Video Assessment Outcome Measures for Muscular Dystrophy using a Validated Mobile Platform

Creating meaningful outcome measures for Duchenne Muscular Dystrophy with an assessment tool that is uniquely designed.

Dalia El-Sherif, Mindy Leffler, Christopher Jones, Christine McSherry, Marielle Goyette, Michelle K. White, and Nicholas Valle

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Mobile health applications are still in their infancy, but present a great opportunity for the healthcare industry. They enable patients and caregivers to have a greater role in their health, empower providers to make data-driven decisions, allow researchers to gain greater insight into patient and disease populations, and give payers a new window into how patients are doing on treatment. In this paper, we look to explore the collection of additional muscular dystrophy outcome measures through mobile video, the benefits of these assessments, and how to develop them.

Muscular dystrophies (MDs) are a group of rare genetic disorders that are characterized by progressive muscle degeneration and weakness. MDs vary by specific groups of muscles affected, age of onset, and severity. The most common MD is Duchenne muscular dystrophy (DMD) and accounts for approximately 50% of all MD cases\(^4\). DMD affected about 15 out of every 100,000 U.S. males aged 5-24 in 2007\(^2\). Muscle weakness in DMD patients begins in early childhood and eventually leads to the loss of the ability to walk. There is no cure for DMD, and a lack of sensitive outcome measures for the disease poses a considerable barrier to the development of potential therapeutics.

Limitation of Current Assessments

The challenge with selecting outcome measures in DMD is in choosing an outcome that is sensitive to change in the entire trial population over a relatively short duration but not beyond the point of recoverability such that a subject could stabilize or improve on treatment. Definitive outcome measures, such as loss of ambulation, require lengthy clinical trials, while timed movement tests, such as the six-minute walk, are subject to motivational factors and a lack of ability to detect nuance.

Movement analysis experts confirmed in interviews with Casimir that patient ease/ quality of
movement reflects disease progression. Therefore, it is critical to capture ease/quality of the movement, not merely the movement speed. Evaluating ease/quality rather than speed of movement removes the motivational aspect of the outcome assessment and allows for the potential to observe involuntary compensatory factors in movement that coincide with disease progression.

Innovative Mobile Approach for Enhancement of Assessments

Casimir and iTakeControl have developed an innovative approach to capture and quantify the ease/quality of movement of DMD patients, providing critically needed sensitive and meaningful outcome measures for this patient population. The approach of using ease/quality of movement as an outcome measure originated from discussions with caregivers about how their children with DMD were progressing.

To capture the ease/quality of movement, Casimir and iTakeControl have developed a standardized way for Casimir’s assessment tools to be embedded within iTakeControl’s mobile application allowing caregivers to record DMD patients doing specific activities of daily living in their own homes using a secure smartphone application. Remote data capture can be more reflective of patient real-world functioning than clinical assessments, particularly in children, because it eliminates the confounds of travel fatigue, and medical procedure and stranger interaction-related anxiety. Physical therapists will use the video data to rate changes in ease/quality of movement using a scoring system that is indicative of disease progression in DMD.

Patient Driven Assessment Tools: Concept & Approach

Casimir’s focus on ease/quality of movement grew from discussions with parents about how DMD children were progressing. When speaking about their children’s status, parents were instinctively picking out changes in the children’s movement patterns that they perceived as representative of decline, stability, or improvement. The more Casimir participated in these discussions, the more we saw similarities between the way the movement patterns broke down from child to child. The children were progressing on different timelines, but the factors indicating movement quality degradation for the same tasks were similar.

Casimir conducted qualitative interviews with DMD clinicians, physical therapists, and movement analysis experts, and they confirmed that evaluating changes in such movement criteria can provide a basis for quantifying disease progression.
The qualitative work with physical therapists and DMD patient caregivers informed a list of activities of daily life for the assessments that are sensitive to disease progression. These included walking front view, walking side view, sitting up, standing up, and going up the stairs.

*mHealth App to Enable Video Capture for Enhanced Movement Assessment*

Travelling and setting time aside for clinic visits can be a large stressor for DMD patients and their families. While clinic visits for DMD patients cannot be fully eliminated for certain clinical assessments, they are not necessarily needed for capturing and assessing the ease/quality of movements.

iTakeControl’s mClinical platform enables the video capture of movement ease/quality with a controlled and validated app that is convenient for patients and their families, allowing them to record these much needed outcome measures from their own smartphone devices with the convenience and ease of their home or alternative setting.

