



## The New Biotechnological Frontier: The Exmovere Chariot

### Specific Aim

Exmovere Holdings Inc. is developing a Segway-based upright mobility device that surrounds the user's thighs, hips and legs in a kind of cocoon, called the **Chariot**. The user's hands, arms and chest remain free to do whatever is desired. This would position the vehicle as a direct competitor to existing sit-down scooters marketed to obese, elderly and limited mobility persons.

The Chariot enables users to maintain an eye level position with people, as opposed to scooters and wheelchairs. The Chariot is Exmovere Holdings Inc.'s starting point for further development for people who have a hard time standing or walking and for those people who must stand or walk long distances.

The Chariot has several competitive advantages. It is the only stand-up vehicle of its type. It is the only, truly hands free self-balancing vehicle. It also serves as a unique platform for integrating vital sign, emotion monitoring and environmental sensors for hospitals, military and hazardous materials workers.

With the Chariot, Exmovere is seeking to benefit from current market trends towards individualized transportation with a focus on low carbon-footprint technologies. Future Chariots will offer unique features such as: smart battery management and inductive charging, core-body temperature monitoring, heating and cooling, dynamic stabilization on rough, sandy, uneven and wet terrain, wireless connectivity and GPS, along with sonar and radar systems for visually impaired riders.

Exmovere's Chariot plans are driven by urgent statistical trends. Over six million veterans have some form of disability and 261,897 were rated as 100% disabled as of 9/30/08, according to the Veterans Administration. There are 1.7 million amputees in the US. Diabetes accounts for the vast majority of lower limb amputations.

## **Research Design and Methods**

The Exmovere Chariot is a wearable, sensor-activated pod designed for use by amputees and others who have difficulty standing.

Unlike other self-balancing vehicles, the Exmovere Chariot is controlled by subtle movements of the lower torso and hips. Sensors inside the cocoon-like shell of the vehicle predict the intended motion of the wearer. The Chariot requires no manual dexterity, minimal physical effort and allows wearers to closely approach and reach objects. The upright form of the Chariot allows its wearer to make direct eye contact with others. The Chariot is battery powered and can travel up to 12 miles per hour.

Current tests are being conducted in public safety applications as well as law enforcement scenarios.

Our staff has done exhaustive research related to muscle movement, physiology, and the overall benefits related to standing mobility for the disabled.

## **Project title: The New Biotechnological Frontier: The Exmovere Chariot**

**Research Area: Biotechnology and psycho-physiological technology.**

### ***Broad Challenge***

Pretty much everyone has heard about the Segway electric vehicle, which can be considered the forefather of the flurry of electric cars and vehicles to follow. However, despite its many interesting features, the Segway does have a problem, namely the fact that users have to stand in order to drive it around. And, although one might say that this is not an issue, the truth of the matter is that there are a lot of people with movement-related disabilities out there for whom a Segway-like device would be extremely useful.

The Chariot is, in fact, a self-balancing, wearable, sensor-activated pod designed for use by amputees and others who have difficulty standing. Unlike other self-balancing vehicles, the Exmovere Chariot is controlled by subtle movements of the lower torso and hips, some sensors inside the cocoon-like shell of the vehicle predicting the intended motion of the wearer.

Furthermore, the Chariot requires minimal physical effort and allows wearers to closely approach and reach objects. The upright form of the Chariot allows its wearer to make direct eye contact with others. The Chariot is battery-powered and can travel up to 12 miles per hour.

The medical advantages provided by this mobility device are enormous. "Passive standing" is used in the Exmovere Chariot. Just some of the advantages of passive standing have long been recognized as:

- Promotes better urinary drainage
- Helps improve circulation
- Stretches hamstrings & heel cords
- Helps control spasticity
- Assists in bowel & bladder regularity
- Helps reduce skin breakdown
- Helps to release & prevent contractures
- Exercises the cardiovascular system
- Assists "feeling good"
- Allows for a more "normal" life
- Assists in muscle building
- Allows for more accepted social interactions
- Allows patients to obtain gainful employ if they choose

Physiological Benefits of Standing - Individuals who use a standing mobility device to prevent secondary complications that often result from prolonged use of a wheelchair. Physicians and therapists recommend standing for these medical benefits: Facilitate a natural symmetrical standing posture, develop and improve upper body balance and strength, improve range of motion in spine, hips, knees, and ankles, decrease abnormal muscle tone and reflexes (spasms, contractures), reduce pressure sores (decubitis) through changing positions, improve systemic functions (bladder, digestive, respiratory and circulatory), lessen progressive scoliosis and assist with skeletal development, stabilize and prevent loss of bone mineral density, alleviate pain caused by prolonged and/or inappropriate position, develop standing tolerance and endurance.

