<i>To what degree of confidence could you justify this recommendation?</i>
61.	She primarily encounters pavement, sidewalk, hard court surfaces and hardwood floors	Ultralight folding frame wheelchair	1 2 3 4 5
62.	She prefers a closed seat to back angle to promote improved trunk balance	Rigid frame manual wheelchair with 1” fixed “squeeze” or “dump” and adjustable wheel camber	1 2 3 4 5
63.	She has multiple steep ramps she uses to access her work environment. She has only tipped over once in her chair on the ramp	Ultralight titanium rigid frame manual wheelchair with a fixed rear axle position set at 1” in front of her center of mass	1 2 3 4 5
64.	In the past she has experienced broken metal spokes due to wheelchair basketball incidents	High performance rear wheels with spokes made out of high strength composite materials	1 2 3 4 5
65.	She is very active and would like her chair to be as light as possible	Push to lock wheel locks	1 2 3 4 5
66.	She has complaints of neck pain and presents with an increased thoracic kyphosis with cervical hyperextension	Rigid ultralight manual wheelchair with a 90 degree fixed seat to back angle with 1” fixed frame squeeze	1 2 3 4 5
67.	She is currently using a gel pressure relieving cushion	Mixed medium foam and air cushion	1 2 3 4 5

- 1 with very little confidence
- 2 with little confidence
- 3 neither favor nor oppose the recommendation
- 4 with partial confidence
- 5 with a high degree of confidence

APPENDIX E

**Seating and Mobility
Script Concordance Test: Spinal Cord Injury
(SMSCT-SCI)**

Short Form-a

NOTE: Short form items correspond with item numbers 12-18, 34-40, and 61-67 from the SMSCT 67

Assessment Knowledge

Introduction – How to answer these questions:

The following clinical vignette provides basic background information about a clinical situation. Think of yourself performing an evaluation, generating a hypothesis and then finding out more information. How would your original hypothesis change based on this new information? Use the scale below. Consider each item separately. Each item is unique and does not build on the previous one.

Do not skip any questions. There is **no** one correct answer. Use your professional judgment to select the **best** choice based on the information provided to you.

Please answer each question by circling the appropriate number on the test sheet. Next, darken your response on the answer sheet using a number 2 pencil. Be sure to check that the item number corresponds between the test and answer sheet. The entire test should take approximately 20-30 minutes to complete. This first test section should take approximately 10 minutes to complete. All data will be kept strictly confidential.

Answer Scale

Use the information provided in the clinical vignette and the hypothesis in column one. (If you were to find out new information listed in column two, to what extent would the original hypothesis change?)

- 1 becomes almost eliminated
- 2 becomes less probable
- 3 is not affected by the new information
- 4 becomes more probable
- 5 becomes most likely probable

Ex.

1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Example

A 42- year old female with T10 paraplegia presents with a complaint of pain when she lifts her right arm overhead.

<i>If you were thinking of (a hypothesis)</i>	<i>And then you find</i>	<i>This hypothesis</i>
Partial rotator cuff tear	No longer able to transfer to her tub seat without assistance	1 2 3 (4) 5

For assessment knowledge

A 42-year-old female with T10 paraplegia presents with complaints of right shoulder pain. She comes into the clinic with a prescription from her orthopaedic doctor stating, “Please evaluate wheelchair seating and mobility, diagnosis right shoulder pain”.

	<i>If you were thinking of (a hypothesis)</i>	<i>And then you find</i>	<i>This hypothesis</i>				
1.	Wheelchair not fitting properly	Her hip width measures 16” and her wheelchair seat width measures 18”	1	2	3	4	5
2.	Anterior/posterior rear wheel axle position not optimal	The rear wheelchair axle position is set in the most posterior position and 50% of her body weight is over the rear wheels	1	2	3	4	5
3.	Rear wheel camber not optimal	There is 0 degrees of camber	1	2	3	4	5
4.	Rear wheel alignment causes uneven tracking during rolling	She complains that the wheelchair pulls to the left when she is propelling on flat terrain	1	2	3	4	5
5.	Excessive stress is placed on right shoulder during wheelchair transfers	She recently switched from a “popover” or “depression” transfer to a sliding board transfer. She transfers to her right whenever possible. She states that the majority of her transfers are to level surfaces.	1	2	3	4	5
6.	Anterior/posterior rear wheel axle position not optimal	At initial wheel contact during propulsion her shoulders are in 60 degrees of extension with 80 degrees of elbow flexion and 15 degrees of wrist extension	1	2	3	4	5
7.	Unequal wheelchair rolling resistance	Both wheelchair tires are inflated to an equal pressure	1	2	3	4	5

- 1 becomes almost eliminated
- 2 becomes less probable
- 3 is not affected by the new information
- 4 becomes more probable
- 5 becomes most likely probable

Intervention Knowledge

Introduction – How to answer these questions:

The following clinical vignettes provide basic background information about a clinical situation including a reason for referral to the clinic. When considering the proposed intervention consider the degree of confidence with which you could justify that recommendation to address the complaint(s) in the vignette in light of the findings listed in the first column. Use the scale below. Consider each item separately. Each item is unique and does not build on the previous one. The recommendation is not intended to solve all the problems presented in the vignette.

Do not skip any questions. There is **no** one correct answer. Use your professional judgment to select the **best** choice, based on the information provided to you. Please answer each question by circling the appropriate number on the test sheet. Next, darken your response on the answer sheet using a number 2 pencil. Be sure to check that the item number corresponds between the test and answer sheet. This test section should take approximately 15 minutes to complete. All data will be kept strictly confidential.

