

COMPASS MEETING REPORT



Parent **JOIN THE FIGHT.**
Project **END DUCHENNE.**
Muscular
Dystrophy

ENDDUCHENNE.ORG   

1 INTRODUCTION

2 TRUE NORTH: VOICES OF DUCHENNE

28 GPS COORDINATES: PATIENT EXPERIENCE DATA

38 CHARTING THE COURSE: PATIENT-FOCUSED POLICY DIRECTIONS

45 IN CONCLUSION AND ACKNOWLEDGEMENTS

The Duchenne Patient-Focused Compass Meeting was held as part of FDA's Patient-Focused Drug Development (PFDD) initiative. As an externally led meeting, it was hosted and planned by Parent Project Muscular Dystrophy (PPMD) in collaboration with FDA and a Community Advisory Board comprised of leaders of 14 independent Duchenne patient advocacy organizations (listed in Acknowledgements on page 49).

Federal partners from the National Institutes of Health (NIH), Centers for Disease Control and Prevention (CDC), Centers for Medicare and Medicaid (CMS), Social Security Administration (SSA), Department of Education, Department of Labor, and Department of Defense also attended. Representatives from industry, including members of PPMD's Duchenne Drug Discovery Roundtable, health insurance plans, and other stakeholders were present on-site and via the live webcast.

DUCHENNE PATIENT-FOCUSED COMPASS MEETING

Introduction

“This is where hope lives,” Pat Furlong, founding President and CEO of Parent Project Muscular Dystrophy said, standing beside director of the U.S. Food and Drug Administration’s Center for Drug Evaluation and Research, Dr. Janet Woodcock. Together, they looked out over a packed ballroom and concluded one of the most powerful days in the history of the Duchenne community. Over the course of six gripping hours, patients, parents, and advocates provided intimate detail of the challenges, heartbreaks, and joys they experienced in living with Duchenne muscular dystrophy. Their testimony from the stage and in discussion throughout a packed ballroom was heard by 551 people in 17 countries, including the audience participating via a live webcast, archived for on-demand viewing.

In opening remarks for this Duchenne Patient-Focused Compass Meeting, Pat prepared participants for what was to come. “It’s a new day in Duchenne, thanks to agencies willing to listen, 46 companies with active interest in Duchenne, two product approvals, and most of all, thanks to all of you here today. Yet, it will be hard to speak about and hard to listen to what we have experienced. Together, we will come away better than we sit here now.” Her forecast was accurate; the four panels of parents and patients and discussion in each session brought forth strong emotions and salient facts. Dr. Woodcock’s closing comments reinforced the importance of hearing both.

The first section of this report, “True North,” depicts each stage of the Duchenne journey as shared by Compass meeting participants. In Section 2, “GPS Coordinates,” their voices are amplified through data collected under various clinical and research initiatives. Finally, Section 3, “Charting the Course,” presents a policy agenda designed to better target research, improve screening and diagnosis, streamline product development, enhance regulatory decision-making, expand access to life-enhancing care, and reduce the burden of living with and caregiving for a person with Duchenne. It documents current reality and asserts a navigation guide for joint action.

SECTION 1 TRUE NORTH: VOICES OF DUCHENNE

The Early Journey & Elementary Years

Four mothers and one father of boys age 11 and younger formed the first panel of the day. Each took five minutes to encapsulate the early years of the Duchenne experience, after which PPMD's Annie Kennedy led a discussion with panelists and other participants.

Emerging symptoms and the diagnostic odyssey

Parents around the room shared similar stories of observed developmental milestone delays or difficulties that led them to ask physicians for additional testing. Crawling, jumping, climbing stairs, running, gripping things with their hands, and rising from the floor were some of the things they noticed their sons couldn't do as well as children of the same age. Young boys were described as being floppy, clumsy, off-balance, and generally weaker than same-age peers, sometimes from early infancy. Concerns were frequently brushed aside by clinical providers with assurances that "every child develops at a different rate." Most parents had to push for testing, or find a specialist willing to explore whether there might be an underlying cause for these physical and developmental delays.

J.C.* explained that when her son Conner was four years old, they noticed he couldn't keep up with his friends or his brothers. "We took him to the doctor hoping for answers. We waited four weeks for results from genetic tests, which were inconclusive. More tests and another four weeks. Waiting was so hard, but the unknown was better than knowing. When the results came back and pointed to an answer, the genetics specialist handed me a

thick packet on Duchenne and said there was no hope, no cure. He told us to do things as a family now, while Conner is still walking. I died that day and my hopes and dreams for Conner died, too."

Lisa also recalled noticing that something wasn't quite right with her son Layne shortly after his second birthday. Five months later they asked their pediatrician to refer them to therapists for delays in speech, growth, and fine motor skills. Lisa did some more research on her own and asked for a creatine kinase (CK) blood draw. "I will never forget that phone call when the results were reported to me. The nurse who called actually asked *me* if Layne should be hospitalized. In that moment, during that call from the nurse, I became an educator about Duchenne."

Other parents recounted the trauma of learning the diagnosis being compounded by a lack of balanced information to accompany the shocking news. Claire's son's pediatrician phoned her on December 30, 2011. "The doctor said lab results indicated Duchenne. My mind scrambled to recall what I knew about Duchenne. He said that it was 'bad' and that I could find more information online until we could see a neurologist after the holidays. My husband and I wept at the prognosis we found on Wikipedia that night."

For others, the diagnosis of Duchenne was complicated by prior diagnoses or concurrent conditions. Several reported ADHD, anxiety, obsessive-compulsive disorder (OCD) or OCD-like behaviors, autism, and growth hormone deficiencies made it even more difficult to assess what was going on.

*Throughout this report when identifying individuals who spoke on behalf of living children (whether minors or adults), first names only or initials are used to protect their child's privacy.

Rhiannon was one of the parents who spoke to this. "Carter was so ill from the time he was born it made it really hard to narrow down a diagnosis. In addition to Becker, he now has multiple rare diagnoses and it's hard to know which one might be the cause of new issues as they arise. We don't fit into any box."

Seeking care and making treatment decisions

Upon diagnosis many sought more expert care, often at a great distance. "Once we had a diagnosis, I did my own research to find the right doctors for our team. We currently travel out of state to a clinic that's eight hours away. We found an in-state pulmonologist and cardiologist who are also willing to follow my son, and our local primary care physician is great to work with," stated Lisa.

The treatments even at the early stage of Duchenne encompass multiple approaches, including: medicines; nutritional supplements; physical, occupational, speech, and aqua therapy; assistive devices like ankle foot orthoses and leg splints; and daily stretching and massage routines. It's a lot for both child and parent to manage, as J.C. reported. "Seven-year-old Conner takes a lot of pills. He takes steroids to build his stamina so he can last a full day at school. He takes pills for digestion and vitamin deficiency to keep his bones strong. He wears uncomfortable braces every single night. He goes to various therapies and he misses school on a weekly basis for appointments. This is our new normal."

The challenge of addressing behavioral changes was mentioned by several parents. Emotional vulnerability, sadness, anxiety, attention deficit, and volatility were raised as concerns during the discussion and through results of the polling questions, described in Section 2.

Age-appropriate things parents said they wish their sons could do that they can't due to Duchenne:

- Ride a bike
- Get on the school bus without having to be carried
- Climb on the jungle gym
- Get on and off the toilet
- Dress and undress himself
- Play sports and field day games with his friends
- Jump on a trampoline or in a "bouncy house"
- Run faster than a "trot"
- Walk steadily
- Get up from the floor
- Evacuate a building in case of fire

Although most of the children are still ambulatory at this stage, many use strollers or manual wheelchairs to conserve energy for school or play. Colleen described the necessity, "At age seven, Brendan can't make park visits without the stroller. The sandy, uneven surfaces at the beach cause frequent falls. Our ventures start out magical but end in tears as a fall or tired legs interrupt or stop our day."

J.C. took a deep breath as she shared the pain of a recent event. "We needed to install chair lifts in our home for Conner. I sobbed quietly as the men measured for the equipment. I felt the need to explain, 'These lifts are for my seven-year-old. His muscles are wasting away.' They looked at me and didn't know what to say. Most people don't."

Clinical trial participation

For this age group, clinical trials often become part of the therapeutic decision-making and family focus. With an active therapeutic development pipeline and the emphasis on disease-modifying therapies that slow or halt progression, inclusion criteria for trial enrollment often target the younger boys who are still ambulatory and have more functional capacity. For the families considering clinical trial participation, there are multiple, complex factors to consider, including medical issues, financial tradeoffs to cover travel and other ancillary costs, and myriad practical matters. Claire said the mode of administration of the study drug was important to her. "Is it an infusion? A pill? How big is the pill?"

The dimensions of uncertainty surrounding clinical trial participation resounded throughout the day, but especially with the parents of these young boys. "There are a lot of choices. You get into one trial and you don't know if the drug is working. You watch your boy to try to tell. Other opportunities arise but there are washout periods to switch trials. It's tricky and it's really tough," said J.C. Several parents regretted the discomfort and pain of the procedures and regimens required, the blood draws, infusions, port implantations, biopsies, and more.

A diagnosis of Duchenne leads to many family changes, including parents' employment decisions to accommodate care needs and clinical trial opportunities, another topic explored through polling questions.

Corticosteroids: A vexing decision

The recommended standard of care for Duchenne includes use of glucocorticosteroids when patients reach the "plateau" stage after which time physical and functional abilities such as walking and rising from the floor become more difficult. The potential benefits of steroid therapy include slowing muscle damage and weakness; preservation of lung function; and reduced chance of curved spine (scoliosis). Yet, there are significant side effects and potential immediate and long-term harms from steroid use, including obesity, behavior problems, bone thinness and weakness (osteoporosis), delayed puberty, stomach problems, cataracts, and increased sensitivity to infections.

Parents in the early years of Duchenne are faced with when and whether to start steroid therapy. Here's what three parents of young boys described:

"Weighing the long list of horrible side effects, the decision to go ahead with daily steroids was probably one of the most painful things besides the diagnosis itself. There's no way to get into clinical trials without being on steroids, so I felt like I didn't have a choice."

—J.C.

"My son has been on steroids since he was four-and-a-half years old. He's six now; he fractured his arm two weeks ago and had to have surgery, so he's already having bone loss. He also suffers from ADHD, has mild anxiety, and some OCD-like traits, so we're getting a neuropsychological assessment."

—Limca

"Initially, my son refused to cooperate with the twice weekly dosage, so we had to pin him on the floor, plug his nose, and force medicine down his little throat. As difficult as it was, we noticed significant improvement in his strength, stamina, and mobility. He fell less, is more stable on his feet, and has become more confident, assertive, engaging—and a little naughty."

—Nate

Colleen described how this plays out in families. “It has been a complex journey for us, although Brendan’s growth hormone deficiency excludes him from certain trials. We chose one we thought was a good fit but the site location requires us to go from our home on one corner of the country to the other. We want to do what’s best and to give him every chance, so we weigh all the benefits and the risks.”

Angela spoke to the tradeoffs between school and clinical trial participation. “We were fortunate that our son was in the first clinical trial for Duchenne at the beginning of his second grade year. The study was in another state and he was also enrolled in a MRI study across the country. We were making these trips on a regular basis and had to ask ourselves, ‘How important is second grade?’ We hoped he’d make up what he lost educationally and we talked to the school about it. But he mostly missed things like being at the class Valentine’s Day party. As parents you’re making these hard decisions. Now he’s 17 and doing great in school and great on the drug. It worked out.”

Lisa explained other considerations that must be made. “I don’t work outside the home so we don’t have regular child care for our other two children. Some of the trials require travel to sites across the country. If we moved to be close to them, we’d lose our community and family supports, so that is not a good option for our family.” J.C. also experienced this challenge. “We try to make the right decisions for Conner’s care, while thinking about our other two children that we’ll have to leave behind for days each month while being part of a trial. Conner’s brothers ask, ‘Are you leaving again to try to help Conner’s muscles?’ The emotional sideshows that occur in our house on a daily basis are heart wrenching.”

For families with more than one child with Duchenne these family considerations take on added



Representatives from most biopharmaceutical industry companies in the Duchenne space participated in the March Compass Meeting.

complexity. Joanna has two boys with Duchenne. “Elliott was eligible for a clinical trial, but his younger brother, Henry, was too young. When Henry was eligible to try to qualify, he walked too fast [on the Six-Minute Walk Test] to be able to be included. As a parent, what do you do? You end up in this ‘Sophie’s Choice.’ Which child’s needs do you accommodate? I’m grateful for companies that offer sibling access.”

With gene therapy studies being initiated in Duchenne, some parents like Nate are exploring all options. “We hope to enroll Andrew in gene therapy clinical trials as soon as he meets age and weight requirements. We’re willing to take on the associated risks, logistical challenges, and necessary sacrifice. We desire to do everything within our control to provide him with a long, joyful, meaningful life,” he vowed.

Accommodating Duchenne in family life

Conversations about Duchenne with children this age and their siblings were hard. Especially trying was finding age-appropriate language to describe the disease and providing explanations to their young sons for circumstances or conditions they couldn't come to grips with themselves. "Brendan asks why his body is the way it is, which is difficult to answer. He wants to know when he can stop taking medicine and why he's not the same as his brother and sister," Colleen recounted, becoming emotional. "He's asked us if Jesus can heal him. We do our best to keep him hopeful and optimistic, but his bad days unquestionably prove to become our worst days as well."