*Caregiver Training to Ensure Consistent Assessment Performance and Video Capture*

In order to ensure consistency and quality of the videos captured remotely by the caregiver, the caregiver must be trained on the assessment criteria and best practices. The caregivers are provided this training and instructions on how to capture the videos and submit them to the study team directly through iTakeControl’s mobile app. They are given specific instructions to standardize lighting, clothing, timing, distances, and activity types. In addition, they are supplied with required training videos to watch within the app prior to capturing their own videos with examples of DMD patients performing the required activities.

As training is an essential component to the program, DMD caregivers using the application must pass all training exercises prior to gaining the ability to record video assessments. Caregivers are required to watch and complete three training videos with a password sign-off to confirm completion. Once all required training has been completed, users gain the ability to begin capturing assessments. Caregivers can easily access the training videos from their smartphone at any time for a refresher course.

*Content Validity of Video Assessments*

In order to assess the content validity of the video assessments, Casimir partnered with Optum to test the understanding of caregivers’ perceptions of the quality, feasibility, and validity of this measurement approach.

Primary caregivers were asked to review training materials, download the app, and record and
submit the Video Assessments. Two independent raters reviewed the submitted videos using a checklist to ensure training materials were followed correctly. Caregivers were asked to provide feedback on the appropriateness of the physical activities recorded, comprehension of the training materials, ease of use of the app, and feasibility of recording the videos. All caregivers were mothers of ambulatory DMD patients aged 9-12 years.

Raters found that caregivers found the training materials and app easy to understand, and reported the videos accurately captured their child's physical functioning.³

Optum also conducted interviews with North American and European clinicians who were asked to comment on the clarity of the training materials, the relevance of each activity, and the feasibility and usefulness of the assessments in clinical trials with DMD patients.

The clinicians found the approach to be relevant and valuable, and felt the activities included were appropriate for measuring change in ease/quality of movement.

Scoring System to Assess the Ease/Quality of Movement of DMD Patients

The specified activities for the assessments that DMD patients perform on a scheduled basis will ultimately need to be scored and assessed by a qualified physical therapist who has completed rater training for these assessments.

Once a caregiver submits a video, a qualified physical therapist who has met qualifications criteria will use specified criteria to rate a video at a particular timepoint. Patients will then be given a severity score based on the percentage of compensatory criteria they demonstrate at each timepoint. The severity scores between two relevant timepoints will be compared to determine an absolute change in severity. This absolute change will be translated into a clinical global impression of change (CGI-C) scale, which uses one score from 1 to 7 to describe the change in ease/quality of movement between two timepoints.

Compliance and Working Through the Health Authority

Although mHealth applications can provide convenient ways to submit and collect data, it is imperative to ensure it is done in a secure and appropriate fashion. iTakeControl works directly with study sponsors and Casimir to ensure the application follows study protocols and adheres to 21 Part 11 and EU compliance. As we deploy this approach in a trial, the assessments and mobile application go through a central IRB approval process in order to remain compliant with Good Clinical Practice and FDA regulations.

Casimir has experience advocating for the consideration of the patient perspective when the FDA reviews potential DMD treatments. Casimir is currently working with the FDA to qualify this clinical outcome assessment for use as an efficacy endpoint measure in clinical trials. The video assessment data can also be used by families as evidence for insurance companies to cover DMD medications that may provide benefit for their child.

Data Security and Software Validation

With potentially sensitive data related to a study, and the verification requirements to ensure a caregiver has completed training and is submitting the assessments, data security plays a key role. To ensure proper access, iTakeControl has completed an independent, industry-standard software validation of our platform. It requires users to log in every time they access the application and automatically logging them out when inactive. Videos are recorded exclusively from within the
application. Caregivers do not have the ability to access completed videos on their device or submit a video previously recorded. iTakeControl also provides audit trail functionality ensuring all actions within the application are tracked and logged for future auditing purposes. Facial blurring can also be applied to the videos to maintain subject privacy.

**Video Capture Schedule and Security**

To maintain consistency of observed assessment changes over time, the caregivers must record videos within a specified time schedule. Reminders and schedules can keep those involved aligned with a protocol to control for consistent windows of performance. iTakeControl provides caregivers with reminders and a schedule for when to capture their video, making compliance to the required schedule convenient. Within the “open” window period, users are able to record their assessments. Once recording has been completed, videos are uploaded and completely removed from the user’s device, this ensures privacy and no potential for alteration of the videos.

**Fully Integrated approach**

iTakeControl’s platform supports both models of conducting the video assessments in isolation of other related studies or as an integrated part of a larger clinical trial. iTakeControl provides the ability to integrate the video and scoring data with other trial data from a clinical study being conducted by a study sponsor. Enabling single login for users and simple management of the data for study coordinators streamlines the end-to-end organization of the study. Integrations such as these can provide study sponsors the ability to benefit from a mobile video assessment solution while also connecting to their current data and trial analytics management systems.

