



ICARE: Intelligently Controlled Assistive Rehabilitation Elliptical

MADONNA
ICARE
by *SportsArt*

The Madonna Rehabilitation Hospital

Madonna Rehabilitation Hospital is one of the nation's foremost facilities for medical rehabilitation and research. Specializing in traumatic brain injury, spinal cord injury and pediatric rehabilitation, Madonna offers hope and healing to thousands of patients from throughout the country each year.

- ➔ **The ICARE system is the brainchild of researchers and clinicians at Madonna Rehabilitation Hospital in Lincoln Nebraska. The project was led by Dr. Judith Burnfield, PT, PhD.**
- ➔ **The National Institute on Disability and Rehabilitation Research grant allowed the team to develop ICARE, an assistive walking system that is highly functional, but also affordable.**
- ➔ **During their research, the doctors at Madonna discovered the E872 elliptical trainer by SportsArt Fitness most closely mimicked a natural walking pattern compared to others in the study, making it the most suitable for a gait assistance device.**



SportsArt Fitness

SportsArt Fitness is an international manufacturer of premium fitness equipment for home and commercial use. With over 35 years of experience, SportsArt is the largest single-brand manufacturer in the world with distribution in over 70 countries and over 100 US and international patents.

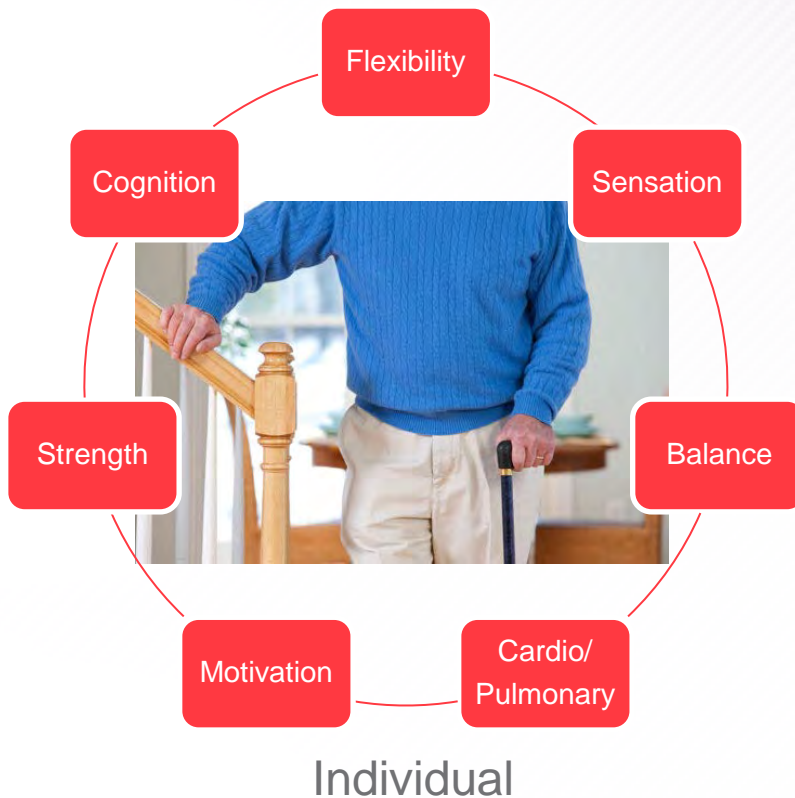
- ➔ **SportsArt Fitness has partnered with Madonna to launch national distribution of the ICARE system.**
- ➔ **SportsArt manufactures the ICARE elliptical, a motorized elliptical trainer for assisted repetitive gait training. Integrated sensors detect the level of assistance an individual needs to advance their legs. The motor reacts accordingly to provide the correct level of support. The addition of ramps, stairs and an unweighting system offer the ability to adapt to the system to a variety of users and environments. Safety straps hold the patient's foot in place while the automated elliptical helps them move their legs in a walking motion.**



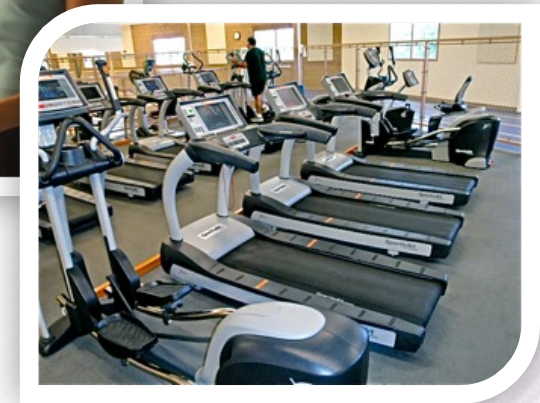
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Barriers to Physical Activity

Physically challenged individuals face multiple barriers to gaining back their health and vitality through physical activity.