Several parents commented on the challenge of allowing their sons more freedom as they got older, while at the same time accommodating greater physical limitations and the whole-family impact of Duchenne. These were recurring themes throughout the day.

As Claire described her family's experience, many people nodded their heads in agreement. "As parents we are forced to see the bigger picture while Duchenne brings time into laser focus. We try to pack all the experiences of life into the short years we might have together, hoping Henry will outlive us with his own family. While my children sleep, we burn hours researching, connecting, and finding ways to change the outcome. We plan for the inevitable and we fight for a miracle."



Early Journey & Elementary Years Panel—Parents of children with Duchenne ages 11 and younger reflect on their experiences.

Transition Time: The 'Tween and Teen Years

By definition, Duchenne is a progressive condition where muscle strength and function decline over time. The early to late teen years are considered a time of transition as Duchenne progresses and boys go from being able to walk to being non-ambulatory, sometimes in a rapid, unanticipated way. A second panel of four mothers and one father of boys in this age group provided raw and powerful accounts of how this time of change was affecting their sons and their families. Other family members contributed their perspectives during the moderated discussion period that followed brief statements from the panelists.

An emotional time in the Duchenne journey

Jessica captured the tragic nature of this phase succinctly in her opening remarks. “The most important priority has been making sure that Wesley is okay psychologically with our ever-changing new normal as his body starts to weaken. This is not easy on him. At an age where his peers are getting stronger and able to go further from their parents independently with ease, we find ourselves struggling to navigate a world that isn’t designed for a 14-year-old in a 400-pound wheelchair whose muscles are slowly surrendering.”

“‘Transition’ is a euphemism for losing the ability to walk,” asserted Amanda. “In Duchenne we soften our words because expressing the true horror that is Duchenne is difficult and it is difficult for others to hear. Loss of walking is an overwhelming time. It’s an extreme event. It is harrowing both physically and emotionally. It is something you know is coming yet how do you prepare? It is standing on the beach watching an approaching tsunami wave.

You know you can swim but you have no idea the force with which you and all members of your family are about to be hit.”

The progression of the condition escalates the care and accommodations needed. As Perlita remarked, “Levi is 11 and is becoming less ambulatory now. Six months ago it took maybe 10–12 hours a week to navigate all this. Now it’s a full-time job. It’s tough.”

Physical features of the transition phase

Parents described an array of disease manifestations at this stage. Back and leg pain become more pronounced. There are more falls and sprains. Bones weakened by immobility and long-term steroid use become brittle and break easily. Even before loss of ambulation, there is a decline of upper body strength and dexterity in the hands often overlooked by medical professionals and researchers. Cough strength decreases, creating potentially serious complications for lung function, especially when respiratory infections hit.

Amanda’s son Jack is adjusting to severe changes prompted by a leg fracture—and so is she. “At 12, my son was able to walk independently for three to four minutes at a time. Years of chronic steroid use had weakened his bones and he fell while walking in his bedroom. When he screamed out in pain, I instantly knew his injury was serious.” She went on to describe a horrific emergency room visit with well-intentioned but uninformed emergency room physicians resulting in a full-length leg cast and no guidance for how to assist Jack, given the added weight of the cast and his limited upper body strength. “We returned home at 4 a.m. with no idea

Ramifications of denials and delays related to durable medical equipment (DME):

- Functional decline, including acceleration of disease progression
- Risk of serious complications and possibly premature death
- Increased caregiver time and burden
- Increased out-of-pocket and system costs
- Risks of injury or to physical functioning when using inappropriate and/or outdated equipment

how we were going to manage. The use of crutches was impossible and we didn't even know how to help our son get to the bathroom." Visiting nurses and rehabilitation services were hard to secure and inconsistent. "I remember begging at the appointment window, 'Do you understand that without these services my kid may never walk again?' My son's upper body and arm functioning also suffered greatly during this time from which he will never recover."

Marissa reflected on her son Joseph's transition. "I didn't know that the agonizingly slow, deliberate steps he took on a nondescript day in June of 2015 would be his last. But they were. Since that day we've managed to overcome many of the big hurdles—fighting our insurance company for a power wheelchair, figuring out how to purchase an accessible van, modifying our home with an accessible bathroom and bedroom. It's those big things we anticipate and hear most about, but it's the smaller hurdles we cannot yet fix that continue to break our hearts. Joseph should not have to ask a friend to open his water bottle for him in the school cafeteria. He should not have to ask me to lift him into the shower chair. He should not have to accept

that he can't get his power chair into his friends' homes to hang out on Friday night. But he does."

Expanding care needs

With the deterioration of muscle function, including cardiac and chest muscle, care for the heart and lungs takes on added importance. This progression prompts more frequent monitoring and can require added medications and therapies such as ventilation with a bilevel positive airway pressure (biPAP) machine to supplement oxygen during sleep and a cough assist machine to help clear lung secretions. Pain management may be needed to address weak back muscles, cramps, and curvature of the spine. Headaches, mental lapses, and difficulty concentrating can become more frequent as a consequence of poor quality sleep, medications, and progression of the disease itself. Puberty delayed by steroid use may require testosterone supplementation.

Assistive devices are used to maximize mobility and independence and reduce the physical strain on caregivers. Paid caregivers may also be hired to reduce caregiver burden and provide some separation between family members. Yet, there are trade-offs. "My son Noah needed 24/7 care and I had people in my house all the time. It's hard to find them and trust them and there is a lot of turnover. Your house is not your house anymore," stated Jeff.

Narrowing clinical trial options

Because the "gold standard" endpoint for treatment efficacy has been the distance walked in six minutes (the Six-Minute Walk Test or 6MWT), the scramble to get into clinical trials before boys go off their feet can be quite urgent. "A difference between this panel and the previous one was the availability of clinical trials once your child becomes non-ambulatory," observed Amanda. "For

the benefit of some of the newer folks in the room, your choices become very limited. Once your child loses the ability to walk, there aren't many studies focused on upper body functioning."

Lance said his family is strategizing for son Micah's next clinical trial, his third. "It won't be a cure and it has a placebo component, but it could slow some of the inflammation. And he will continue being a superhero in the future of defeating Duchenne."

Similar to the earlier panel, other parents reported feeling shut out of clinical trials due to lack of resources such as time off from work, child care for non-affected siblings, or educational support to make up for missed school days.

Kathleen's son, Aaron, is 17. "Talking about clinical trials gets more difficult over time. We have had hope from the time of Aaron's diagnosis at age two, but then your child is 17 and you're still trying to dig for that hope. You hear great things are coming but you have to be concerned about safety and everything else. At a certain point he walks too far or not far enough and falls short of eligibility. He asks, 'Why didn't I get another chance?' So, you worry about nurturing that kernel of hope. Still, we hope to find a clinical trial that will open that door or window a little more, enough to keep doing those daily life activities as long as possible."

Having better tools to help decide among clinical trials and how long to stay in one was a need raised by Amanda. "Some of the trials are very long and we should have better indicators for responders and non-responders so that children aren't hanging out in a trial for four or five years without knowing it's beneficial."

As with the younger boys' parents, this conversation prompted discussion about gene therapy trials. "The

Clinical trial participation barriers:

- Lack of awareness about ongoing clinical trials
- Challenge of deciding between various clinical trials and factoring in how emerging opportunities may be affected by past and present choices
- Eligibility criteria and outcomes focused on ambulatory status
- Concerns about immediate and longer-term potential harms and risks of therapies and related procedures
- Financial resource constraints for travel to sites, lodging, and related participation costs
- Concerns about impact on relationships with medical care providers and local care providers' abilities and willingness to handle adverse events arising from study intervention
- Limited paid time off from work, loss of income, risk to employment for parent(s)
- Lack of or inability to pay for childcare/overnight care for siblings, especially for single parents
- Negative impact on educational progress and social bonds with classmates and/or siblings
- Disruption of family schedules
- Potential negative impact on parents' ability to meet other family members' needs and obligations
- For families with more than one affected child, suitability and eligibility for each child and consequences if those differ between children

question for 12-year-old Lucas has become not can we get him into a trial, but which one to choose? We work closely with his doctor to determine the way forward. Lucas is most excited about the gene therapy trials that have begun enrolling. As a family we have decided to see how those go before pursuing trial participation for him," stated Karla.

PPMD's Annie Kennedy asked how parents were involving their sons in care and clinical trial decisions at this age. Lance replied that his son's cognitive and learning deficits make it difficult to involve him. "Inherently he trusts us; sometimes I wish he didn't. He's had a lot of needle probes, pokes, missed veins, and painful things through all this. We take on the burden of doing the benefit-risk analysis and making very important decisions for him in light of his more limited intellectual abilities."

Joseph was required to participate in the informed consent meeting for a clinical trial at age 15. His mom, Marissa, reflected on the challenge of preparing him for that. "How do you have a preliminary conversation about things like catastrophic side

effects and the potential for unknown effects? As they get older, you realize this has to be a team effort and the only way to build trust and openness is to have really tough, horrible, difficult conversations with them. We talk about death. We talk about the fact that nobody knows what's coming down the pike."

Angela involves son Jack in decisions now. "He's 17 and his priorities have changed a lot. Once he chose a clinical trial because his friend could be part of the control group. He and his doctor talked directly about whether he wanted to rejoin an imaging trial. Now he's more focused on going to college so decisions revolve around how this trial schedule will fit in with his AP studies and SAT prep classes."



Duchenne: The Tween & Teen Years—Panel of parents explore access to needed accommodations and the psychological impact of the transitions being experienced during this time.

Social and educational needs

Middle and high school years present new challenges, as children yearn for more freedom and new social experiences. Several parents spoke to the difficulty of finding activities that their sons could do with friends; even “hanging out” often had to occur at home because of the accommodations boys required access to.

Micah’s monthly testosterone shots—or “Vitamin T” as Lance referred to them—had caused a number of changes, including Micah’s intensified interest in girls. This too had its challenges. “All of Micah’s attempts at charming girls occur within a few feet of his 62-year-old peer educator. At summer camp, the ultimate 15-year-old freedoms of loud music, bathing suits, and ice cream parties were followed by me being there to put on his night boots and help him into his bunk at lights out. God bless his friends who took turns feeding him.”

Getting appropriate educational services is an ongoing challenge, particularly as children age and administrators and teachers expect students to be more self-reliant and autonomous. Several parents spoke to the constant “strategizing” required to ensure that the right kinds and combinations of educational and environmental accommodations are provided while still allowing for normal social and interpersonal experiences. Marissa commented, “The attitude of schools and their interpretation of the Individuals with Disabilities Education Act varies, sometimes within the same school. In theory this shouldn’t happen but in reality there are few standards, very little predictability, and few answers about what support we will get.”

Access and advocacy

As a single parent with a full-time job, Jessica feels an enormous burden to secure everything

her son needs. “One of my biggest hurdles is navigating the accommodations Wesley needs at home and school and ensuring he has adequate qualified personal care attendants. I spend my nights worrying how long his heart and lungs will stay healthy as I handle nighttime repositioning on my own. I dedicate hours and too many sick days to count making doctors’ appointments, getting his therapies and school accommodations, pushing insurance companies to pay for what’s covered, and finding funding for things that aren’t covered, like accessible vehicles and bathing and mobility accommodations. Duchenne is a full-time job on its own for a caregiver.”

Leandra had to quit her job as a dental assistant to handle all the phone calls. Her son is 11 and has multiple diagnoses in addition to Duchenne. “We dedicate a day each week to making phone calls. The rest of the week are therapy days. It’s constant. It doesn’t end.”

“We’ve heard this range of emotions we deal with and up until now—when I spend 70 percent of my time fighting for things my 11-year-old son needs—none of those emotions had been anger. But I’m angry now,” declared Kelly. “I’m angry that I have to constantly convince people who don’t understand the disease that we’re trying to obtain the best care for our children. It’s a very devaluing process. There’s nothing worse than being constantly told, ‘No, he doesn’t need that.’ It has to change.”

Marissa put a finer point on this, stating, “Kelly is fighting for something that’s medically necessary. It’s important to remember she’s not trying to get a wheelchair with spinners on the wheels or in a custom color. As long as these accommodations are in limbo, our boys are losing function they will never regain and they’re at risk. When you talk about a young man who needs a power wheelchair, it’s not



Federal agency partners gathered with the Duchenne community for a powerful day.

a convenience. He needs it for back support because his muscles are deteriorating and he could be facing scoliosis and spinal rod surgery. Access to this equipment directly impacts the health of our sons.”

Jessica had recently been told by her insurance company that her son wasn’t sick enough to warrant a cough assist device. “He got the flu and I’m watching him cough and cough. He’s achy and hurts all over. He’s in tears because his lungs are deteriorating and the payer is telling me he’s not sick enough.”

Maintaining access to other types of therapies came up as well. Lance described that it took nearly a year for his insurance company to approve coverage for his son’s “workhorse” drug therapy. He worked with his law firm’s insurance broker to find a plan that saved his family \$50,000 a year. “If we had remained on the old health plan, it

would not have been covered. We avoided switching drugs and putting Micah in a substandard care situation, but I know the plan cost my firm and my business partners more money. The stress of this disease hides in funny places.”

Amanda offered an important reminder. “The folks in this room who have found their way to Washington and have the strength to advocate are a fraction of the parents out there. When you have the strongest advocates fighting for what they need and still coming up short, there are a lot of families far worse off than we are.”

