Standers

The following document reviews clinical indicators for standing technology and supporting research:

Standing devices are often medically necessary, as they enable certain individuals to:

☐ Improve functional reach to enable participation in ADLs (Activities of Daily Living (i.e. grooming, cooking, reaching medication)

☐ Enhance independence and productivity

☐ Maintain vital organ capacity

☐ Reduce the occurrence of Urinary Tract Infections

☐ Maintain bone mineral density

☐ Improve circulation

☐ Improve range of motion

☐ Reduce muscle tone and spasticity

☐ Reduce the occurrence of pressure sores

☐ Reduce the occurrence of skeletal deformities, and

☐ Enhance psychological well being.

Functional reach and access to ADLs
Standing adds significant amount of vertical access. This allows people to access kitchen cabinetry, light switches, microwaves, mirrors, sinks, hangers, thermostats, medicine cabinets, and many other surfaces to enhance their abilities to perform ADLs, depending on the client's upper extremity function.

Range of Motion, Contractures
Standing extends the hip and knee joint to provide position change. Animal studies have shown that muscles which were fixed in a flexed position resulted in increased contractures of the joints, especially when the bones are still growing [3,4].

Vital organ capacity
During standing, the pelvis tends to assume a more anterior tilt or neutral position, allowing for an increase in lumbar lordosis as compared to sitting. This in turn helps establish a better alignment of the spine and extend the upper trunk. Extension of the upper trunk results in reduced pressure on the internal organs, thereby enhancing respiratory and gastro-intestinal capacity and functioning. This can prevent or delay many secondary complications so often seen in wheelchair users.

☐ *Respiration.* Many users experience improved lung capacity when standing often.

Studies have shown that those who stand frequently have lesser or delayed occurrence of respiratory complications and improved respiratory volume [2]. Standing can help also reduce congestion and
coughing [5].

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☐ *Gastro-Intestinal problems.* Standing users also experienced lesser or delayed occurrence of gastro-intestinal complications, for example via improvement in gastric emptying [1,2].

☐ *Bowel function.* Some users have experienced improved bower regularity, reduced constipation, and lesser occurrence of accidental and unregulated bowel movement as a consequence of using standers[1]. Elimination of chronic constipation and significant reduction in bowel care time has also been shown as a result of frequent standing [2,6]. Chronic constipation can lead to bowel obstruction, a dangerous condition often requiring surgery. Unregulated bowel movements can lead to fecal incontinence at a time when the client cannot be cleaned by a caregiver, increasing the risk of developing pressure sores.

☐ *Increased Bladder emptying.* Users of standing devices reported that they were able to empty their bladders more completely than prior to using the device [1].

Urinary Tract Infections

Urinary Tract Infections (UTI) is the third most frequent complication for clients with SCI [7], and a frequent secondary complication for many other wheelchair users. Prolonged immobility causes hypercalcemia, increased urinary calcium output [8], and also reduces bladder emptying [1]. By reducing contributing risks, standers have been shown to reduce the occurrence of UTI for wheelchair users [1], which could lead to kidney infections.

Bone Mineral Density

Many wheelchair users experience significant reduction in Bone Mineral Density (BMD) due to the lack of weight bearing in the lower extremities. In fact, without gravitational or mechanical loading of the skeleton, there is a rapid and marked loss of bone. This results in osteoporosis and risk of fractures. Research suggests that weight bearing is superior to nutritional supplements in preventing BMD loss, and that the mechanical loading of the bones should be dynamic for full prevention of BMD loss. It also appears that with discontinuation of the weight bearing program, BMD levels will continue to decrease and/or return to pre-weight bearing values.

Populations with a variety of disabilities have been studied for loss of BMD, such as children with Cerebral Palsy (CP) or Spina Bifida, as well as adults with Stroke, Multiple Sclerosis and SCI [9]. Even if BMD loss has not yet occurred in a user, standing can be an effective mean to help prevent this secondary complication.