Individual



Societal

Rimmer et al, *American Journal of Preventive Medicine*, 2004

ICARE Conceptual Framework

➔ **Task Specificity:** If you want to work on walking, then task needs to simulate walking

➔ **Mass Repetition:** Neuroplasticity of the brain requires not just 10-20 steps, but 100s to 1000s

Richards et al 1993; Kwakkel et al, 1999;
Carr and Shepherd, 1998; Nudo, 1997.

Partial body-weight supported treadmill training

- ➔ Improves walking function
- ➔ Unfortunately, labor intensive, equipment not readily accessible, and equipment can be costly (up to \$75,000)
- ➔ Demanding and labor intensive for therapists



Buster TW, Goldman AJ, Corbridge LM, Shu Y, Burnfield JM (2009). Partial Body Weight Support Treadmill Training: Clinician's Upper Extremity Muscle Activation During Facilitation of Hemiparetic Limb Movement. *Proceedings, GCMAS 14th Annual Meeting*, pgs 258-259.

Corbridge LM, Goldman AJ, Shu Y, Buster TW, Burnfield JM (2009). Clinician's Muscle Effort During Partial Body Weight Support Treadmill Training: Is it Hard Work? *Online Proceedings, American Physical Therapy Association's 2009 Annual Conference and Exposition* (http://www.apta.org/AM/abstracts/pt2009/abstractsPt.cfm?m_id=19675).

Robotic Devices

- ➔ Provide mass repetition of gait with less labor demand
- ➔ Highly cost-prohibitive for most facilities: \$100,000 - \$360,000 per device



Colombo et al, 2000; Werner et al, 2002

ICARE is. . .

An inexpensive tool to help people with physical disabilities regain walking capacity and physical fitness in inpatient settings, outpatient settings, fitness facilities or homes.



Intelligent Motor Control System

The ICARE elliptical has an intelligent motor to enable individuals with lower extremity muscle weakness and/or reduced endurance to train for physical therapy and fitness

- Generates sufficient torque to move pedals at constant speed while clients use ICARE
- Integrated sensors detect the level of assistance the user needs and the motor reacts accordingly, to deliver the correct level of support
- Training speed ranges from ~25 to 65 RPM

Nelson CA, Burnfield JM, Shu Y, Buster TW, Taylor A, Graham A (2011). Modified elliptical machine motor-drive design for assistive gait rehabilitation. *Transactions of the ASME Journal of Medical Devices*, 5:021001.1-021001.7.

Burnfield JM, Buster TW, Taylor A, Keenan S, Shu Y, Nelson CA (2010). Intelligently Controlled Assistive Rehabilitation Elliptical (ICARE) Training: An Analysis of Lower Extremity Electromyographic (EMG) Demands with Varying Levels of Motor Assistance. *Online Proceedings, Rehabilitation Engineering and Assistive Technology Society of North America's 2010 Annual Conference* (http://web.resna.org/library/conference_2010/JEA/BurnfieldJ.html).