Future aspirations

Individuals contributing to the discussion during this session had been living with Duchenne for 10 years or more and its impact on their families was apparent. Karla spoke of son Lucas’s growing awareness of his limitations, even though he’s still walking at age 12. “His friends are hitting puberty and getting taller, yet he stays the same height. A classmate told him she felt sorry for him because he was going to die soon. When we’re away from home, my husband and I have to carry our 70-pound child up and down stairs. But he’s still remarkably well adjusted and is able to find humor in most situations. And we can still motivate him with the promise of his favorite spicy curry dish.”

“Fourteen-year-old Wesley just learned that his body, ‘would not grow old,’ as we phrased it. No parent should have to have this conversation with their child. It was heartbreaking,” grieved Jessica. Although he can no longer raise his hands above his head, he is determined to pursue his dream of being a small-animal veterinary technician. “We hope for advances like robotic exoskeleton arms and speech-to-text technology and we’ll find a way to make it happen,” Jessica said with tentative confidence.

“With every sprain or fracture, you wonder if it will be the last. You think of sudden, unexpected deaths in Duchenne. In this time of transition your son fights to keep walking and you realize you really are fighting for his life,” said Amanda. Her son’s very recent loss of ambulation made this an especially raw time for them. “Honestly, it’s rough. Right now Jack is just hoping he can have a roll-in shower. At age 13,” she admitted with deep sadness in her voice.

“Micah’s vice principal recently asked him what he wants to do after high school. He told her he wanted to live with his buddy Landon or with mom and dad,” explained Lance. “He can live with us as long as he wants, but I’ve just started to grasp how you continue navigating to get benefits for the high level of care he’ll need and how to make sure he

has a meaningful, socially engaged experience. I’m kind of overwhelmed by it right now.”

The reality of Duchenne sometimes presents in unexpected ways, like this anecdote from Marissa: “A few weeks ago my daughter called from college in a panic wanting to know how her brother would hide in a closet or under a desk if a shooter entered his school.” She continued, “We have learned to look at just the next step, not 10 years ahead. Joseph plans on going to Michigan State. No, he *is* going to Michigan State. He wants to be a sportscaster, to contribute, to be independent. I wonder if we will fight hard enough and make the right choices and progress in time to help him realize those dreams?” Marissa’s question weighed heavy on the mind of every parent in the room.

Through the Adult Lens

Introducing this session, Annie Kennedy quoted a friend who is a man living with muscular dystrophy who once observed of himself and others living into adulthood, “We were the population who was hoped for—and now we’re here.” For much of the past, the average lifespan for someone with Duchenne rarely extended beyond the teenage years, when life-threatening cardiac and pulmonary consequences become more prevalent. Hence, Duchenne has typically been considered and described as a “pediatric condition.” Now, with improvements in supportive care and advances in understanding the underlying cause of Duchenne, individuals are living longer lives, with the life expectancy for Duchenne often now possibly extending into the 30s and early 40s. However, it is important to state that disparities in

access to well-informed care, resource limitations, complicating comorbidities, and other factors cause too many people experiencing progressing disability and death early in life.

This panel was comprised of five men living with Duchenne and Becker who serve on PPMD’s Adult Advisory Committee (PAAC). They began the session with remarks that described their present-day lives, shedding light on the needs and perspectives of this growing segment of the patient community. Colin R., whose travel from Michigan was thwarted by a major windstorm that roared through D.C., was heard from via a prepared statement read aloud by Annie Kennedy. Other men living with Duchenne and parents of adult patients participated in the discussion.

College and post-graduate achievements

Building on hopes expressed in the previous session by parents of teenage boys, educational attainment among these men was high; all five panelists had graduated high school and gone on to college. Colin R. is completing his master's thesis in musicology on the subject of jazz in Vienna during World War II and he has applied to a doctoral program with the goal of becoming a professor. Colin W. has been working part-time for three years, putting to use his associate's degree in information technology doing web design for a marketing firm. Ben has applied to genetic counseling graduate school programs that

will fit into his daily life, accommodate his medical needs, and help him fulfil his future aspirations. Jonathan would like to pursue graduate school, but he requires so much assistance with activities of daily living that he can't consider it at this time. In the 18 months since Jonathan graduated college with a bachelor's degree in biology and minors in toxicology and chemistry, he hasn't yet found a job so he volunteers at a local zoo. "This allows me to practice my knowledge in biology and to communicate with zoo patrons about important conservation programs," he said.

After college, Mario earned his juris doctor degree. His experience living with Becker and his educational



Members of PPMD's Adult Duchenne and Becker community candidly describe their journeys, successes, and aspirations.

training combined enable him to consult on disability and civil rights issues, as well as serve on Institutional Review Boards for a biopharmaceutical company and the National Institutes of Health (NIH). He had recently crossed a personal milestone that was unique to the panel and somewhat unusual in the Duchenne/Becker community. He and his wife, Teresa, welcomed a daughter, Petra, in September. He shared some of the difficult questions they wrestled with before becoming parents. "Are we ready for parenthood when I have so many needs of my own? Would I be a good father? Would I be here long enough for our child to remember me? If we were to have a girl, would she be a Duchenne/Becker carrier?" After an unsuccessful attempt to determine the gender of their child through in vitro fertilization, they conceived naturally. Their daughter is a carrier. "In 20–25 years when Petra wants to start a family of her own, Duchenne and Becker may not be something she has to worry about. That is definitely our hope."

Adaptation

Each of the men credited their academic, vocational, and personal achievements to the strong support provided by their families and constant adaptation. As Colin R. stated, "To live with Duchenne means that I'm constantly adapting to changing physical norms. If I'm suddenly unable to complete a function that had previously presented no challenge, I either have to develop a work-around or ask someone for that extra bit of help. To live with Duchenne also means advocating for myself by helping others help me." Jonathan agreed, "The prognosis is constantly changing and we must adapt appropriately through adjusting our treatment options, looking into new emerging treatments to keep up with our rapidly changing bodies. It requires meticulous planning and choosing how to use your time day by day."

All of the panelists spoke to their total reliance on others, including family, friends, and paid caregivers. The four single men live at home with their parents. They all need some measure of help with basic functions including eating, showering, dressing, toileting, and transferring from one seated position to another and to bed. They rely on transport services to get to work, therapy sessions, and medical appointments. "There are things I can't reach on my own and I must wait for someone else to become available to get it for me. For a 24-year-old man who must be treated like a newborn in terms of basic necessities, it is grating on one's self-image," Jonathan conceded.

His mother, Christine, spoke to the fact that the whole family must adapt to ever-changing circumstances. "It's a long haul; we've been at this for 20 years. You strategize every step, every day. You look at what you can do to live your lives and make it better. I worry though, what's going to happen when we fall off that cliff when there's a change we're not quite prepared for?" she asked.

To help provide the level of support required at this stage, reliable paid care assistants are an essential part of the team. Colin R. cast it as the difference between a good day and a bad day, "On a good day my personal care assistant shows up on time and my ride service also picks me up on time. These two things help me maintain my rigorous schedule of graduate academic work and engage in social activities while preventing my family members from spending all their spare time helping me. They already sacrifice so much. On a bad day, the care assistant is late, preventing me from getting out of bed until he arrives. My ride service cancels and I have to ask my mother to drive me to campus." The availability of personal care attendants that could meet his schedule and his needs is one of the many factors that Ben thinks about as he considers graduate school programs.

Mario described the steps his care assistant takes him through before he can greet his daughter each morning:

“My aid enters my bedroom, removes the ventilator mask and turns off the BiPAP machine. She takes away all the pillows that I use at night to support my back, arms, and legs. She conducts a brief stretching routine to loosen up my tight muscles. She’ll sit me up in bed, give me my water bottle and hold it while I take a sip. Then she transfers me to a shower wheelchair, being careful not to bump the area of my chest where my implanted defibrillator is located—it hurts when someone hits that. She rolls me into the bathroom and I go to the bathroom. She rolls me into the shower, washes my face, my hair, and my body. Occasionally, like today, she helps me shave. She dries me off, rolls me back to my bedroom, and transfers me onto my bed. She uses a massager on my hip and leg muscles, applies some medicated skin creams, puts on my deodorant, and dresses me. She puts lotion on my face and gel in my hair—I’m Italian so I’m very demanding with the hair thing. She puts me back in the wheelchair and prepares my breakfast. With my breakfast I take my cornucopia of medications—Entresto, metoprolol, digoxin, furosemide—all part of my daily regimen. Then I use my cough assist and suction machine to get up any secretions that might be there. And after all that is done, then it’s baby time and I get to visit Petra. I give her a kiss and say good morning. It’s a tremendous feeling when she smiles back and knows that daddy is there.”

He becomes emotional when he reaches that last bit of the description of his morning routine.

Symptom impacts

All the men who participated in this discussion were no longer able to walk, utilizing power wheelchairs for mobility. When asked about symptoms that most impacted their daily lives, they focused on weakness in their arms and necks and limited fine motor skills. “My neck weakness, partly a symptom of Duchenne and partly a result of my fused spine, prevents me from sitting comfortably without a head support,” stated Colin R. “I would like to be able to lift my arms to reach my face so I can lift a straw to my mouth or scratch an itch on my head. It’s getting harder for me to brush my teeth,” said Colin W. Jonathan demonstrated how he uses the tabletop to pivot his arm at the elbow and reach his face with his fingers. He expressed hope for new robotic technologies being supported by PPMD to someday aid him in raising his arms independently. “I may have lost use of my legs, but I want to have the strength in my arms to essentially be my legs and my arms at the same time.” These statements were echoed in the polling data, presented in section 2 of this report.

Mario added that preserving some use of his arms was important not only for eating and drinking, but using the urinal device to go to the bathroom so he can avoid a catheter. Ben, who is still able to shower and use the bathroom mostly on his own, wanted to delay progressing upper body weakness for another crucial reason. “I can transfer from my chair seat to another seat on my own, but that’s dependent on being able to push myself with my arms.”

Colin R. reported that loss of upper body strength made it hard to turn himself in bed or adjust his body position anytime. As a musician, the loss of fine motor skills had made playing piano more difficult and drumming “nearly impossible.” Patrick mentioned the importance of being about to use his arms and hands enough to use his computer and

play video games, activities that are important for him and contribute to his quality of life.

Diminished heart and lung function were ever-present concerns. They are certainly on Ben's mind as he looks at grad school programs. "I have to think about how I will maintain access to routine monitoring of my cardiac symptoms. That way I'm prepared in case of a rapid decline in the condition of my heart," he asserted. Growing importance of access to mechanical therapies, such as cough assist and BiPAP machines, was mentioned several times. Flu and other respiratory infections were looming threats. Sleep quality was affected and some required more of it now.

Michael, a college student and another member of PPMD's Adult Advisory Committee, pays close attention to his pulmonary capacity. "I try to keep my heart and lungs healthy and work on raising the amount of air I can get out on the forced vital capacity test."

At age 40, with a severely compromised heart and lungs, Mario is starting to research heart failure clinics. "When I need a heart transplant, hopefully not before 10 years from now, I want to have a relationship with them so they will do a transplant operation on someone who has Becker, who is non-ambulatory, and has severely compromised pulmonary strength." He added, "Those are scary thoughts, but we have to focus on those issues and plan for the future."

Body pain in the back and legs and bone density loss were two other symptoms identified by the young men as affecting their lives. Ben was the first to acknowledge the impact of living with Duchenne on his mental health. "For many years I struggled with depression, partly due to feelings of isolation and inability. I have since worked to develop a support system to keep myself emotionally balanced since that makes it easier for me to keep up with



Compass Meeting attendees included a cross-section of Duchenne community stakeholders, including families, physicians, regulators, and industry.

the multitude of daily care tasks that come with managing a diagnosis of Duchenne. I have worked on becoming more flexible when considering how my symptoms and care needs fit into my daily life and future endeavors."

Mario emphasized the need for professional support, too, "Broadly speaking, for any person to talk through issues with someone else can be cathartic and therapeutic. Add in life-threatening issues and seeking help from mental health professionals should not be something that has stigma attached to it. It's definitely the right approach."

As the men discussed their complicated care routines and treatment regimens, Annie asked about whether they made these decisions alone or in consultation with others. Jonathan indicated that he manages his own care now, in consultation with

Observations & Issues Highlighted by the Adult Panel:

- Unfailing support of their families
- Interest in participating in clinical trials
- Compassionate use programs for experimental therapies that would give them access
- Need for non-ambulatory outcome measures
- Eligibility for cardiac transplant as heart and lungs become more compromised
- Access to and reliance on personal caregiving assistants
- Mental health care
- Pain control
- Maintenance of upper body strength, grip strength, and flexibility, as being critical to quality of life
- Evolving trade-offs for benefits and risks of therapies and activities
- Importance of developing resilience and finding equilibrium
- Challenges of pursuing advanced education and finding and keeping employment
- Family planning and heritability of Duchenne/Becker

his mother since she will sometimes come across information from PPMD or other parents that could influence his decisions.

Mario also handles all his care decisions, and he and his wife talk about the best options for the future. He recalled how his parents actively involved him in care decisions when he was young which prepared him for countless experiences where he encountered physicians not familiar with Becker or Duchenne. "I think the earlier kids can have a greater share of responsibility, the better in the long run. There will be times when a parent, sibling, or caregiver isn't there.