☐ *Loss of BMD.* Review studies establish the direct relationship between weightlessness and loss of BMD, as well as the relationship between osteoporosis and the high risk of fractures [10-12]. Studies with astronauts and people in bedrest quantify the negative effect of weightlessness and lack of weightbearing on BMD [13-17]. This loss can be as high as 36% loss of the cross sectional area of a nonweight bearing bone within a month [18]. In bed rest, the average urinary calcium loss at the peak is about -150 mg per day, which corresponds to 0.5 percent of total body calcium [19-21]. For people with disabilities, numerous studies point out the benefits of frequent passive standing and weight bearing/exercise on BMD [22-25].

☐ *Fractures and loss of independence.* Loss of BMD leads to osteoporosis and the

consequent risk of fractures. Articles on children with Osteogenesis Imperfecta recommend frequent standing in childhood to maximize adulthood independence by minimizing fractures and the likelihood of broken bones [26,27]. Many people with disabilities often heal slower, as well. Fractures may limit short and long term function.

☐ *Supplements*. Evidence suggests that while appropriate nutritional supplements may reduce calcium loss from the bones, mechanical loading is superior to supplements for BMD maintenance[18]. Dietary changes, such as increased intake of calcium and/or vitamin D, have not proven effective at minimizing disuse bone loss [28].

☐ *Mechanical weight loading*. Living bones constantly adapt themselves to the mechanical forces applied to them, and their structure is directly linked to their weight bearing activity and forces occurring due to movement against resistance[29]. Weight-bearing activity can be thought of as any activity that is done while upright, requiring the bones to partially or fully support the body's weight against gravity [30]. Impact-loading, weight-bearing activity, therefore, involves some impact or force being transmitted to the skeleton during weight bearing. Standing provides mechanical loading through the longitudinal axes of the lower extremity bones. When the body is upright and extended, the bones of the lower extremities carry the entire weight of the body therefore loading is most efficient. Since the lower extremities normally carry the entire body's weight, they are the most prone to bone degeneration due to reduced or limited weight bearing.

☐ *Maintenance of weight bearing*. For the weight bearing exercise to be effective, the mechanical stress placed on the bone must exceed the level to which the bone has adapted (i.e., short periods of intense loading can produce more new bone than long-term routine loading) [36]. However, long-term routine loading is important in maintaining bone density. And although bone responds to mechanical loading, it is easier to lose bone through inactivity than to gain more through changes in functional loading. When weight-bearing exercise is not continued, bone mass reverts to pre-training levels [37, 38].

Circulation

Users have also experienced improvement in lower extremity circulation as a consequence of utilizing a stander [2]. Some benefits are reduced swelling in the legs and feet.

Tone

Standers also aid in reduction of access muscle tone; research indicates that muscle stretch combined with weight loading reduces muscle tone more than stretching alone (32% vs. 17%) [39]. Some users experience tone reduction in their upper extremities due to better skeletal alignment in a standing position. This may translate into improved speech and better hand and arm function to perform ADLs. Tone reduction can improve comfort, minimize further range of motion losses, improve function and conserve energy.

Spasticity

Research studies show that stander users have experienced significant reduction in spasticity [1,2]. This helps with transfers, can aid in better sleep, reduces

fatigue and pain, and improves positioning in the wheelchair. Standing has an immediate and significant effect on spasticity [40].

Pressure sores
When fully standing, pressure is 100% relieved off the Ishial Tuberosities (ITs). However, when tilting or reclining, there is only partial reduction of pressure underneath the ITs [41, 42]. Pressure ulcers are the primary complication for people with SCI [7], and many other adults who sit in wheelchairs all day long. There is evidence that users have suffered fewer pressure sores while using standers [41].

Skeletal deformities
Clinical experience suggests that extension of the upper trunk and proper alignment of the hip during standing helps delay typical skeletal deformities often seen in people who sit in a wheelchair for long periods of time, such as fixed posterior pelvic tilt, kyphosis and scoliosis of the spine, and windswept deformities of the lower extremities. During standing the head of the femur usually ends up better seated in the acetabulum,which is important especially for children, to promote healthy skeletal alignment, as well as to promote proper development of the acetabular socket.

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