

Telerehabilitation Applications for Cognitive and Vocational Rehabilitation

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Michael McCue: Thank you Dave, and good morning every one. Commissioner Rutledge, I thank you very much for allowing me a few extra minutes. I'd like to acknowledge our funding source for these projects that includes the National Institute on Disability and Rehabilitation Research's support of our Rehabilitation Engineering Research Center on Telerehabilitation, and also funding from the public vocational rehabilitation program in the State of Pennsylvania, through a long-standing interagency agreement with the Hiram G. Andrews Center, which is the state-operated vocational rehabilitation facility in Pennsylvania. I would also like to acknowledge funding from the Pennsylvania Department of Public Welfare through the Autism Services Education Research and Training Centers supporting our projects on autism. I want to start with a discussion of telerehabilitation in the context of the broader field of telemedicine. We are all aware of telemedicine and telehealth. Our colleagues Bambang Parmanto and Andi Saptono pointed out, in a publication in the Journal of Telemedicine and E Health, that telerehabilitation is unique when compared to the broad telehealth and telemedicine continuum. They identified a continuum based upon the intensity of the technical services that are delivered, as well as the duration that those tele-services that are delivered. While there are some exceptions, telemedicine tends to load much more heavily in high intensity technology, such as in radiology or surgery, whereas telerehabilitation often tends to be more characterized by long duration activities, such as therapies over an extended period of time. Also, telerehabilitation as a general rule tends to be less demanding in technical intensity. Now there are exceptions to this.

So that's the context in which we look at telerehabilitation, emerging as something that is different and unique from the broader, more medically oriented telemedicine, and this presents unique challenges to the clinical practice and technology worlds. We are disappointed by the lack of strong evidence for the efficacy of telerehabilitation, such as what may result from well-controlled clinical trials. There really hasn't been support to drive clinical trials in the area of telerehabilitation. Recently, there have been three quite comprehensive literature reviews on telerehabilitation. One is by Kairy, Lehoux, Vincent and Visintin in 2009 in the journal, Disability and Rehabilitation. A second review was conducted by the Canadian Institute of Health Economics in 2010. Most recently, a publication in the journal, Neurorehabilitation, by Rogante, Grigioni, Cordella and Giacomozzi in 2010 surveyed telerehabilitation evidence from 2000 to 2010. What we find that is relevant to my topic today is that there is very limited study of employment, vocational rehabilitation and community

independence. Because we lack evidence and support, I hope to make some suggestions and recommendations how we might move forward.

When we look at evidence in telemedicine and telerehabilitation, we see that the general emphasis has been on what we call equivalence or noninferiority studies. That is, are those services that we provide as tele-services at least equivalent to what we are doing face-to-face. That has been the initial challenge. Can we do something as well remotely using telerehabilitation as we do face-to-face, while at the same time saving consumer travel time, saving money, saving clinician time? The second thing that we look at in evidence studies is, are the users of this system, including consumers, of course, but also clinicians who are using telerehabilitation, satisfied, and do our usability studies allow us to document the usefulness of these technologies, as well as use this information to refine or improve those technologies. However, we want to push our evidence studies beyond this. We believe that there is a likelihood of evidence out there for, as Commissioner Rutledge indicated, providing supports to people in life as the challenges occur to them. We believe that there is ample evidence in the literature to support in vivo treatment, such as is reflected in the literature in vivo behavior therapy for anxiety disorders for pain, for phobias, and we know in the vocational rehabilitation literature how effective supportive employment is. That's one of our strongest, evidence-based approaches in rehabilitation, to put job coaches with people in real jobs in the natural environment. That is clearly a winner. However, it is a challenge to provide supported employment to all who want and need it. It is a resource challenge. It is a cost challenge. We also see evidence in stroke rehabilitation of early discharges and home-based treatment to facilitate resumption of community independence following stroke. We also know that our conceptualization of disability through the International Classifications of Functioning or ICF focuses on contextual factors in our environment, so we have a lot of forces that are pushing us to look at naturalistic aspects of rehabilitation.