You need to have a voice for yourself and an understanding of the medications you're on, what you're allergic to, what contraindications you may have for anesthesia, the effect of diet and sodium on your heart, and so forth. Autonomy and independence are good skills to develop as young as possible."

Research hopes

At several times throughout the session, there were remarks about the tremendous growth of Duchenne research during their lifetimes. Colin W. stated it well. "Since being diagnosed 20 years ago, the Duchenne community has come a long way. It is amazing how many drug trials are currently underway and other therapies that are coming down the pipeline." He then lamented, "Unfortunately, due to my age and the progression of my condition, I'm still waiting for drug trials that will accept non-ambulatory individuals."

Julie echoed Colin W.'s assessment. "When my son Nicholas was 10 there was hardly anything in the pipeline. He's 26 now and we've got so much opportunity, but we should open it up for more participation, especially by older patients because there's so much they can offer. Maybe through compassionate use they could participate and then see how well a drug works for them."

Colin W. responded to her comment, "We were talking yesterday with industry partners about whether the enrollment criteria could be based on function instead of age."

Angela brought up a desire for an alternative to steroids and clinical trials that incorporate more than one therapy at a time. "If we pursue just one drug per generation, we're going to have a real problem on our hands. Discussion of a drug 'cocktail' approach needs to start."

Brian raised the hope for future therapies that could restore lost function. He also acknowledged that for families who had found a sense of homeostasis at any point along the progression, staying there was beneficial. "When you stop the progression, it's not a cure, but it's a heck of a victory."

For this group, maintaining function and stopping progression was tied to upper body strength and fine motor skills, harkening the need to develop outcome measures to effectively assess them. "I understand there is currently a lack of convincing outcome measures for older Duchenne patients, but having to wait longer for access to possibly beneficial drugs is hard on me," Colin W. stated.

Gene therapy held great interest for Jonathan. "I'm most interested in broad spectrum gene therapy that would maintain skeletal, cardiac, and smooth muscle strength. When smooth muscles around your diaphragm are getting weak and affecting digestion that can be life-threatening—in addition to life-threatening cardiac and pulmonary issues." Michael noted that he has been doing an internship with a biopharmaceutical company while finishing his undergraduate studies in communications. "I have this amazing opportunity to see the progress with gene therapy. After graduation—a big milestone in itself—I'm looking to help with the science from a communications perspective."

Austin, too, signaled an interest in getting personally involved in the search for solutions. "I'm very ambitious and I look forward to learning more about exon-skipping and gene therapy. I hope to go to school for mechanical engineering and to work in biotech so I don't have to wait around for a drug. I'd like to use technology to work around my disability, whether or not I'm on drugs that help."

Future aspirations

This kind of optimism rang throughout the session, in the face of the very serious challenges each of the young men face daily. "None of these things prevent me from engaging in advocacy and doing things that I love. I've been so proud to participate very actively in this community," declared Colin R. Colin W. made a similar affirmation: "Despite all the burdens of living with Duchenne, I still live life to the fullest and don't let it stop me from following my dreams."

Ben spoke to the importance of creating more resources that allow for greater independence, as well as clinical trials for treatments that preserve function or slow decline. Jonathan was at a personal crossroads in figuring out what might be next for him, but he didn't want to be passive. "I'm hopeful I can figure that out soon and be able to get there eventually. I know if I sit and wait for something to get approved or another thing to happen, just sitting and waiting means you're not going to get anywhere."

Mario commended the younger panelists, "As the old guy in the group it's really gratifying to see their intelligence and optimism. I have a lot of hope for this community because of them. And on a personal note, I want to be around as long as I can with my wife and daughter. I hope there will be solutions that stop the decline in heart and lung function and allow them to improve a bit, with the end-goal of prolonging life."

Annie brought the session to a close in a similar fashion to its beginning, by quoting a friend who is an adult living with Duchenne. "At some point, he tells me, he stopped worrying about his CK and began focusing on his 401(k). And I think that really speaks to some of the issues these men raised."

Reflections on Highs and Lows of the Duchenne Journey

This session focused on the impact of Duchenne on the entire family unit—the diagnosed individual, his parents, siblings, grandparents—and the toll it takes physically, emotionally, financially, professionally, interpersonally, and socially. The panel featured three prominent leaders within the Duchenne community, each of whom had experienced the full Duchenne journey, including the heartbreak of losing a child to the disease’s relentless progression. An aim of this discussion was to inform future data collection efforts to ensure that future policy

initiatives and health economic assessments of Duchenne more accurately reflect a holistic view.

PPMD founder and CEO Pat Furlong took the stage and set up the next hour. “This panel is about looking back. The three of us sitting before you have lost a son to Duchenne. When you receive a diagnosis of Duchenne muscular dystrophy you begin the grieving process for the person who is alive. In fact, I think we all are grieving, so we’re going to talk about learned experiences and things we think



The Duchenne Experience of the Family Unit—Panelists reflected on the impact that having a child with Duchenne had on the entire family unit.

about as we look back on our lives.” Each of the three provided an account of their lives and then engaged in a dialogue about some common experiences. Their discussion was powerful and encapsulated many of the threads that had been addressed by panelists throughout the day. And with great eloquence, love, and candor they reflected on Duchenne’s collateral costs; the wake of destruction the disease’s progression had on the entire family.

Jeff was first to speak about his son, Noah, who passed away two years ago at age 33.

“In 1988 when Noah was diagnosed with Duchenne, my wife, Lilly, and I had just moved from Colorado to Maryland where I joined a small consulting firm based in Annapolis. I was 41 and Lilly was 33. Noah was 5. Noah’s brother and only sibling, Woody, was 14 months younger than Noah. He didn’t—does not—have Duchenne. Noah’s grandparents, aunts, uncles, and cousins all lived in other states throughout the Eastern U.S. so they weren’t available to provide us local support. However, we lived in a very close-knit neighborhood and both boys were very adept at making friends, so we never felt isolated. We had local emotional support, although it wasn’t directly from family members.

“The diagnosis was devastating. On a physical level it felt like a truck had just run over us. I’ll never forget that feeling. Noah got pneumonia at age 33. It was a tough battle and he didn’t win that one. But one thing about Noah, he never ever complained about his condition. And he never used it as an excuse not to participate in life. He battled until the end. His life has been an inspiration to all his friends and family who are now stronger from knowing him.”

Brian spoke next about his family and their journey with Duchenne.

“I live in Maine with my wife Alice and son Patrick. My adult daughter, Rachel, lives in Portland. The four of us survive my son Matthew, who succumbed to heart failure in 2012, a consequence of his having Duchenne. Matthew was diagnosed at age five in 1997. His brother, Patrick, also lives with Duchenne. Despite losing the ability to walk at age eight, Matthew did well in school, lived his dream, and attended college in Maine, majoring in political science. He planned to live in Washington, DC upon graduation.

“Regularly surrounded by friends, actively involved in college life, Matthew matured on campus. Simultaneously he participated in clinical trials and we traveled regularly out-of-state for clinic. Life in the pursuit of goals was important to Matthew. In spite of limited physical ability and diminishing endurance, he lived every day to capacity. Heart failure took him during his sophomore year in college at age 20.

“It has been our experience with both our sons that each new stage is preceded by fear and sadness followed by compensation and transforms to acceptance. Stability at any stage becomes welcomed. All the difficult moments we faced pale in comparison to the hardest of all—learning to live without someone so loved as Matthew.”

Pat shared her family’s story.

“I’m from Middletown, Ohio, a very small burg about 35 miles north of Cincinnati. I’m

a carrier of Duchenne, information I didn't have when I married Tom, an Irish Catholic football player. I've had seven pregnancies; miscarriages in the first trimester followed every live birth. I have four children. In order of appearance, they are Jenny (born in 1974), Michelle (1976), Christopher (1978), and Patrick (1980). 'How many children do you have?' is a question that stops my heart every time it's asked. How should I respond to that question now?

"On a sunny day in June 1984 Chris and Patrick were diagnosed with Duchenne Muscular Dystrophy. While the word 'Duchenne' was not in my vocabulary, I would often sit in my car after taking Chris and Patrick to school wondering why other children literally flew up the steps. I struggled to understand that. My daughters could do it; other children could do it. My sons could not. I listened while family members talked about the boys' big calf muscles. They said, 'They're just like Tom'—this 230-pound, 6-foot-3 defensive end from Notre Dame. But Tom didn't have big calf muscles. They suggested, 'Those are football player legs.' They weren't.

"I watched neighbor children jump and run while Chris and Patrick stared, their eyes wide. These worries nagged at us until that word Duchenne crashed our house. It crashed the very walls of everything we knew.

"One evening while playing outside, Chris attempted to pedal a bike, something he couldn't really do. He suddenly screamed in pain. I carried him into the house and met my husband at the door. Chris was in tears. I asked my husband—a physician—'What

do you think of this?' He said, 'I don't know.' I fought this word Duchenne with every breath of my body and it entered that day. It moved into our house. It interfered with every plan. And it rippled throughout our family and our extended family.

"The diagnosing physician was a neurologist and a colleague of my husband. To this day I remember the chair I was sitting in, holding my sons. I remember his tie; it was grey and it was striped. I remember that he didn't look at me. He simply said, 'Chris and Pat will lose the ability to walk. They'll lose the ability to lift their arms and they will die.' He added that my daughters would stop enjoying our family; they would lose themselves because of the limited amount of attention I would be able to give them. And he said my marriage would fail. It wasn't my best day.

"Chris died on September 29, 1995. Seven months later—to the day—Patrick died. Did we give up on him? Did he give up on us? Did he just plain give up? Did he watch his brother die and fail to live? I'll never know.

"Just after Chris died, I read his Latin notebook. I still do today. In it was a post-it-note that read, 'The meaning of life is a life of meaning.' And then a small little scribble, 'Mom, do something.' And here we are."

Collateral costs of Duchenne

Following those potent recollections, the panelists began a discussion of "hard costs," not just in terms of the expenses related to making their homes accessible, purchasing power wheelchairs and accessible vans, and out-of-pocket costs for

medicines and doctors' fees, but other costs. Jeff offered an example, "I mentioned that Noah was able to go to college, but in order for that to happen, I had to go further in debt and buy a small house so three of his close friends, fraternity brothers, could live rent-free in exchange for helping Noah make transfers and get around campus. I think they might have done it anyway, by this way they were always there. You just do what you have to do."

"Prior to Matthew's diagnosis, I was quite frugal and I worked night and day. My family saw very little of me," disclosed Brian. "Things had to change and I made a conscious decision that life wasn't about possessions—it was about doing things together. I realized every moment was important. I became like the 20-year-old who has no sense of finances and I took my family wherever we needed to go, often spending well beyond our means. We live in Maine and it can be quite abrasive in the winter months so we would go to Florida for a week just to get through the winter. There was always something more important than the 401(k)."

Pat nodded in agreement and added, "Years ago the banks were really open to loaning money to young physicians, so my husband took out loans on his office, his practice, and our house to make accommodations for two wheelchairs and two boys who were growing tall and big in the absence of steroids. One day the bank president said to Tom and me, 'You are now \$1,000,000 in debt. You'll pay this off when you're about 70 years old.' And indeed, my husband recently retired at 71 having made the final payment."

As the panelists described the diagnosis and early life with Duchenne, each spoke of time spent navigating clinical care, trial options, and advocating for their children and needed resources. Jeff

Direct costs related to Duchenne and caregiving for a person with Duchenne, as identified at the Compass Meeting:

- Relocation of or modifications to home(s) to improve accessibility and mobility
- Purchase of or modifications to vehicles to improve accessibility and accommodate large, heavy wheelchairs
- Out-of-pocket (unreimbursed) payments for in-patient and out-patient medical and supportive care, medications, over-the-counter medicines and supplements, medical devices, home nursing services, durable medical equipment, medical supplies, health insurance premiums, mobility devices, and other assistive devices such as orthotics, eyeglasses, and hearing aids
- Out-of-pocket (unreimbursed) costs for personal care assistants, child care, and other household help
- Transportation and travel primarily for and essential to obtaining medical care and/or participating in research, including the cost of ride services, tolls and parking, overnight accommodations, and meals
- Additional expenses incurred to ensure appropriate education, including alternative schooling, tutoring, specialized equipment, counseling, and testing
- Registration, transportation, accommodations, and meals related to attendance at educational and advocacy events for Duchenne families
- Participation fees, equipment, and travel costs related to accessible athletic, enrichment, and recreational activities to enhance well-being, such as sports leagues, camps, and summer programs
- Additional food costs to adhere to particular dietary restrictions and/or provide meals to caregivers, extended family, and/or friends who help with family or household tasks
- Loss of income as a consequence of changing professions, jobs, or employment schedule (including resigning a job) to accommodate caregiving and/or enable access to specialty care, research study participation, and/or educational services
- Carrying costs of debt incurred to pay for above expenses



Participants in the Compass Meeting included adults from the Duchenne and Becker community.

described this in terms of financial costs and tradeoffs, “My job enabled Lilly not to have to work outside the home, so she was a full-time advocate for Noah. This was extremely important to his quality of life.”

As came up earlier in the day, they recounted how much there is to do to support someone with Duchenne.

“Lilly was able to uncover numerous public and private resources that helped with home modifications, paid caregivers, and allowed Noah to participate in sports. Woody played a central role in enhancing Noah’s quality of life, too. He always made sure Noah was included in physical activities as much as possible and with friends and family. He became Noah’s best friend and biggest social advocate.”

