

**Neuro Rehabilitation,
Cognitive & Physical Therapy
Facilitated by Interactive Media
Technology**

or

**If this doesn't work,
We are all in big trouble...**

Walter Greenleaf, PhD

We Have a Problem

The basic paradigm of rehabilitation has not changed much over the last 30 years.

It's boring and inefficient.

With an aging population - living longer - clinical resources will be spread thin.

In order to maintain quality of life as we age, there must be a fundamental change in how rehabilitative care is provided.

We Have a Problem

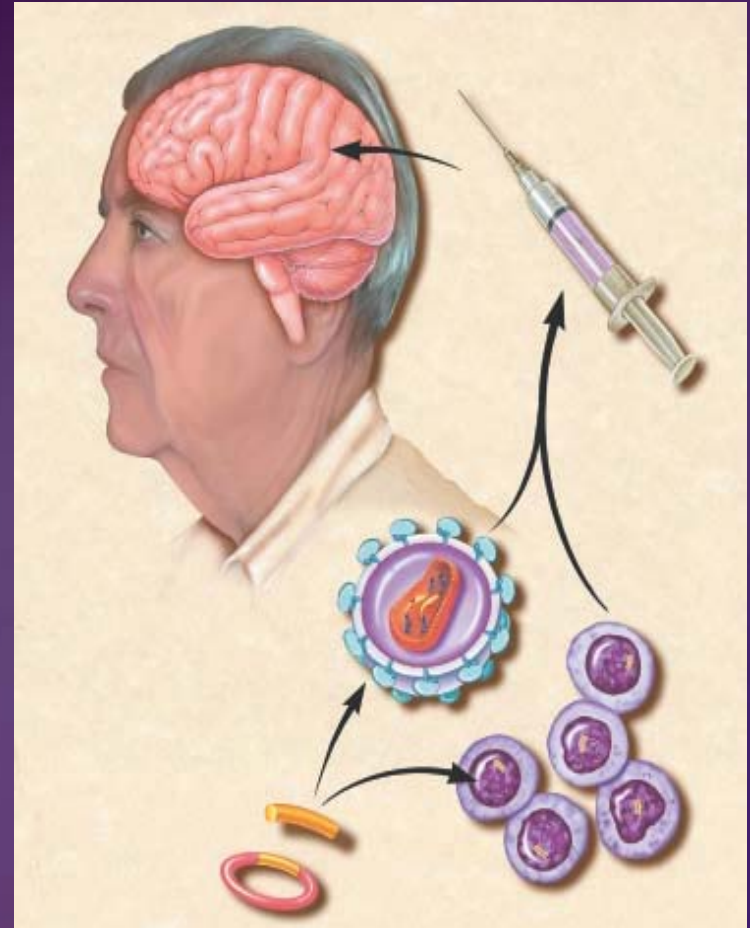
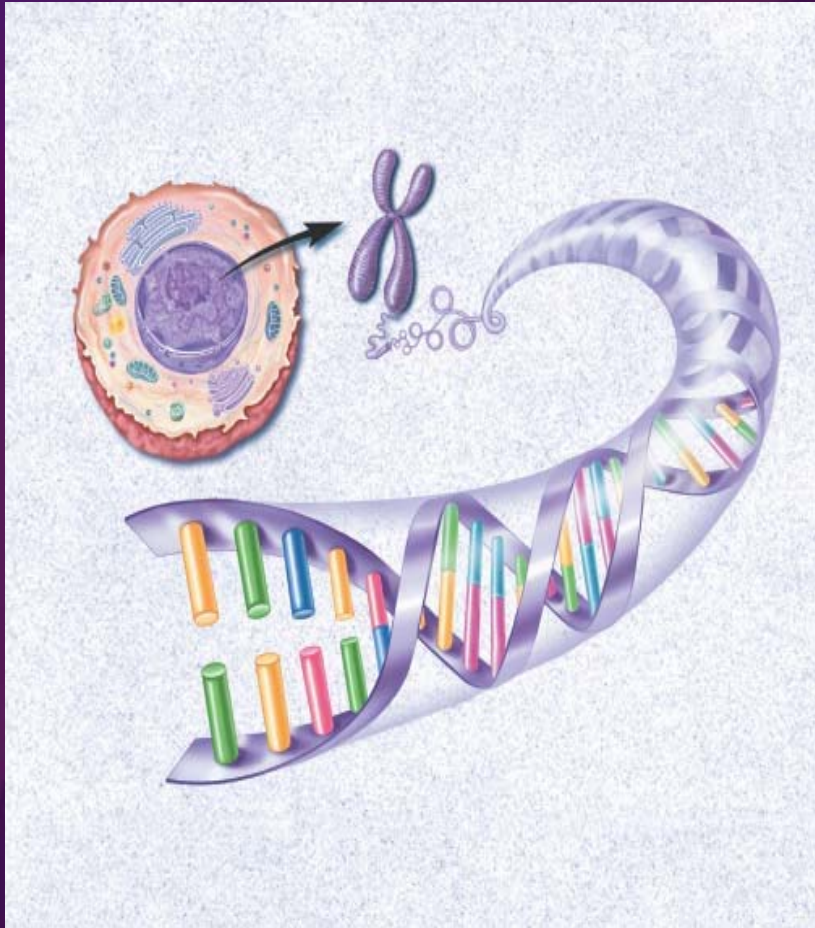
Occupational and Physical Therapy