So to sum up, what works for telemedicine may not necessarily work for telerehabilitation. When we think about rehabilitation, there are characteristics of rehabilitation that are different from telemedicine. We find that in rehabilitation, including vocational rehabilitation, our encounters between clients and professionals are usually characterized as repetitive, established relationships that take place over time. This is contrary to what happens in medicine, where when you have an injury or a disease, you go to a physician and the physician treats that disease and as you get better, you have less need for that physician and that medical contact. Well, based upon our evidence in rehabilitation with persons with significant disabilities, such as traumatic brain injury, client needs for services often escalate over time as they recover, so the community-based needs that

these individuals have actually become greater and more involved as they move forward. Unfortunately, our system is not set up to reimburse such services or to provide the resources and service options that many of those persons need. The difficulties people experience are often most evident where and when they interact with demands in their community, at work, when they are shopping, when they are interacting with peers, or when they are trying to have a social relationship, rather than in the clinical settings those individuals most often receive services.

Furthermore, rehabilitation prescribes, requires and enables clients to practice extensively what they learn in the clinic and then try to apply it, and generalize it to their lives. We also know that rehabilitation typically involves a lot of different professional disciplines. As a result, we are required to work together to insure that what happens in one rehabilitation situation carries over, rather than reinventing the wheel with each professional seen. We have to have a mechanism for what is learned or gained to carry over from one situation or setting to the next.

Given the unique aspects of rehabilitation, coupled with the fact that we acknowledge chronic stubborn poor employment rates for individuals with significant disabilities, we really need to think about ways of expanding community-based services, and we happen to believe that telerehabilitation is a potential strong tool to facilitate that process. When we look at what we are challenged with, the contextual factors that impact people, those environmental pulls and pushes on an individual, we recognize that there is overwhelming evidence to suggest that what people learn in clinical settings don't necessarily generalize to what happens in their life settings. So, for example, we can show remarkable recovery on a computer-based memory training task in the clinic or lab. However, there is very limited evidence to suggest that such gains have anything to do with people's memory in the face of the real world demands. That's unfortunate because we are making assumptions that people are getting better but we haven't dealt with that problem of generalization to real world demands. We know from our experiences that a "train then place" traditional model of vocational rehabilitation may not be as effective as putting people in the natural environment, placing and then training and supporting individuals through techniques like supported employment, or variants of supported employment, where we can provide it where it really matters; where people encounter challenges and obstacles. We use strategies like assistive technology, cognitive rehabilitation, mentoring, and peer supports to assist people in those environments. Rehabilitation also uses education about injury, education about disability, education about the world, the world of work, careers, the interaction between what an individual brings to a situation and those contextual factors like the demands of a potential employment situation. It requires that we gather detail about

the environment, so that we fully understand, in detail, those requirements that individuals face in the environment. If we are going to help an individual navigate those demands, knowledge of requirements and demands has to be part of the rehabilitation.

We know that what tends to work are compensatory strategies that people can apply in real life situations. We also know that self-awareness is critically important to success. Several well-controlled longitudinal studies of vocational rehabilitation reveal that problems with self-awareness are a major obstacle to people being successful. So increasing self-awareness and incorporating accurate information about self through the rehab process is critical.

People have complex follow-up needs. If somebody has a spinal cord injury, they may also have emotional and psychosocial, family and relationship role issues, and return to work issues, in addition to physical rehabilitation needs. People also live in communities that are not necessarily readily accessible to our rehabilitation interventions, due to distance or transportation problems. Commissioner Rutledge mentioned our reach and our access, and I agree that those are critical issues. We recognize that people want to be in their communities, where they can thrive and profit from those community benefits. Arguably, it is sometimes difficult to conduct rehabilitation in the community context because of distance factors, or because it is more time consuming for rehabilitation professionals to intervene in people's homes, communities and workplaces.