They also spoke of the costs related to caregiving and time lost from work for parents and unaffected

siblings. Jeff shared, “Because I had my own business I could take time off to be with Noah as well. So even though his care became a lot more intensive the older he got, between Woody, myself, and a dedicated team of caregivers, Noah essentially could enjoy the last years of his life.”

They also spoke of the “soft costs” required in supporting their children with Duchenne and keeping the families functioning. Pat shared a weekly family tradition of entertaining all the boys’ neighborhood friends. “Our door was open to friends and families. Every single Friday night we invited every single kid in the neighborhood or in school for dinner, which I cooked following a menu that was delivered to me on Thursday afternoon. We wanted to bring smiles inside; we would do anything to bring increased socialization and add to the number of friends our boys had.”

Jeff reflected on the gradual investments his family made to ensure that Noah could continue to participate in outdoor recreational activities as long as possible by seeking out accessible leagues, even when they required significant travel. “As Noah became more dependent on his wheelchair he joined a wheelchair sports club league and we’d go skiing in Colorado because Noah could do sit-skiing. He’d sit on a chair and a skier behind him would brake for him just before he crashed into the trees, which he seemed determined to do quite a few times,” Jeff said with a wistful smile.

Marital strains

Some of these soft costs were exacted in the form of frayed bonds and relationships, especially marriages. Pat made a bold statement: “The diagnosis of Duchenne ends marriages. The marriage that you had, the marriage that you thought about is ended. Now you’re just parents. As a couple you try

to navigate your way back together. If you can find your way into the marriage again, you do. Sometimes you don't."

Brian concurred. "When our daughter, Rachel, was 5, she was diagnosed with type-1 diabetes. We learned to give injections and test blood. We thought we had 'our' condition and that we were 'good.' But that was not where it ended. Upon Matthew receiving the Duchenne diagnosis, Alice and I each focused in different areas. She was at home caring for the kids and I was at work. I got the bright idea to help my kids' parochial school raise money to install a lift so he could continue going to school with his siblings. A lawsuit followed when they didn't install the lift, even after the money had been raised. That all took an extraordinary amount of time and a lot of nights away from home, which fostered further division between Alice and me. Happily, I think we have come to some sort of agreement, but I think our family is like many others. You have one parent who technically understands Duchenne and is on the computer until 2 a.m. and the other one is providing the financial wherewithal so that you can do all this. Coming to some sort of arrangement is important. Even when a marriage ends, mom and dad may not go their separate ways. It means that things are very, very different at home and strained."

Jeff described how Lilly couldn't bear seeing Noah go downhill after he graduated from college. "After Noah graduated from college with a degree in marketing, he came home to Annapolis and took a part-time job doing market research. But he was rapidly losing upper body strength and his time using a computer was limited, so he couldn't keep his job for very long. At just about this time Lilly was diagnosed with a brain tumor. She died three months later at age 50. We weren't divorced but we were living in separate residences half a mile apart.

She couldn't handle it and I could. Some people are better able to adapt; it just goes with the territory. I think that it may have contributed to her brain tumor in some manner; that she did not want to be around to see what happened to Noah."

"As a physician, my husband helped 50 people a day at his office," Pat stated. "But when he came home, he just couldn't do it. We hit a point where we didn't like each other anymore, but we saw the need to be roommates, to share the responsibility of our family, and then see if we could come back to each other. It ended up that we became good friends, sharing jobs and responsibilities, knowing the rhythm of each other, and then finding a path forward together."

Glass houses

These painful realities were hard enough for the couple and the family to endure, but they were often witnessed by the myriad other people who were part of the household, providing care and otherwise lightening the burden of Duchenne. "Your family is constantly on display," acknowledged Brian. "Sometimes the caregiver comes in right after you've had an argument. It's more than you need." Jeff nodded in agreement.

They exchanged light anecdotes about awkward moments with these once-strangers who were integrated into intimate moments of family life. While humorous, they underscored the challenge of finding trustworthy professionals at the level of compensation covered by state and federal aid. For Brian, this made the decision to bring paid caregivers into the home quite difficult. "We didn't have the financial resources to provide additional support. Between offering a schedule that is irregular and cobbled together a couple hours at a time, and the types of tasks they're doing—

wiping someone's backside, giving a stinky teenager a shower—it's hard to attract the highest caliber help. So it was frustrating."

Sibling impacts

In spite of the rippling effects of strained relationships between their parents, the loss of family privacy, the suffering they witnessed their siblings endure, and the grief they experienced after losing their brothers, each of the panelists described special bonds that existed between their children.

Brian recalled how his daughter handled all this. "Rachel and Matthew were exceptionally close but she and Patrick fought like cats and dogs. About the time Rachel was graduating from college, Matthew was becoming very ill. She had a degree in communications and needed to live somewhere other than Maine if she wanted any type of robust employment. She decided she needed further education and was taking additional courses when Matthew passed away. That changed everything for her. She went from part-time job to part-time job and it took her a long time to find herself. Recently, she went back to school and now she's a registered nurse working at our local medical center. The weight of Duchenne is really extraordinary, but fortunately, there was a silver lining for Rachel. And the other aspect is that she and Patrick have rehabilitated their relationship and are now great friends."

"Total strangers would tell Lilly and me how they'd never seen such love between two brothers," Jeff recalled from family vacations spent around a swimming pool where Woody would be helping Noah into the water, helping him swim, hanging out. "It was just amazing. Woody came back to Annapolis after college and delayed his career for 10 years to be around Noah. When Lilly died, Woody and I looked at each other and said,

'Okay, it's the three of us now.' Noah was living with me and Woody was finishing college in New York City. Instead of going onto a career in New York after graduation, he came back to Annapolis to live and work there so he could be near Noah. When Noah passed away two years ago, Woody was devastated to say the least. But he has a good job now, he has a lot of friends, and it's a good story for Woody."

Pat's daughters were away at school when their brothers were admitted to the hospital and when they both died. "And for that, they've suffered," she said. "A few years ago Michelle was working for an international bank in London. She had just learned she was to be transferred to Singapore and we were thrilled for her, knowing her career was going to accelerate. Soon after she called to say she had quit her job and was coming home to be a yoga instructor. When she arrived, she had this strange bandage on her wrist. And because I worry about all these things, I jumped to conclusions about her slicing her wrists. As it turns out, she had gotten a tattoo with Chris and Pat's initials"

For siblings who both have Duchenne, their relationship can be complicated by differing abilities and watching one another lose function. Brian's boys fueled each other. "Matthew was older, so he was on student council first and Patrick had to be on student council. Matthew joined a variety of clubs, so Patrick did too. When they were playing video games in another room, they'd yell and argue the way siblings do. We'd often hear, 'I can't wait until there's a cure so I can beat you up!' Patrick was able to drive independently and his goal was to drive Matthew to college, which didn't come to be because Matthew passed away. But they helped each other understand there's more to life than dwelling on things you cannot change."

Pat described her sons as total opposites who united in support of their family. "Had Chris lived, he would have been Valedictorian of his class, whereas Patrick's goal was to buy a Ferrari. They protected us. They would tell each other, 'Mom's upset. You had better get her another Diet Coke so she can survive.' Or, 'Don't be too hard on her today, it's been rough.' Having two boys, they protected us together which seemed so much stronger than having a single protector. I drew my resiliency and strength from them."

Joys between sorrows

Pat closed the session by asking Jeff and Brian to recall a moment of joy along their Duchenne journeys before sharing one of her own. For Jeff, it was a memory of Noah on a sit-ski in Winter Park, Colorado. "It was the first time since age five or six that he was in control of his body to the extent he could maneuver down the hill. To see the smile on his face when he came down the mountain, that said it all."

Brian related a moment he was able to let go and allow Patrick his independence, in spite of concern. "Patrick has been driving for five years and I worry when either kid is out on the road, but it's more burdensome with Patrick because if he gets in a wreck, I worry about his ability to get out or to text for help. But I want Patrick to experience life fully. He got to drive over the George Washington Bridge once coming back from clinic in New York City. That is probably my proudest moment."

Pat concluded, "My sons planned a family intervention, with pizza (they ordered), a bottle of wine (purchased by their older sister), and brownies. They sat us down and told us we were so overprotective—and had been since their diagnosis—that we were 'stifling their enthusiasm' and that we needed to stop and get out of their way. Which we did."

Collateral costs of Duchenne for the family, as identified at the Compass Meeting:

- Health, well-being, and self-image of all family members
- Loss of family members' individual and collective privacy, if home healthcare workers and assistants are employed
- Loss of earning potential as a result of deferred or delayed educational and/or career advancement for the person living with Duchenne, parents, and siblings
- Loss of enjoyment of relationships between spouses, unaffected children, extended family, and friends
- Disruptions of family life that may include deferred or delayed pursuit of athletic, enrichment, volunteer, and recreational activities due to financial and/or caregiving demands
- Effect on family planning as a consequence of concerns related to bearing a(nother) child with Duchenne, the demands of caregiving, and/or financial strain
- Opportunity costs of funds expended to cover direct costs related to medical and other expenditures, including effect on retirement planning and future financial security

SECTION 2 GPS COORDINATES: PATIENT EXPERIENCE DATA

To complement the first-hand accounts and stimulate discussion among participants, multiple choice questions were posed throughout the day. Those in attendance, both in the meeting room and watching the webcast, were able to respond to these questions in real-time using cell phones. The questions were kept open for three weeks following the meeting to allow those who watched the archived webcast to also participate. In all, approximately 140 people responded to the Compass meeting polling questions, however the number of responses to any single question varied. Families with multiple family members in the meeting were asked to designate a single family member to participate in the live polling to ensure that each response represents a unique family's experience. If a teen or adult with Duchenne participated in the meeting, we invited him to participate in the polling along with a parent.

PPMD has other sources of community data, including The Duchenne Registry (previously known as Duchenne-Connect) that has collected data about more than 4,000 patients since 2007. PPMD has also conducted four patient preference studies in collaboration with researchers at Johns Hopkins School of Public Health and RTI International. Another important data source, the Muscular Dystrophy Surveillance, Tracking and Research Network (MD STARnet), is funded by the U.S. Centers for Disease Control and Prevention under The Muscular Dystrophy Community Assistance, Research, and Education (MD-CARE) Act. It has a three-fold purpose of locating everyone born after 1981 who has Duchenne and Becker muscular dystrophies in five catchment areas in order to estimate disease prevalence, track changes over time, and collect information about these diseases. Data from MD STARnet is also referenced in Section 3 of this report.

Data from these sources is in this section to provide additional context, support, and comparison for results of the Compass meeting polling questions. Quotations from meeting participants further illustrate the perspectives these data represent.

The Compass Meeting Cohort

At the beginning of the meeting, 128 individuals responded to the initial polling questions to identify both their "relationship" to the condition (individual with Duchenne or Becker, parent/guardian, or other family member) and the age of the patient for whom they were responding.

Relationship to person living with Duchenne/Becker	Total number	Percentage
Parent/guardian	113	88.28%
Individual with Duchenne or Becker	7	5.47%
Family member (grandparent, other relative)	8	6.25%

Diagnosis	Age of person with Duchenne/Becker				Total number	Percentage
	10 or younger	11–17	18 or older	Age not given		
Male with Duchenne	35	51	32	2	120	96.77%
Male with Becker	1	3	1	0	4	3.23%
Total	29%	43%	26%	2%	124	100%

Individuals with more than one child with Duchenne/Becker were asked to respond to later questions on behalf of the older (oldest) child.

This group as a whole was quite actively participating in research studies, with 75 percent of respondents indicating some type of research participation, including clinical trials, natural history studies, and imaging studies. Half the group indicated that they had taken part in a clinical trial for an investigational drug. In addition, seven people (5%) responded that their son had taken part in a clinical trial for gene or cell therapy. Eight people (6%) had taken part in a clinical trial for a robotic device.

“We try to participate in every single clinical trial possible because we want to help and give back as much as we can.”

—Ethan, father of Peyton, age 12

Ethan’s statement is consistent with research findings showing that parents cited the sentiment “the trial would improve researchers’ understanding of Duchenne” as being the highest rated facilitator to their interest in having their child participate in a clinical trial.¹

Mobility, symptom expression, and progression by age and stage

During each of the age-focused panels, questions specific to that stage of the disease were posed. Similarities in the questions across each of the panels enable comparisons and also depict the shifting concerns as the disease progresses, as physical functioning becomes more limited, and as costs of all kinds mount.

For example, as depicted below, when asked about using a wheelchair or other mobility device to get around, only 3 of 40 (8%) respondents for children age 10 and under responded that they predominantly rely on a mobility device, while 28 of 51 (55%) respondents for children age 11–17 answered affirmatively, and all 37 (100%) adult patients indicated that they rarely or never walk. So, while 52 percent of participants reported relying on a wheelchair or other assistive device for mobility, a more revealing story is told by the age-based responses. It is also notable that in the children age 10 or under, 8 percent reported rarely or never walking, and among teens, only 8 percent reported that they can always or usually walk without help or mobility devices—truly a major transition time as parents’ remarks underscored.