Answer Scale

Use the information provided in the clinical vignette plus the finding in column one. If the supplier on your team makes the recommendation in column two, select the degree of confidence with which you could justify that recommendation to address the complaint(s) in the vignette.

- 1 with very little confidence
- 2 with little confidence
- 3 neither favor nor oppose the recommendation
- 4 with partial confidence
- 5 with a high degree of confidence

Ex.

1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Example

An 18 year old newly injured man with C5 complete tetraplegia

<i>If you find (Column 1)</i>	<i>And then the supplier recommends the following (Column 2)</i>	<i>To what degree of confidence could you justify this recommendation?</i>
He has strong biceps but no finger flexion strength	Projection hand rims	1 2 3 4 (5)

Definitions

These definitions (Cooper, 2001) are intended to clarify the use of the following terms.

UW- Ultralight wheelchairs weigh less than 30 lbs, are moderately adjustable or selectable manual wheelchairs intended for individual use [K0005]

LW- Lightweight wheelchairs weigh less than 35 lbs, and are minimally adjustable or nonadjustable manual wheelchairs intended for individual or institutional use [K0004]

DW- Depot wheelchairs weigh 35 lbs or more, and are minimally adjustable (i.e. hemi or standard height) or nonadjustable manual wheelchairs intended for institutional or commercial use [K0001, K0002, K0003]

For intervention knowledge

A 45- year old man 20 years status post C6-7 spinal cord injury is referred to your clinic for a replacement wheelchair. He is an experienced manual wheelchair user and is currently using a 10 year old, folding frame, depot manual wheelchair with a fixed seat to back angle and no rear wheel axle adjustability. This chair presents with vinyl upholstery that is overstretched and results in his body being positioned between the back posts. He has removed the armrests for easier wheel access. He sits with a slumped posture with rounded shoulders and forward head position. His main complaint is neck and shoulder pain of recent slow onset (less than 4 months). He reports an active lifestyle including driving a car, independently loading/unloading his folding wheelchair, and employment as an architect. He lives in an accessible home environment with his wife and two children 5 and 7 years old. He states he is interested in trying new things that may alleviate his current problems or improve his pain.

	<i>If you find</i>	<i>And then the supplier recommends the following</i>	<i>To what degree of confidence could you justify this recommendation?</i>
8.	He reports that his neck and shoulder pain is less severe when propelling his wheelchair	Duplicating features of current wheelchair with a lightweight wheelchair	1 2 3 4 5
9.	When sitting on the mat he falls forward and he puts his hands on the mat in order to stop himself	Adjustable tension back upholstery	1 2 3 4 5
10.	When repositioned in his current wheelchair so that his hips are beneath his shoulders he is unable to lift his arms without falling forward	Ultralight folding manual wheelchair with rear wheel axle adjustability with axle plate positioned 1” higher than the standard setting. Solid back insert to replace the sling upholstery	1 2 3 4 5
11.	Complaints of pain with shoulder extension, abduction and internal rotation	Ultralight manual wheelchair with rear axle adjustability positioned in a mid to forward position	1 2 3 4 5
12.	When repositioned in his current wheelchair so that his hips are beneath his shoulders he is unable to lift his arms without falling forward	Solid back insert to replace the sling upholstery	1 2 3 4 5
13.	When sitting in his current wheelchair with properly adjusted arm supports he has a level shoulder position but no change in neck and shoulder pain	Recommend that he use his armrests	1 2 3 4 5
14.	He drives a 2 door sedan	Ultralight rigid manual wheelchair frame	1 2 3 4 5

- 1 with very little confidence
- 2 with little confidence
- 3 neither favor nor oppose the recommendation
- 4 with partial confidence
- 5 with a high degree of confidence

For intervention knowledge

29-year-old T8 paraplegic, 8 years post injury presents to your clinic for a replacement wheelchair and seating system. She is self-employed in her own business with her husband. She is very active and travels often for her business. She reports being unhappy with the performance of her existing ultralight rigid frame manual wheelchair.

	<i>If you find</i>	<i>And then the supplier recommends the following</i>	<i>To what degree of confidence could you justify this recommendation?</i>
15.	She primarily encounters pavement, sidewalk, hard court surfaces and hardwood floors	Ultralight folding frame wheelchair	1 2 3 4 5
16.	She prefers a closed seat to back angle to promote improved trunk balance	Rigid frame manual wheelchair with 1” fixed “squeeze” or “dump” and adjustable wheel camber	1 2 3 4 5
17.	She has multiple steep ramps she uses to access her work environment. She has only tipped over once in her chair on the ramp	Ultralight titanium rigid frame manual wheelchair with a fixed rear axle position set at 1” in front of her center of mass	1 2 3 4 5
18.	In the past she has experienced broken metal spokes due to wheelchair basketball incidents	High performance rear wheels with spokes made out of high strength composite materials	1 2 3 4 5
19.	She is very active and would like her chair to be as light as possible	Push to lock wheel locks	1 2 3 4 5
20.	She has complaints of neck pain and presents with an increased thoracic kyphosis with cervical hyperextension	Rigid ultralight manual wheelchair with a 90 degree fixed seat to back angle with 1” fixed frame squeeze	1 2 3 4 5
21.	She is currently using a gel pressure relieving cushion	Mixed medium foam and air cushion	1 2 3 4 5

THE END.

Please turn in your test packet.

- 1 with very little confidence
- 2 with little confidence
- 3 neither favor nor oppose the recommendation
- 4 with partial confidence
- 5 with a high degree of confidence