Through telerehabilitation, I believe that we can extend ourselves to meet these needs. We can obtain information about client environments through our technology, using pictures, sounds, and videos. We can capture that information through telerehabilitation technologies. We can implement real-time therapy or supports or coaching, precisely when an individual faces these environmental and context-dependent problems. That is what we refer to as "in vivo" intervention, delivered via telerehabilitation. We can provide education and feedback, at a pace that's tolerable to the individual. We can provide this as they need it, not when it is convenient for the provider, with the hope that this will generalize to something useful to the client as they later face life's challenges. It also enables the client to self-monitor, and for us to track client progress and changes. Such monitoring can be built into a telerehabilitation system. We can also anticipate that people may move from one system to another, and that ability to connect those systems through telerehabilitation can benefit the individual. So given the premise that rehabilitation presents unique demands, as well as opportunities, I'd like to just give you some examples of how this plays out.

I'll give examples in two areas. First, I would like to share some vocational rehabilitation state agency experiences in regards to this tele-concept. Then I will share some things that we are doing at the University of

Pittsburgh.

There is a community of practice in program evaluation involving vocational rehabilitation outcomes called the Summit Group that I believe is a joint undertaking of the Region 8 Technical Assistance and Continuing Education Program, The National Consortium on Rehabilitation Training Materials (NCTRM) and the Utah vocational rehabilitation agency. The Summit Group has a very active list-serve involving looking at rehabilitation practice and outcomes. I polled this group using the list-serve and received a strong response that illustrated examples of tele-applications within state VR agencies. Results indicate that it is quite common for state agencies to utilize video conferencing and other technologies for staff training. Most states have videoconference networks set up across their district offices, and this appears to be a commonly used tool for administrative meetings and training. Several state VR agencies use telerehabilitation technologies for counselors to access experts for case consultations. For example, in the Oregon VR agency and at the Woodrow Wilson Rehab Center in Virginia, TR supports access to specialists in varied professional areas, such as neuropsychology. Many state VR agencies implement direct client services via TR, through deaf and interpreter services. VR programs in South Dakota, Maryland and Oregon are implementing these services through TR. In a few states, staff reported that direct client counseling and case management services are being delivered via telerehabilitation. In states such as Montana and Oregon, imagine managing caseloads across hundreds of miles. These state agency counselors use telerehabilitation services, such as telephone, email, video conferencing and even text messaging to connect with clients. The Woodrow Wilson Rehabilitation Center uses telerehabilitation for training in AAC, as well as supports neuropsychological services. Nebraska is researching using the iPad for client services. There is a NIDRR funded Research and Training Center on Disability and Rural Communities in Montana that has produced informative research on Telecommunications and Rural Americans with Disabilities. Clearly, telerehabilitation has begun to emerge within vocational rehabilitation.

Next I would like to provide illustrations of some of the work we are doing at the University of Pittsburgh to test the use of TR to deliver services “in vivo”. We did a study at the Hiram G. Andrews Rehabilitation Center (HGAC) in rural Johnstown, PA that involved supporting persons with disabilities in work settings using multiple mobile and Internet applications in addition to traditional face-to-face contact. We tested telephone, text messages, instant messaging on a computer and email correspondence. We found from usability and satisfaction data that these mechanisms were very positively received and effective in providing coaching support. We found that people tended to value text messaging more than any of the other modalities

for on site support. They explained that they could respond after having time to think about an issue or a problem. It gave them time to think through problems before they interacted with their coach.