How do you get around?	10 or younger	11–17	18 or older	Total number (n=141)	Overall percentage
Can usually or always walk without help or mobility devices	26	4	0	31	21.99%
Can get around on own but sometimes need help from mobility device	11	19	0	36	25.53%
Use a wheelchair or other mobility device and rarely or never walk	3	28	37	74	52.48%

“It’s difficult for us to convey to payers that when your child loses the ability to walk, the needs are suddenly compounded. They don’t just need a chair, they need everything—all at once. It has been eight months since his power chair was ordered; it was approved two weeks ago and we still don’t have it.”

—Kelly, whose son lost the ability to walk at age 9

In each session, questions were asked about the top three symptoms that have the greatest impact on the boy/man's day-to-day life. Here is how these symptoms ranked across groups:

Symptom	10 or younger (42 respondents)	11–17 (60 respondents)	18 or older (45 respondents)
Fatigue and feeling tired	76% (ranked 1st)	70% (ranked 1st)	29% (ranked 5th)*
Muscle cramps and tightness	50% (ranked 2nd)	—	—
Learning/behavioral issues	45% (ranked 3rd)	40% (ranked 3rd)	—
Difficulty walking/unable to walk alone	29% (ranked 4th)	52% (ranked 2nd)	56% (ranked 2nd)
Problems lifting arms above head	—	33% (ranked 4th)	67% (ranked 1st)
Problems using hands	—	—	42% (ranked 3rd)

* Breathing problems ranked 4th in list for 18 or older

"I wonder what small increases in muscle function would mean to Joseph. What if he could have maintained the ability to walk even a few steps so he could make it into his friends' homes, or been able to go to his grandma's home because he could still use a regular bathroom? What if he could continue to use his arms to hold a pen for one more year so he could keep score for the high school football team? I worry that my son is going to lose the ability to hug me. And that time is close."

—Marissa, mother of Joseph, age 15

Behavior, learning, and mental health concerns

As heard in discussion throughout the day, physical symptoms were not the only concern of parents and the men with Duchenne/Becker. Questions were asked to identify concerns that would be more than typical for someone of the same age.

Across all groups, 72 percent of respondents indicated that they were “somewhat” or “very” concerned about behavior problems for the person with Duchenne/Becker. When stratifying the results by age group, 88 percent of parents of the younger children expressed concern, compared to 66 percent of parents of teens, and 45 percent of adults or parents of adults.

“Even simple things like a favorite TV show not being on at the usual time can send Layne into a meltdown where he throws things, yells, and cries. Ten minutes later it’s as though nothing happened and he’s back to being his happy self. We’ve gone to counseling to learn ways to cope with these episodes, which adds another appointment to the long list of appointments we already have.”

—Lisa, mother of Layne, age 6

Similarly, the parents of young children had the highest rate of concern about learning difficulties, with 86 percent expressing being “somewhat” or “very” concerned about their sons. This measure dropped to 60 percent among parents of teens and 40 percent of adults or parents of adults.

While concerns about depression and anxiety were high across all groups at an overall rating of 84 percent being somewhat or very concerned, the parents of teens had the highest rate of concern at 90 percent, followed by 81 percent among adults/parents of adults, and 75 percent of the parents of young children. Of note, 45 percent of adults/parents of adults indicated they were “very concerned” about depression or anxiety; 40 percent of parents of teens identified this degree of concern as did 31 percent of younger children’s parents, so the severity of the concern seems to grow as the patient ages. Further exploration is needed to understand whether rates of concern would reveal any differences had questions been asked about depression and anxiety separately, rather than combining them in a single construct.

“My happy boy grows sadder and angrier as his friends become bigger and stronger. Henry wonders where he fits. Yet here we are, the parents of a fifth grader who walked into school last week, something I did not dare to hope when he was diagnosed in preschool.”

—Claire, mother of Henry, age 10

I've incorporated seeing a psychologist every so often into my healthcare routine to check in on my mood and perhaps get medication prescribed to help with it. It's not just physical, Duchenne is an emotional thing too."

—Jonathan, adult with Duchenne

Priorities for new therapies

Two questions asked of each group attempted to elicit priorities among the various age groups and stages of progression. When asked which three activities would be most important to preserve or maintain "right now," here is how responses stacked up across groups:

Activity to preserve or maintain	10 or younger (42 respondents)	11–17 (60 respondents)	18 or older (45 respondents)
Walk for a longer time	74% (ranked 1st)	not asked	not asked
Walk up stairs	65% (ranked 2nd)	not asked	not asked
Rise from the floor	60% (ranked 3rd)	not asked	not asked
Feed self/bring hands to mouth	7% (ranked 9th)	57% (ranked 1st)	64% (ranked 1st)
Walk around the home	not asked	42% (ranked 2nd)	not asked
Stand up from sitting in a chair	12% (ranked 7th)	37% (ranked 3rd)	not asked
Reposition self at night	not asked	not asked	53% (ranked 2nd)
Use cell phone/controller	not asked	32% (ranked 4th)	31% (ranked 3rd)

Of particular interest here is the dramatic rise in the priority given to feeding oneself ("bringing hands to the mouth," as it was phrased to the adults) between the youngest group, where it ranked ninth, to first in the teen age group. It held top ranking among the adults. This is especially important because preserving this function is not a current focus for products in clinical trials and there are no agreed upon outcome measures that correlate to it.

“Conner has trouble walking and he has leg pain. At some point in every day he feels fatigued, exhausted, embarrassed, sad, and angry. He cannot use the stairs in our home or on the bus and he has to be carried like a baby. His friends innocently ask why Conner’s muscles don’t work and why he can’t run at recess or go to gym class. I know he wants to be more independent at seven.”

—J.C., mother of Conner, age 7

“I’m doing my best to manage the effects of Duchenne currently, but keeping stable and even getting a bit of strength from a new drug would mean a lot living with a degenerative disease.”

—Colin W, adult with Duchenne

A second question about potential new therapies was designed to ask which three measures of health would be most important to preserve or maintain “right now” at the current age.

Global measure to improve or preserve	10 or younger (42 respondents)	11–17 (60 respondents)	18 or older (45 respondents)
More energy	76% (ranked 1st)	47% (ranked 3rd)	36% (ranked 4th)
Stronger heart	40% (ranked 2nd)	53% (ranked 1st)	78% (tied for 1st)
Stronger bones	36% (ranked 3rd)	45% (ranked 4th)	53% (ranked 3rd)
Better behavior	31% (ranked 4th)	10% (ranked 9th)	not asked
Stronger breathing	26% (ranked 6th)	48% (ranked 2nd)	78% (tied for 1st)
Healthy weight	19% (ranked 8th)	40% (ranked 5th)	13% (ranked 6th)

The priority for improving energy as a top-three choice across group tracks the high ranking of fatigue as a symptom with high impact across the three groups. The top rankings for stronger heart and stronger breathing (lungs) in the two older groups is similar to the finding in PPMD's preference studies where cardiac and pulmonary function were identified as very important therapeutic targets. In one study involving a total of 133 parent- and patient-respondents, results indicated that the greatest preference was for therapies that maintained current levels of cough strength for either 10 or 2 years. In exchange for maintaining cough strength for 10 years, respondents were willing to tolerate high probabilities of diarrhea and additional blood draws. Results of another set of questions in the same preferences survey indicated that patients and caregivers prioritized weaker heart pumping and the pulmonary symptoms of lung infection and weaker ability to cough as the most valued targets for intervention. The least important target was poor attention span.²

Also of interest is the fact that responses in the middle group (age 11–17) were distributed across five different measures, with just eight “votes” separating the top answer (stronger heart) from the fifth ranked answer (healthy weight). This echoes the statements made by parents about this transition time and the rapid emergence of many new needs at once.

“I am taking an oral interpretation class and we have to learn to project our voices. I have noticed that my lungs can't hold as much air as everyone else, so I can't speak as loudly as everyone else does. I also like writing and performing music. Often I have to stop because I can't hold enough air for the length of a song.”

—Austin, adult with Duchenne

Understanding the financial burden of Duchenne/Becker

While the tolls of the disease are many and varied from family to family and across time, a section of polling questions asked of the whole group at once attempted to quantify some of the economic costs arising from various changes and expenses precipitated by the disease. Thirty-eight percent of respondents reported that a parent or family member changed jobs to have more time for caregiving; 35 percent noted that a parent had stopped working for this reason. Nearly 70 percent of families modified their homes to be more accessible, 38 percent moved to a more accessible home, and 11 percent moved to be closer to extended family. Some likely took two or more of these actions over time. These changes to career paths and homes occurred with the highest frequency among the parents of teenagers—another reason the term “transition” is so fitting for this period of time.

“When my son was six, he was invited to take part in a clinical trial across the country. I didn’t have time off from my job so my husband made the decision to take a different job so he’d have more flexibility in his schedule and could take Lucas to participate in the trial.”

—Karla, mother of Lucas, age 12

A question about the estimated out-of-pocket costs in the past year for home modifications, vehicle modifications, and other physical accommodations is challenging to put in appropriate context due to the timing and one-time nature of some of these expenses. However, there was a trend in the responses indicating that the teen years were the costliest to the family, with 27 percent of respondents reporting out-of-pocket costs in excess of \$10,000 in the past year and 35 percent of parents with children in this age group indicating costs of \$20,000 or more. By comparison, 22 percent of adults/parents of adult patients had paid \$10,000 or more for such expenditures and just 11 percent incurred this level of expense in the past year. The majority of parents of young children with Duchenne/Becker (63%) reported paying less than \$1,000 in the past year for these types of expenses.

These polling results align with data from patient registries in five countries, including PPMD’s Duchenne Registry. The study concluded that Duchenne represents a significant economic burden on society and families and that the burden increases significantly as the disease progresses.³

“Duchenne truly impacts every single aspect of our families’ lives: the houses we live in, the cars we drive, the way we participate in activities, the activities we choose to participate in. It impacts every single thing with one exception—how much we deeply love our boys.”

—Lisa

Another type of out-of-pocket expense, in the form of direct medical expenses for unreimbursed medical care, prescriptions, supplements, and hospitalizations hit families at different levels. Patterns by patients' age were not as discernable. The out-of-pocket costs for these expenses may have more to do with the type of health insurance coverage the family has, deductible limits, access to specialty care, treatment decisions, and other factors than the stage of the disease. Generally speaking, 36 percent of families incurred out-of-pocket costs for direct medical expenses of \$1,000 or less in the past year, and 14 percent reported costs at the highest level of \$7,000 or more.

Finally, questions about paid caregiver assistance (PCA) attempted to quantify this expense. Among the families with young children, only 6 percent relied on paid caregivers, with 55 percent of parents of teens employing paid caregivers, and 41 percent of adults/parents of adults reporting they employed aides. Medicaid was the greatest source of funding for PCAs, with similar rates of state aid and self-pay. A follow-up question posed after the meeting to attendees attempted to quantify the out-of-pocket expense, with some reporting it was as high as \$15,000 per year, but most indicating it was below \$500 per year.

"Three formerly complete strangers now have keys to our home—our son's caregivers. The respite time is nice for my wife and these state-paid helping hands relieve us of the stuff that sometimes grinds your attitude—bathing, toileting, etc. I've been around this community long enough to know things aren't going to get easier. I consider these three people gifts our family, but they're so difficult to find and they're so difficult to secure with a solid schedule."

—Lance, father of Micah, age 15

SECTION 3 CHARTING THE COURSE: PATIENT-FOCUSED POLICY DIRECTIONS

Looking Forward

Working on behalf of all those affected by Duchenne, PPMD and the Duchenne community are united as a strong and unrelenting force for change, charting strategies, securing resources, and forging partnerships that have shaped a robust therapeutic pipeline and responsive regulatory infrastructure. While the timeline of Key Events presented in this section reflects important milestones in the mission to end Duchenne, significant work remains as illuminated by the compelling parent and patient experiences shared at the Compass Meeting and documented in the first two sections of this report.

The diverse community perspectives about current and emerging gaps and opportunities provide a navigational guide for developing and implementing policy that enhances quality of life, extends life-span, and reduces burdens for every person living with Duchenne and for those who care for them. Unwavering urgency has propelled the Duchenne community from its earliest days and it continues to fuel and focus our efforts as we embark on this freshly charted course.

Early detection and diagnosis

As parents described during “The Early Years” session (pages 2–6), there remain significant delays in detecting and diagnosing Duchenne that contribute to inappropriate management, added costs, and unnecessary and additional suffering. In 2009, according to surveillance studies by the Center for Disease Control and Prevention’s (CDC) DBMD surveillance program, MD STARnet, the mean age of a child at diagnosis of Duchenne was four years.¹ This delay occurs in spite of the fact that laboratory

evidence of elevated creatine phosphokinase (CPK) level is present in newborns with Duchenne. Further, data has been collected to establish the presence of delayed neurodevelopmental milestones in motor skills, speech, and cognition in boys with Duchenne beginning as early as infancy.^{2,3,4} In 2009, MD STARnet identified a 2–5 year average diagnostic delay from the time parental concerns were first reportedly voiced to a primary care physician to the date of confirmed Duchenne diagnosis,⁵ as several parents described at the Compass Meeting.