**A Successful Use Case**

In a Phase 3 pivotal trial, DMD caregivers were provided with iTakeControl’s mobile app configured with the Casimir Caregiver Assessment tool. The caregivers were able to easily download the iTakeControl mobile app through the Apple App Store or Google Play and log in with credentials previously created. They were able to record their videos within the allotted time window. The videos were stored securely, scored, and provided the sponsor with valuable movement data to inform the disease progression of patients on treatment.

**Conclusion**

DMD video assessments provide a unique opportunity to monitor nuanced changes in DMD patients over time. Instead of using outcome measures that are based on speed and involve
motivational factors, these assessments allow physical therapists to have a window into the ease/quality of functions as DMD patients do everyday tasks in their own homes. This sensitive and meaningful outcome measure could be used in the development of future DMD therapeutics or for payers to understand the outcomes of certain treatments on DMD patients.

Casimir’s Caregiver Assessment tool is grounded in a deep understanding of DMD progression, patient and caregiver experiences, and clinician and physical therapist evaluations. Their experience and qualitative research with key stakeholders created an outcome measure that is designed to detect nuanced changes in DMD patient ease/quality of movement.

The iTakeControl mClinical platform is an important tool for monitoring DMD patient ease/quality of movement. The mobile application provides a convenient, compliant, and user-friendly way to instruct caregivers and gather the video assessments in a controlled and validated manner. DMD video assessments provide a valuable way to monitor disease progression and potentially improve patient health.

References


About the Authors

Dalia El-Sherif, PhD
Co-Founder and CEO of iTakeControl
Dalia has a doctorate degree in Biomedical Science and over 20 years of Industry experience in entrepreneurship and management consulting, including leading strategy roles with PA Consulting, IBM and Shire. Dalia has successfully delivered over 40+ engagements across 20+ accounts in the pharmaceutical, medical device and healthcare industries. Prior to founding iTakeControl, Dalia has helped various life science clients implement leading digital and advanced analytics capabilities.

Mindy Leffler, MA
President and Co-Founder of Casimir
Mindy's background in project management, software development, and information architecture came in handy when designing a PRO program for her son, Aidan, a 14-year-old with Duchenne Muscular Dystrophy. That PRO program then proved instrumental in the approval of EXONDYS51, the first FDA-approved treatment for Duchenne. When Aidan's insurance company denied coverage for EXONDYS, the data Mindy captured overturned the denial in 24 hours without engaging in the appeal process.

Christopher Jones, PhD
Co-Founder and Executive Vice President of iTakeControl
Chris has over twenty years of experience growing businesses and advising organizations through innovation and the adoption of digital technology in the biotech industry. He has previously led the strategy and development of a real-world data analytics platform in the disease registry space. He spent ten years with Genzyme Corporation, heading the digital marketing programs in the Rare Genetic Disease group and in senior positions in Medical Affairs.

Christine McSherry, BSN, RN
Co-Founder of Casimir
Christine founded Jett Foundation in 2001, when her son Jett, now 20 years old, was diagnosed with Duchenne Muscular Dystrophy. As head of the Jett Foundation, Christine co-founded the International Duchenne Alliance, a partnership of over 40 independent organizations that has funded nearly $15 million dollars in research to date. Christine has advocated for the patient perspective to be considered by the FDA when reviewing safe and potentially effective treatments for Duchenne.
Michelle K. White, PhD
Vice President of Outcomes Insight Consulting and Senior Scientist
Dr. White develops and validates patient-reported outcomes (PROs) across a broad range of therapeutic areas. She has led more than 60 studies that have included both qualitative and quantitative research methodologies. Prior to joining Optum in 2008, Michelle conducted addiction treatment outcome studies and developed surveys for addiction and mental health treatment. She has also held adjunct positions at Illinois State University and the University of Illinois, where she earned her master’s degree and PhD in sociology, respectively.

Marielle Goyette, MPH, PhD
Research Scientist at Casimir
Marielle earned her MPH and PhD in Epidemiology from the University of Washington, where she gained experience conducting HIV/STD prevention research, analyzing qualitative and quantitative data, and writing and presenting scientific findings. Through her PhD work, she became increasingly interested in the use of mobile health technology to monitor and improve health outcomes. Prior to graduate school, Marielle served as a Peace Corps health volunteer in rural Senegal.

Nicholas Valle
Product Manager at iTakeControl
Nic has a background in biological anthropology with over seven years of experience in quantitative data analysis, consumer insights, and product management. Prior to joining iTakeControl, Nic worked in market research with a focus on the mobile industry, supporting companies in analyzing mobile trends and conducting research using mobile devices.