Neuro Rehabilitation

Closed Head Injury, Spinal Injury, Stroke

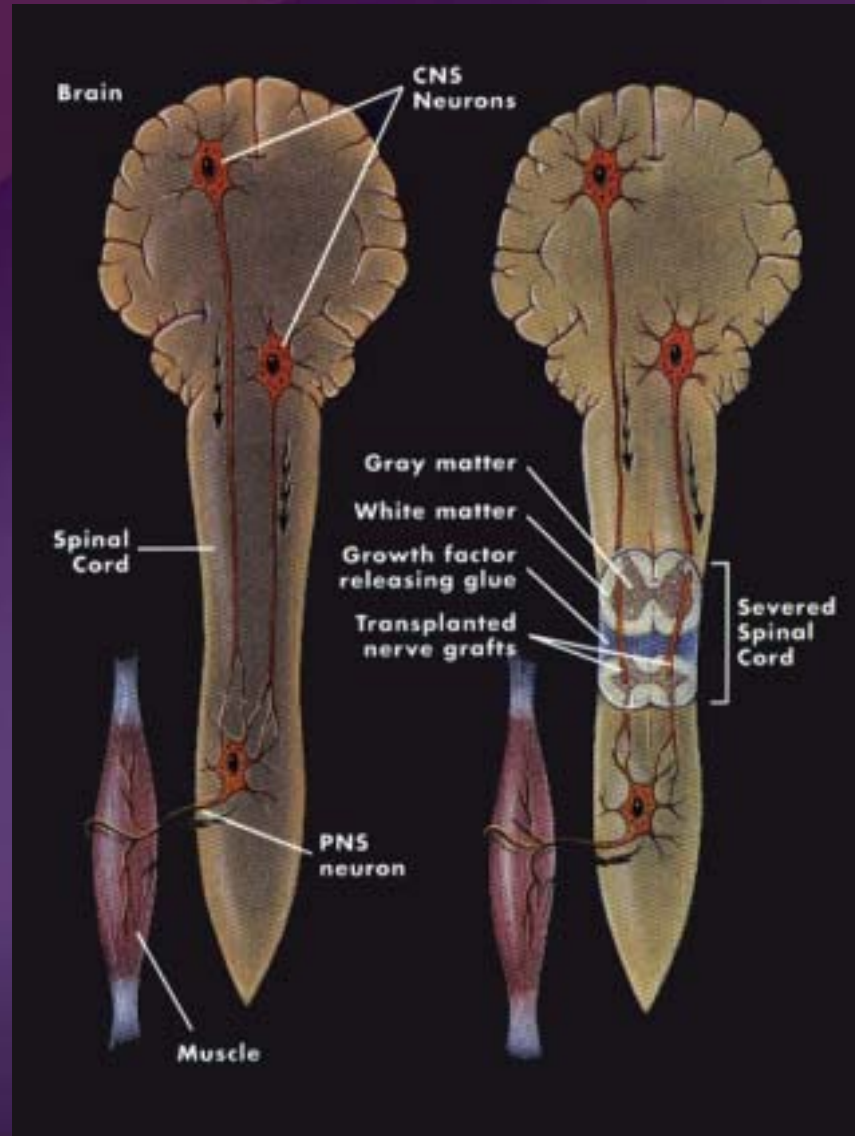
Cognitive Rehabilitation

Conventional Thinking