As part of the first round of our NIDRR funded RERC on telerehabilitation, we have studied using sensors and machine learning software to detect an individual's behavior at work tasks. We felt that we can enhance remote coaching if we could somehow assess an individual in real time and determine whether or not they were meeting task demands. If they weren't meeting task demands, we were interested in what were they doing wrong and how could we intervene. We developed a system first using video motion capture and that evolved to using accelerometers to detect how people were performing on a hamburger turning task that was a standardized task by Wendy's. We have gotten to the point where we are very good at detecting some very complicated movements. The task involved grilling 16 burgers in a systematic pattern, using a melody of sequential motions. The system would be trained to detect whether or not people were doing this correctly and then deliver cues via audio or visual feedback to an individual. When we examined the accuracy of this robotic job coach, we were 94 percent accurate when people were flipping burgers, 91 percent accurate for picking the burgers from the grill, almost 96 percent accurate for placing the burgers, and pressing burgers at 82 percent and salting at 90 percent accurate. We were able to define distinct movements and then accurately determine whether or not individuals were doing that.

Another example that we have is we use a combination of the technology that Dr. Parmanto is going to talk about this afternoon, our VISYTER technologies, to support our clinical and supervisory interactions with the Hiram G. Andrews Center. At HGAC, we provide a pre-vocational cognitive skills program for individuals with significant cognitive disabilities. We have a number of faculty, staff and students in Pittsburgh and who are required to provide clinical services to clients in Johnston, which is 90 miles away. While our staff travel to Johnstown, it is only one or two days per week. In order for them to maintain contact with their clients, we have an electronic portal that allows us to store and share all of our case records and all ongoing documentation about clients. We have a videoconferencing system (VISYTER) that allows our clinical faculty and students to interact from Pittsburgh with clients in Johnstown for cognitive rehabilitation therapy.

Two projects focus upon remote standardized assessment. One protocol tests the reliability and validity of a remote autism assessment called Autism Diagnostic Observation Schedule or ADOS, which is a standardized behavioral assessment of Autism Spectrum Disorder. Our VISTYER system is a very robust and flexible video conferencing system that you will have an opportunity to observe this afternoon with Dr. Parmanto, who is the architect of this system. We are also conducting a protocol for remote

neuropsychological assessment that is similar to the ADOS study. Two studies involve remote job coaching protocols and remote cognitive rehabilitation using mobile technology including wireless tablet PCs or smartphones to meet individuals unique support needs. For example, if someone is out in a job situation, they can access a video task guidance library using their smartphone to help them through the stages of a complex task. They can have a real time text chat with a job coach. We can use a tablet PC or a smartphone to have a live coaching session between a client in the workplace and a job coach in the clinical setting.

In summary, community-based rehabilitation, including vocational rehabilitation, has been traditionally underfunded, less rigorously researched and therefore underutilized and untested. We already know that telemedicine focuses efforts on equivalence – whether we can do something remotely as well as we can face-to-face. We believe that we need to go beyond this in rehabilitation. We think that TR has the potential to enable the extension and expansion of services beyond the clinic to serving the client where they live, work and learn. This is consistent with a rehabilitation model of intervention in the natural environment. What works is rehabilitation conducted in the natural environment. We believe that we have a tool that will allow us to do that. Let's take advantage of that. Interventions that promote and result in employment and self-management are examples of this. The efficacy of supported employment found in the literature, the research on the value of self-management, some of which you will hear about from Dr. DiCianno this afternoon, are perfect examples of how we can take valuable services into the client's environment.

The public Vocational Rehabilitation program offers unique funding opportunities for clinical applications. One reason telerehabilitation is not more widely applied and tested is because of the obstacles to reimbursement. Well, VR puts decisions about funding and services in the hands of the professional vocational rehabilitation counselor. Counselors have their own budget to provide services to clients. They have the ability to negotiate with providers to identify resources. Let's get these telerehabilitation resources in the hands of the counselors and job coaches so they can extend their work and see twice, perhaps three times as many individuals receiving support.

I will conclude with some recommendations. We need new models for expanding TR applications to vocational rehabilitation and independent living. I would encourage new funding opportunities for model demonstrations of telerehabilitation applications with VR clients. We have wonderful university state VR collaborations. Many of the examples I have discussed today are a product of strong University - VR collaboration; we ought to promote such collaboration across the country. We also need to establish stronger telecommunications industry - VR collaborations. Thank you.