Psychological Benefits of Standing-In addition to the physiological health benefits, many people also experience psychological benefits from being in the upright standing position, such as improved self-esteem and social development.

Children who are diagnosed with a physical disability or a developmental delay may not have the ability to move and explore their surroundings, particularly indoors where they spend 80% of their time. These children typically lie or roll on the floor, sit in a supported chair, or stand in a standing frame. They may use bath seats, braces, and special strollers. In spite of all this equipment, these children do not have the ability to access their environment or experience the stages of development that depend on hands-free, upright, self-initiated mobility.

Children who have a means for self-initiated mobility decide where, when, and how to move to explore their surroundings. Those who cannot move across a room to reach out to explore an object or place are at a great disadvantage. They do not experience a variety of sensory motor and developmental activities such as pushing or pulling toys, seeking and touching what they see, or moving around or under objects. If they do experience mobility, it is primarily passive, while being held or pushed in a stroller.

Restricted experience and mobility during early childhood have a diffuse and lasting impact on development. If a child's mobility continues to be one of a passive nature, never active or self-initiated early in life, the child is further disadvantaged in his development. The significance of experiencing mobility in early childhood has been demonstrated. The challenge then is to determine how children with developmental delays can experience upright, self-initiated mobility so they can access their environment, explore their surroundings, and experience developmentally appropriate activities.

The Chariot solves this problem.

The broad implications for law enforcement usage are many. The Exmovere Chariot can be retrofitted with body armor and used in situations in which a live, but protected person is needed.

Secondary to law enforcement, is the usefulness in HAZMAT scenarios. The number one rule in any HAZMAT scenario is to not become causality and liability to your team. Self-protection and public safety go hand-in-hand. The Exmovere Chariot can also be used in biohazard situations when human footing can potentially carry infectious materials outside the safe zone.

The Exmovere Chariot is fitted with micro-biosensors that detect minute muscle movement and reflex. Used as a means of guiding the vehicle, the Chariot also monitors the user's vital signs and emotional status. The Chariot requires control only of the waist and torso muscles. It is ideal for persons who have disabilities below the waist, including amputees, those with spinal cord injuries, and others. Within the Chariot, there are motion sensors that detect how the person intends to move, and is much more precise than hand controls. It is like controlling a pair of pants, and should be thought of as much as an exoskeleton as a vehicle.

### ***Specific Challenge***

Exmovere's Chariot plans are driven by urgent statistical trends. Over six million veterans have some form of disability and 261,897 were rated as 100% disabled as of 9/30/08, according to the Veterans Administration. There are 1.7 million amputees in the US. Diabetes accounts for the vast majority of lower limb amputations.

Over two percent of the US population uses a wheelchair or assistive device, including scooters, canes and walkers. There are 7 million mobility product customers in the US, all ages and disabilities included. The main distribution channels are private medical insurance, Medicaid, Medicare, private pay, workers' compensation and state assistance programs.

High end wheelchairs and scooters range in price from \$6500-\$7800. Although low volume production Chariots are expected to be priced at \$6999-\$9999 per unit, the company believes that mass production can reduce the Chariot over the next 5 years unit price by at least 50%.

Exmovere intends to sell the Chariot through a licensed dealership network to be established first in the United States. Exmovere will target E-2 visa immigrant investors interested in coming to the United States with their families to help market and service the vehicle through Chariot Stores. At Chariot Stores, customers will have the opportunity to not only test drive Chariots, but order accessories and apply for financing.

The Exmovere Chariot will also be targeted to public service use.