Following the publication of this finding in 2009, PPMD and the CDC together convened an effort to address the diagnostic delay in Duchenne through the formation of the National Task Force for Early Identification of Childhood Neuromuscular Disorders. While this effort yielded a robust clinical resource (www.childmuscleweakness.org) and awareness campaign, it did not significantly impact the diagnostic delay within Duchenne (<http://www.childmuscleweakness.org/about-us>). The latter activities also included the development of treatment guidelines, educating health care professionals in the care and treatment of Duchenne, and an additional collaboration between PPMD, CDC, and the American Academy of Pediatrics (AAP) to develop an interactive online tool, “Physical Delays: What to Look For,” for parents of children under age five to assess motor delays.⁶

These strategic, forward-thinking collaborations and public health education efforts generated vital resources for both parents and providers; yet they have not yet effectively reduced the delay in diagnosis or the mean age of diagnosis. Consequently,

in 2014, PPMD launched the US Duchenne Newborn Screening Initiative to work toward a national public health infrastructure for identification of newborns with Duchenne through state-based programs. As a part of this effort, PPMD convened clinical experts in Duchenne and representatives from relevant federal agencies to develop guidelines for the clinical care and follow up for infants and toddlers identified through early intervention programs. A 2016 publication followed.⁷

Early detection and diagnosis will enable the families access to interventions at optimal time-points, as well as opportunities to participate in research at the earliest stage of the disease, including natural history studies, imaging studies, and interventional trials. Collecting information about children in the early stages of the disease will become even more vital as science supports new treatment, including cellular and gene therapies.

Research priorities

The gene responsible for producing dystrophin, the body's "shock absorber" at the level of the muscle, was discovered in 1986, but research funding into Duchenne languished. Duchenne and Becker muscular dystrophy are a spectrum of the same dystrophinopathy, differing in presentation and severity. They are caused by a mutation in the gene that encodes for a protein called dystrophin. Without dystrophin, muscles are not able to function or repair themselves properly. Becker muscular dystrophy, which is less severe than Duchenne, occurs when dystrophin is manufactured, but not in the normal form or amount. PPMD is committed to serving all members of the Duchenne and Becker community, as well as female carriers of Duchenne/Becker. Individuals with both Duchenne and Becker, carriers, as well as their families participated in the Compass Meeting.

Areas of Priority Interest and Need

Non-motor symptoms

- Fatigue
- Pain (especially in the back, legs, neck, and head)
- Depression
- Anxiety
- Behavioral issues

Functional capacities not dependent on ambulatory status

- Upper body strength
- Flexibility including grip strength
- Lifting arms above the head
- Weight-bearing for purposes of repositioning the body while seated or lying down
- Raising a hand to the mouth for self-care activities like eating and teeth-brushing

In 1999, federal funding for the muscular dystrophies (which includes 7 diseases of which Duchenne and Becker are considered to be 1) was only \$17 million and there were no clinical trials or pharmaceutical industry partners in the space. The Duchenne community activated and partnered with Congressional champions to pass landmark legislation known as the Muscular Dystrophy Community Assistance Research and Education (MD-CARE) Act and galvanized the community. The bill helped to establish a national research and public health infrastructure for Duchenne and convened partners. It also has leveraged the funding from patient advocacy organizations, with that of the federal government and life sciences companies to create a landscape shift in Duchenne.

What was once a barren research landscape is now a robust pipeline that includes 46 life sciences companies, multiple animal models, trial networks, a pre-competitive industry consortium, some two dozen actively recruiting interventional trials, and two drugs—EXONDYS 51 (eteplirsen) and Emflaza (deflazacort)—have been approved by the U.S. Food and Drug Administration (FDA) for treatment of Duchenne. Notwithstanding these important advances, as was evident throughout the day at the Compass Meeting, there remains a great deal of unmet medical need and many unanswered questions about Duchenne and its treatment that warrant an even more robust research and development efforts.

To complement and enhance current research efforts underway at federal agencies, in academic research centers, and biopharmaceutical laboratories, participants in the Compass Meeting highlighted areas of priority interest and need, including more focused investigation of the non-motor symptoms experienced by individuals living with Duchenne. Foremost among these underappreciated symptoms are fatigue, pain (especially in the back, legs, neck, and head), depression, anxiety, and behavioral issues. Study of these symptoms and their contribution to the overall level of disability experienced by individuals with Duchenne could elucidate novel management strategies, yield new insights into pathophysiology, and establish patient-centered outcome measures. With the stated importance of maintaining cardiac and pulmonary health to both function and lifespan, greater research into preserving heart and lung function is needed as well.

There was strong interest expressed in having a broader array of outcome measures as a tool for charting disease progression, assessing effectiveness in interventional trials, and focusing attention on these features as targets for therapy. In addition to developing measures for the non-motor

symptoms listed above, patients and parents expressed strong desire to develop measures for functional capacities not dependent on ambulatory status, particularly those associated with upper body strength and flexibility including grip strength, lifting arms above the head, weight-bearing for purposes of repositioning the body while seated or lying down, and raising a hand to the mouth for self-care activities like eating and teeth-brushing. These functions are essential to quality of life, yet receive little attention in formal research studies.

A third area of heightened interest was research that would inform or serve to further refine standards of care through clinical and health services research programs. Questions about benefit-risk tradeoffs related to corticosteroids were raised, pointing to the need to understand patient/caregiver preferences and to identify more therapeutic options for achieving the benefits of steroids while mitigating some of the harms and risks that were identified (see page 4). Results of these types of studies would be useful in developing shared decision-making tools to further improve care and management, as discussed below.

Therapy development

The development pipeline for Duchenne includes approaches that seek to restore or replace dystrophin and those that aim to treat Duchenne symptoms. The current pipeline includes drugs, gene therapy, cellular therapy, and medical devices. Duchenne is benefiting from scientific advances such as gene editing and robotics, and there is opportunity to expand the array even more. Two specific themes heard throughout the day at the Compass Meeting, building on statements above, were to focus more development effort on relief of non-motor symptoms and to discover and develop approaches that would preserve, improve, or restore non-ambulatory function. Progress in these areas will be closely tied

A new paradigm for payer engagement must be innovated.

to the validation of measures of these symptoms and functions, so parallel efforts are required.

Another recurring theme throughout the day and in many other patient-centered discussions is the need to move beyond single intervention studies, to test therapies in combination and develop combination therapies. As precision medicine tools advance more broadly, those can be applied to Duchenne to optimize a custom “cocktail” of therapeutic approaches tailored to the individual.

Essential to advancing therapeutic options is the availability of a research-ready patient population and clinical trial designs that reflect patient perspectives and minimize participant burden. Compass Meeting participants may not be fully representative of the Duchenne community as a whole; however, the high rate of participation in research studies—75 percent—does reflect the attention that has been paid by community leaders to mobilizing community members to actively seek opportunities to engage in studies of all kinds.

The Duchenne community has been active in working with clinical trial sponsors to improve clinical trial experience for participants. Sponsors benefit from the draft guidance developed through a multi-stakeholder process led by PPMD in 2014, followed by FDA’s issue of draft and then final guidance in 2015 and 2018, respectively, as well as the efforts by PPMD’s Duchenne Drug Discovery Roundtable (DDDR) to promote collaboration and synergies in development efforts.

Opportunities remain for clinical trials that capture and focus on outcome measures beyond those that depend on ambulatory status, age limits (versus functional abilities), and otherwise restrict entry to a narrow population. Compass Meeting participants identified a host of barriers to clinical trial participation (see page 4), importantly the demands

and burdens associated with distant clinical sites. Exploring possibilities for community-based trial sites and remote participation would expand the pool of participants able to enroll and remain in studies.

Recognizing that the nature of some interventions drives decisions about inclusion and exclusion criteria that may limit the eligible population, there was great interest in compassionate use programs being established for others—particularly older patients and those with more advanced disease that generally have fewer opportunities to join clinical trials.

Finally, the challenges of choosing among clinical trials, especially with so many focused on the younger, more ambulatory patients raises the importance of master protocol development, already under way through the DDDR. It also draws attention to the need for even more community education and resources to facilitate informed choices about clinical trial enrollment, particularly as new types of therapies such as gene and cellular therapies advance. Discussions around narrowing inclusion criteria also raised the need to incorporate payer perspectives within development programs earlier in order to better align regulatory and reimbursement perspectives. It was noted that coverage and policy determinations are trending to mirror clinical trial inclusion criteria. However, as noted during the discussion, trials often do not include the full population intended to benefit from the study drug and inclusion criteria are not set with the intention of establishing coverage policy. A new paradigm for payer engagement must be innovated. These will require new and rapidly evolving understanding of patient and caregiver expectations and preferences

for benefits and tolerance for harms to aid target selection, endpoint and outcome measurement, clinical trial design, and regulatory decision-making.

Disease management and patient care

The Duchenne community benefits from clinical guidelines developed and endorsed by the U.S. Centers for Disease Control (CDC) and a network of care centers that deliver optimal, evidenced-based care through standards established by the PPMD Certified Duchenne Care Center Program (CDCCP). The Duchenne Care Considerations have been recently been updated and published in 2018 in *The Lancet Neurology*.^{8,9,10}

The experience of parents and patients articulated at the Compass Meeting revealed that families piece together care, often traveling great distances to obtain care from Duchenne experts with significant direct and indirect costs. Care provided by local community physicians and in emergency situations is still generally challenging to experience due to the need for parents, who are better informed about Duchenne than the treating provider, to act as educator, patient advocate, and parent in such situations. This points to the need for greater community education of healthcare professionals in both primary care and specialty care settings about Duchenne to ensure that patient health is not compromised by suboptimal quality care.

As Duchenne progresses, the need for personal care attendants, home health services, respite, and end of life care increases as part of the overall management of the disease. These services can be even more challenging to obtain than care delivered in traditional settings, so pro-active and on-going planning by families and better education of providers of these services about Duchenne can improve the level of success.

The effort devoted by parents to obtaining high quality care was reported to be further challenged by rising costs of care and pressure exerted by benefits managers and payers to contain costs. Increasing attention is paid to value and health technology assessments, with scant attention paid to the patient/family perspectives on what aspects of care delivers value in short- and long-term time-frames. PPMD has participated actively in initiatives including Avalere and *FasterCures*' effort to establish a patient-centered value framework and the Institute for Clinical and Economic Review's (ICER) process assessing their framework's appropriateness for appraising new therapies for rare diseases as they receive FDA approval.

For now, the burden of securing appropriate levels and types of health insurance coverage that support high quality care for Duchenne falls to parents and adults with Duchenne. Healthcare coverage policies for therapies, care services, durable medical equipment and supplies, and other types of assistive devices and services vary greatly. Compass Meeting participants expressed great frustration about the enormous investment of time and energy required to direct their sons' care and navigate the coverage and payment policies of public and private payers. Stories of appeals and delays were common and contributed to a very high burden imposed on individuals and families already stressed by the demands of caring for one or more severely compromised persons living with Duchenne. It was clear from the community's experience that delays and denials in accessing care had often-serious negative consequences for the health of the individual with Duchenne, adding further costs to the family and the health care system. This is a situation that must be addressed, yet immediate remedies are elusive.

More holistic assessments of the true economic costs of Duchenne and its care would be useful tools in assessing optimal coverage, reimbursement, and

payment policies. These must approach Duchenne from a family-centered viewpoint in order to accurately measure the myriad direct and indirect costs (see page 22) so that policy is appropriately calibrated from a holistic perspective. Caregiver burden is an important component of the total cost and must be factored in value assessment as well.

Finally, Compass Meeting participants drew attention to the importance of establishing and reinforcing the therapeutic value of social bonds and meaningful activities for the person with Duchenne and his family members in managing the burdens and losses arising from Duchenne. Participants spoke to the impact of Duchenne on identity, as children and adults with Duchenne compared themselves to able-bodied peers who had less restricted physical, social, intellectual, and emotional opportunities. This was especially true among the adults with Duchenne. The importance of identifying enriching activities and settings that help to reduce loneliness, validate self-worth, and build support networks cannot be overlooked, in addition to access to appropriate mental health care. It bears repeating that these also are vital for family caregivers. Duchenne community events, such as PPMD's Annual Conference, End Duchenne Tour stops, and locally based Connect support groups, can help fill this need and link individuals to additional resources.

Educational and vocational services

Although state and local laws and education systems vary widely, federal statutes provide a basis for every person living with Duchenne to expect "free appropriate public education in the least restrictive environment."¹¹ Families with Duchenne must often become fluent in provisions of the Americans with Disabilities Act and the Individuals with Disabilities Education Act, as well as enforcement support available through the U.S.

Department of Education's Office of Civil Rights, in order to secure and maintain access to appropriate education services. Vigilance is required and, as more than one parent stated at the Compass Meeting, interpretations under the law vary not only by region, but within schools and among administrators. Advocacy at the federal level is important, but is unlikely to suffice. Advocacy at the state, local, and especially the school level is most often needed to secure ongoing access to fully appropriate education services. PPMD has developed a set of resources (available in downloadable or hard copy formats) to assist parents and teachers in providing a quality education for students with Duchenne.

In the public school setting, the Individualized Education Plan (IEP) is a cornerstone of communication between the family, the student, school administrators, and teachers. It may need to be updated regularly as the student experiences physical, intellectual, and emotional changes and in response to demands of medical treatment and school curricula. Some families find that educational consultants can be helpful in navigating this process, while others turn to independent school and alternative learning environments. Accessibility of facilities is important too, particularly as ambulation becomes more difficult or impossible. Whether public or private, the school may need to play a role in administering medications or other medical supports during the school day and/or provide flexibility for attendance to ensure treatment is optimized for the student.