ICARE Clinical Applications

The ICARE elliptical system can assist in therapy for a variety of diagnosis

Stroke

Hip fracture

Traumatic brain injury

Amputation

Spinal cord injury

Joint replacement

Multiple sclerosis

Rheumatoid arthritis

Parkinson's disease

Osteoarthritis

Cerebral palsy

Lumbar disc herniation

Guillain-Barré syndrome

Spinal stenosis

Encephalitis

Stiff person syndrome

Developmental disability

Heart disease

Microlissencephaly

Hypertension

Diabetes mellitus

Deconditioned

Cancer

Obesity

Complete ICARE System

State-of-the-art SportsArt
Fitness elliptical trainer

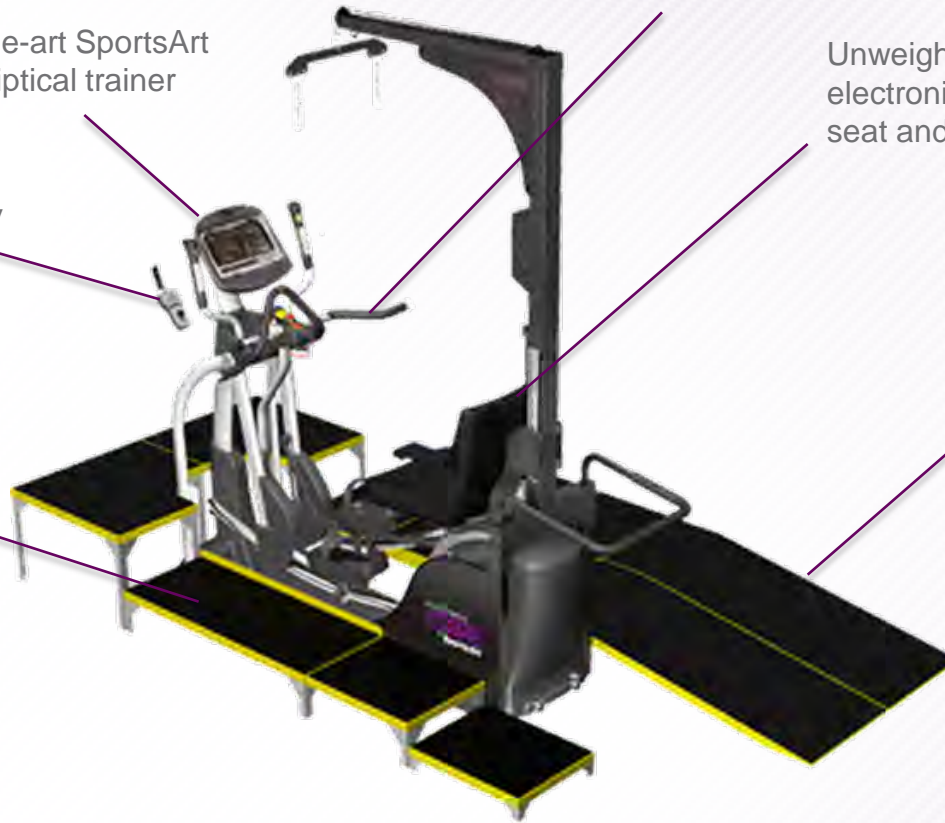
Adjustable safety
handle for patient

Unweighting system with
electronically adjustable
seat and safety strap

Remote control for easy
therapist adjustment

Wheelchair ramp

Patient access stairs



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Modular design offers three options



ICARE Elliptical Specifications	
Programs	ICARE, Manual, Interval (x3), Random, Plateau, Quick Start, Vari-Stride, Custom HRC, Cardio and Weight Loss HRC
Feedback	Calories, Distance, Time, Speed, Calories/Hr, WATTS, Heart Rate (Actual & Target), MyGoal, Workout Level, Stride/min, Total Strides (Calories, Cal/Hr & WATTS displays are for non-ICARE programs)
Heart Rate Tools	CardioAdvisor™, Telemetry Heart Rate, Contact Heart Rate
Console	Dot matrix display w/LEDs, ActivZone™ Icon, MyGoal Display, Integrated 3-speed fan, SPM remote control
Max User Weight	500lbs (300lbs for single leg in ICARE program mode) for Elliptical
Stride Length	Electrically adjustable 17-29" stride length
Resistance	20 Levels
Pedal Cushioning	MyFlex
Dimensions	86.6" x 31" x 71"
Additional Features	<ul style="list-style-type: none"> •Additional height adjustable handlebar for safety •Adjustable pedal foot straps for security
ICARE Protocol	<ul style="list-style-type: none"> •Forward and reverse motor assistance while training at speeds ranging up to 65 cycles per minute •Motor automatically adjusts to changing assistance needs of user during training •Single or dual leg training options adjust to needs of clients with and without amputations •Passcode control and integrated safety switches (button and safety key with lanyard) for added security •Remote control for easy clinician adjustment •Summary display tracking client's progress •Protocol is passcode protected so unit can be used as a standard elliptical trainer

Unweighting System Specifications	
Features	<ul style="list-style-type: none"> •Electronic height adjustable rotating seat •Ultra Quiet Compressor •12" Electric Actuator •IGUS Drylin w/double rail •Michigan Seat with Armrest •Springfield Marine Seat Swivel •Added safety strap •SMC 3-way Pneumatic Valve
Max User Weight	500 lb body weight at 80% supported
Dimensions	8.5' x 3.5' x 9' (elliptical plus unweighting system)

Ramp Specifications	
Features	<ul style="list-style-type: none"> •Wheelchair ramp •Patient access stairs •Therapist access platform in front of elliptical •Non-skid surface
Dimensions	12' x 7.2' x 9' (elliptical plus unweighting system and ramp/stairs)

International Da Vinci Awards Finalist



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AWARDS

2011 **FINALIST**



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