## ***Challenge and Potential Impact***

Increasing evidence in the lifetime management of physical disability points to the horrendous impact of secondary complications of disability as well as the associated financial consequences involved. The study of the natural course history of mobility impairment in the disabled has established a consistent chain of predictable events that adds to the morbidity and mortality of these individuals.

This chain begins with individuals assuming any prolonged positional posture of sitting and/or lying or any recumbent posture that permits alteration of full extension required for standing and ambulating. Musculo-ligamentous imbalance associated with prolonged sitting in particular produces predictable contractures in all individuals. When contractures are not reduced completely and continually, the patient will then develop immobilization osteoporosis further complicating the postural impediment. Contractures further limit sitting and lying postures and positions.

This promotes longer periods in which skin surface areas are under inordinate pressure under bony prominences, promoting the development of pressure sores. The pressure sore phenomena will, at the very least, be subject to septicemia. Blood born abscesses and infection sites may be carried to any part of the body to further complicate this problem. In order to correct these problems, prolonged medical treatment with either recurrent high cost surgical care or long term medical hospitalization is often necessary. Thus, prolonged immobilization and sitting posture becomes a cumulative risk factor and the patient will require attendant care and develop the classical dependency found in many disabled individuals.

In order to treat existing contractures, or prevent their development in people with extensive non-ambulatory disability, it is absolutely imperative that this group of patients be given the opportunity to have a daily routine of stretching the tight contractures that develop in the above circumstances.

To this end, many devices have been employed to reduce the dependency on an attendant or a family member for this process. These mechanical aids have included the Tilt Table used in hospitals and some homes; the Parapodium often used by children; leg and body braces either for assisted standing and/or assisted ambulation; stand-in-tables; mechanically-assisted standing devices such as stand-in wheelchairs; and hydraulic and/or electric-assisted standing frames or electric mobility devices employing the same.

It has been demonstrated by many investigators, as well as clinicians dealing with these options, that the use of personal or manual assistance is often costly, prohibitive and unavailable and societal third party financial reimbursement programs will not pay for this continuity of care over a person's lifetime. In the next instance, the use of braces, if not used for ambulation per se, is often difficult to apply and, again, require assistance if the person is non-ambulatory and requires assisted aids. The cost for a complete pelvic, knee, ankle, and foot orthosis usually exceeds \$3500.00 and is almost prohibitive if done for this cause alone.

The use of stand-in frames or boxes also require the assistance of an additional aide or attendant to help the mobility impaired person arise from the chair and lock them into the stand-in device. This requirement for personal physical assistance in order to make the process regular and effective is also cost prohibitive. In the case of assisted standing devices coupled to wheelchair, these devices have not to this date shown the ability to bring the patient up to a standing position beyond 70 degrees so that the patient is always somewhat lying backwards and unable to perform any functional hand or arm activities. The wheelchair devices, the Tilt Table, as well as the stand-in frames never completely reduce the final 15-20 degrees of hip, knee and knee ankle flexion postures, so that complete obliteration of the contractures is never possible.

Flexion is also accommodated on the Tilt Table. Most clinicians, to date, have therefore found that the most therapeutic, effective, as well as cost benefit situation, relies on the use of a hydraulic or electric-assisted

standing frame or device, or an electric mobility device employing the same. The electric mobility devices that include assisted standing are very effective.

Society is often not willing to cover these other devices through third party reimbursement process. Therefore, it has been found that the most reasonable and most physiologic and therapeutic effective device available to disabled individuals with this inevitable risk of contractures, osteoporosis and pressure sores, is that of the hydraulic and / or electric standing device.

The Exmovere Chariot frame has been able to provide a more controllable, graduated, independently useable device than any of the other equipment on the market to date. It is also, therefore, the most inexpensive means available for providing long-term treatment or resolution of these problems. In addition, we have found that those who have spasticity have often had marked reduction of the level of their spasticity. The need for pharmacological agents that inhibit the spasticity has been significantly reduced by enjoining a daily standing program in a hydraulic -assisted standing frame. Furthermore, the adaptive phenomena of the standing frame, with the abdominal control, enhances the splanchnic pressure within the abdomen and promotes assisting refilling by the peripheral vascular system of the venous circulation to the right side of the heart and reducing the orthostatic hypertension that is often present in other types of standing devices, including orthotic devices.

## Conclusion

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