As described in the preceding section, the educational experience provides not only intellectual stimulation and development, but is an important setting for age-appropriate socialization that contributes to well-being. As IEPs and other arrangements are made to support the student's learning, attention should be paid to accessible extracurricular activities that aid development of identity, character, and

personality. Finding ways for the student to contribute to classroom, team, and club activities can help foster peer-to-peer and student-teacher/leader bonds.

In the higher education setting, services will vary according to institution and will be an important consideration for young men going on to college or graduate studies. Most institutions will have an office dedicated to supporting individuals with disabilities in the classroom, in residential experiences, and with extracurricular activities.

As individuals with Duchenne complete their education and transition to the workforce as health and other factors permit, it can be challenging to find accommodating employment arrangements, as we heard at the Compass Meeting from several individuals. It is important to become familiar with rights prescribed by the Americans with Disabilities Act and the Workforce Innovation and Opportunity Act. Resources available through the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR), federally-funded Centers of Independent Living, and Department of Rehabilitation Services vocational rehabilitation offices across the country can also help to identify and facilitate removal of architectural, communication, technology, and attitudinal barriers to full participation in the community and the workforce. With many companies devoting more resources to inclusion and diversity, remote working arrangements becoming commonplace, and an increasing array of technologies such as voice command devices being used to drive business functions, people with all types of disabilities are finding new employment possibilities that leverage their skills, talents, and interests.

Disease prevention

The gene mutation that causes Duchenne is carried on the X chromosome and females can be

carriers. Carrier phenotype is variable across the community ranging from women with slight muscle cramping or no symptoms, to those with cardiac symptoms, to manifesting carriers with the classical Duchenne presentation. At the Compass Meeting, several women expressed surprise when they first learned they were carriers for Duchenne; for some that accompanied guilt for passing along a defect that caused their sons so much suffering. This raised the potential need for more widespread genetic screening and counseling as part of routine family and prenatal planning to help women and couples make more informed childbearing plans. Today there are many reproductive options available to carriers.

Although it did not receive attention at the Compass Meeting, carriers have an increased chance of heart problems and, sometimes, skeletal muscle weakness. If a woman knows she is a carrier, she should be evaluated regularly by a doctor who is familiar with Duchenne. Genetic carrier testing is also important because once one carrier is identified in a family, there could be several more carriers identified in the extended family. It is important to share this information with other females in the family so they can pursue carrier testing if desired.

Gene editing techniques are advancing rapidly to the point where someday it may be possible to repair mutations before they cause symptoms or compromise the health and lives of carriers and their children. Much more study is needed to establish the immediate and long-term safety and effectiveness of such approaches, as well as all the ethical considerations that surround this burgeoning area of science and commercialization. Yet, the fast-evolving realities of such techniques support the promise of a future free of the suffering and burdens caused by Duchenne, possibly within a generation or two.

IN CONCLUSION

Dr. Woodcock reflected on the journey that the Agency and the community have traversed together:

"I'm really thrilled to be here. What has become clear is that we are in a different place today than we were many years ago in rare diseases. Treatments are being developed for many serious diseases like Duchenne, some of which are becoming available to patients. We have also recognized that we can be a force for how new treatments are thought about, how they are developed, and how fast they become available."

"For the Duchenne community, I think the draft guidance that was sent to FDA was a big start. It was a step forward to us that stated from the community perspective, 'This is what we care about, this is what we think should be studied, this is the burden of the disease, and this is the patient and family voice.' That helped us to understand the impacts of the disease, the types of outcomes and endpoints we should be looking for in trying to ameliorate the disease in some way. So that was a huge step and your community was the first patient group to do this."

Dr. Woodcock went on to reinforce themes she and her FDA colleagues had heard throughout the day that fit into drug development constructs. She noted several ways in which FDA is working with PPMD and others to advance treatment options for Duchenne and she affirmed FDA's commitment to the Duchenne community.

Dr. Woodcock's comments and the participation of all the federal agency partners in the meeting underscored the opportunity this Compass meeting presented for engagement across many areas of collaborative endeavor to address unmet needs experienced by Duchenne patients and families. The multi-dimensional nature of the discussion and dialogue would not have been possible without the support and encouragement of Dr. Theresa Mullin, FDA's director of the Office of Strategic Programs, who leads Patient Focused Drug Development (PFDD) efforts. Dr. Mullin and her team attended the full day meeting and in the planning and preparations stages, allowed PPMD to expand upon the firm foundation laid by FDA in its 24 PFDD meetings and "Voice of the Patient" reports. PPMD's hope is that the Compass meeting format may serve as a template for future meetings hosted by other communities as we work to together evolve the science of patient-input and discovery effective therapies.

The perspectives and insights shared at the extraordinary Compass Meeting will be used by PPMD and the Duchenne community to inform strategy, ground action, and focus our vision to end Duchenne. To close the day, Pat Furlong acknowledged the community that has formed around a dream they share for the future: "We are a really good team—our families, our children, our federal partners, our industry partners. Hope lives here, with us. We envision a day when the inclusion criteria for clinical trials are expanded from the littlest guys to the adults; where there is less exposure to placebo; when we have biomarkers to help assess whether someone is responding to a given drug so that if they're not responding, they can move on quickly to another drug; when our studies test therapies in combination; when the CK levels we see in the middle of the night and the middle of day are 900 instead of 9,000. THAT would be quite a day; quite a day indeed."

KEY EVENTS TIMELINE

- 1986** Gene producing dystrophin identified
- 1994** PPMD formed by parents and grandparents of persons with Duchenne
- 2000** NIH holds first-ever Duchenne workshop at PPMD's request
- 2001** Muscular Dystrophy CARE Act (MD-CARE Act) enacted into law by President George W. Bush
- 2001** MD STARnet established by CDC in response to the MD-CARE Act
- 2005** MD Action Plan issued by Muscular Dystrophy Coordinating Committee
- 2007** The Duchenne Registry (previously known as DuchenneConnect) established
- 2008** First Reauthorization of MD-CARE Act
- 2010** CDC's Duchenne/Becker Care Considerations published in *The Lancet Neurology*
- 2011** Duchenne "One Voice" Summit hosted by PPMD
- 2012** "Putting Patients First" white paper issued by PPMD calls for regulators to exercise greater flexibility in assessment of novel therapies
- 2012** "Transforming Duchenne Care Initiative" leads to formation of the Certified Duchenne Care Center Program
- 2013** First formal quantitative study of benefit-risk tradeoffs of Duchenne caregivers
- 2013** PPMD hosts Duchenne Policy Forum with FDA
- 2014** MD-CARE Acts Amendments signed into law by President Barack Obama
- 2014** PPMD issues "Patients Are Waiting" collection of patient perspectives on benefit expectations and tolerance for risks and harms
- 2014** Draft guidance on Duchenne, including patient imperatives, submitted to FDA

KEY EVENTS TIMELINE (continued)

- 2014** PPMD's Certified Duchenne Care Center Program certifies its first center
- 2015** PPMD's Duchenne Drug Discovery Roundtable (DDDR) formed
- 2015** FDA issues draft guidance for Duchenne
- 2015** PPMD forms Adult Advisory Committee (PAAC) to help guide organization's mission
- 2016** PPMD submits results of preference study focused on non-skeletal treatment targets to FDA
- 2016** FDA approves EXONDYS 51 (eteplirsen) for treatment of Duchenne
- 2016** 21st Century Cures signed into law by President Barack Obama; includes Patient Focused Impact Assessment Act, initiated by PPMD
- 2017** FDA approves Emflaza (deflazacort) for treatment of Duchenne
- 2017** FDA Reauthorization Act signed into law, including patient-focused drug development provisions of PDUFA-VI
- 2017** DDDR conducts series of meetings covering clinical trial harmonization, clinical trial optimization, and clinical trial harmonization
- 2017** PPMD hosts meetings on the role of inflammation, cardiac outcome measures in Duchenne, and the burden of clinical trial participation.
- 2018** FDA issues final guidance for Duchenne
- 2018** Updated Duchenne/Becker Care Considerations published in *The Lancet Neurology*
- 2018** PPMD hosts Compass Patient-Focused Drug Development Meeting
- 2018** PPMD launches global study of benefit-risk preferences and a study focused on risk tolerance in gene therapy interventions

Acknowledgements

PPMD gratefully acknowledges the many contributions made by all the Compass Meeting participants and offers its special thanks to the following individuals and organizations:

Community Advisory Board

All Duchenne community foundation partners were invited to join a Community Advisory Board. The following organizations responded to that invitation; they helped shape the planning process and reviewed the draft report, providing input that is reflected in this final version.

Best Day Ever Foundation

Jett Foundation

Coalition Duchenne

Little Hercules Foundation

Foundation for a Future

Powers Promise

Foundation to Eradicate Duchenne (FED)

Ryan's Quest

Hope for Gus

Team Joseph

Hope for Javier

Walking Strong

JB's Keys

Zach Heger Foundation

Staff and Consultants

Preparations for, facilitation of, and follow-up to this meeting and development of this extensive report was a team effort as well, involving many individuals working independently and in collaboration. Special recognition is paid to the following people:

Parent Project Muscular Dystrophy

Ryan Fisher*

Pat Furlong

Annie Kennedy*

Will Nolan

** Co-led meeting planning and facilitation, as well as production of meeting report*

Faegre Baker Daniels

Provided support of panelist preparation and review of meeting materials

Tim Franson, MD, YourEncore

Nick Manetto

Allison Martin

David Zook

The Kith Collective

Provided support for the meeting structure, panelist preparation, and primary authorship of the meeting report

Kim McCleary

RTI International

Provided guidance and design on polling questions

Holly Peay, PhD

ENDNOTES

Section 2

- 1 Peay HL, Biesecker BB, Wilfond BS, Jarecki J, Umstead KL, Escolar DM, Tibben A. Barriers and facilitators to clinical trial participation among parents of children with pediatric neuromuscular disorders. *Clinical Trials*. Vol 15, Issue 2, pp. 139–148. 2018.
- 2 Hollin IL, Peay H, Fischer R, Janssen EM, Bridges JFP. Engaging patients and caregivers in prioritizing outcomes for Duchenne and Becker Muscular Dystrophy. *Qual Life Res*. 2018 May 26. doi: 10.1007/s11136-018-1891-7. Epub ahead of print.
- 3 Landfeldt E, Lindgren P, Bell CF, Schmitt C, Guglieri M, Straub V, Lochmüller H, Bushby K. The burden of Duchenne muscular dystrophy: An international, cross-sectional study. *Neurology*. Aug 2014, 83 (6) 529–536; DOI:10.1212/WNL.0000000000000669

Section 3

- 1 Mathews KD, Cunniff C, Kantamneni JR, Ciafaloni E, Miller T, Matthews D, et al. Muscular Dystrophy Surveillance Tracking and Research Network (MD STARnet): Case definition in surveillance for childhood-onset Duchenne/Becker muscular dystrophy. *Journal of Child Neurology*. 2010;25(9):1098–102. Epub 2010/09/08.
- 2 Dubowitz V. Intellectual Impairment in Muscular Dystrophy. *Archives of Disease in Childhood*. 1965;40(211):296–301. Epub 1965/06/01.
- 3 Gardner-Medwin D, Bunday S, Green S. Early diagnosis of Duchenne muscular dystrophy. *Lancet*. 1978;1(8073):1102. Epub 1978/05/20.
- 4 Smith RA, Sibert JR, Harper PS. Early development of boys with Duchenne muscular dystrophy. *Developmental Medicine and Child Neurology*. 1990;32(6):519–27. Epub 1990/06/01.
- 5 Ciafaloni E, Fox DJ, Pandya S, Westfield CP, Puzhankara S, Romitti PA, et al. Delayed diagnosis in duchenne muscular dystrophy: data from the Muscular Dystrophy Surveillance, Tracking, and Research Network (MD STARnet). *Journal of Pediatrics*. 2009;155(3):380–5. Epub 2009/04/28.
- 6 See www.Motordelay.aap.org
- 7 Kwon JM, Abdel-Hamid HZ, Al-Zaidy SA, Mendell JR, Kennedy A, Kinnett K, et al. Clinical Follow-Up for Duchenne Muscular Dystrophy Newborn Screening: A Proposal. *Muscle Nerve*. 2016;54(2):186–91. Epub 2016/05/14.
- 8 Birnkrant, D.J., et al. Diagnosis and management of Duchenne muscular dystrophy, part 1: Diagnosis, neuromuscular, rehabilitation, endocrine, and gastrointestinal and nutritional management. *Lancet Neurology*. 2018.
- 9 Birnkrant, D.J., et al. Diagnosis and management of Duchenne muscular dystrophy, part 2: Respiratory, cardiac, bone health, and orthopaedic management. *Lancet Neurology*. 2018.
- 10 Birnkrant, D.J.; et al. Diagnosis and management of Duchenne muscular dystrophy, part 3: Primary care, emergency management, psychosocial care, and transitions of care across lifespan. *Lancet Neurology*. 2018.
- 11 Individuals with Disabilities Act, accessed May 2, 2018 at <https://sites.ed.gov/idea/statuteregulations>

Parent JOIN THE FIGHT.
Project END DUCHENNE.
Muscular
Dystrophy

401 Hackensack Avenue, 9th Floor

Hackensack, NJ 07601

800.714.5437

facebook.com/parentprojectmd

youtube.com/user/ParentProjectMD

twitter.com/parentprojectmd

ENDDUCHENNE.ORG