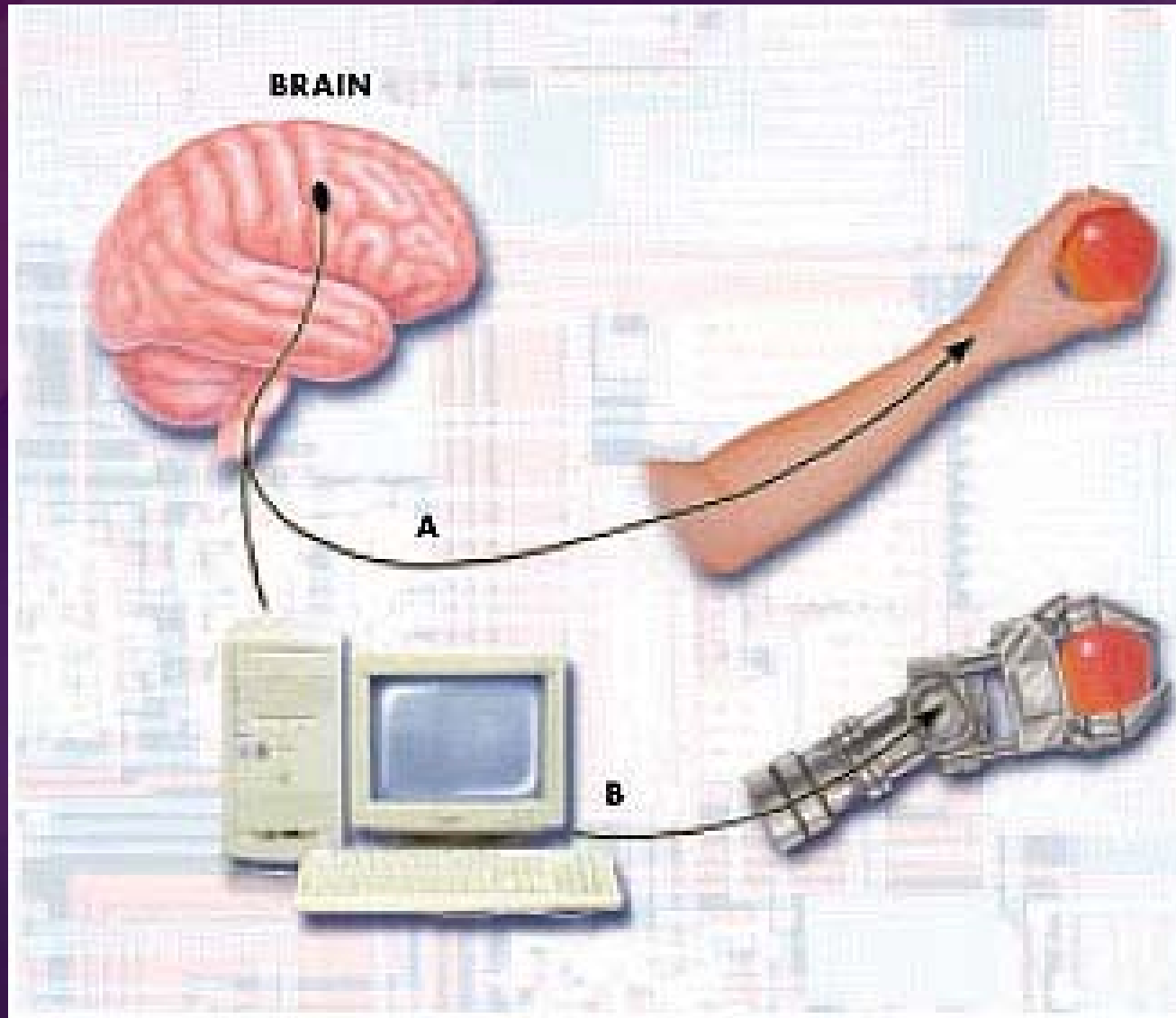


It will be the molecular biologists and pharmaceutical firms that principally solve the difficult problems that we address.

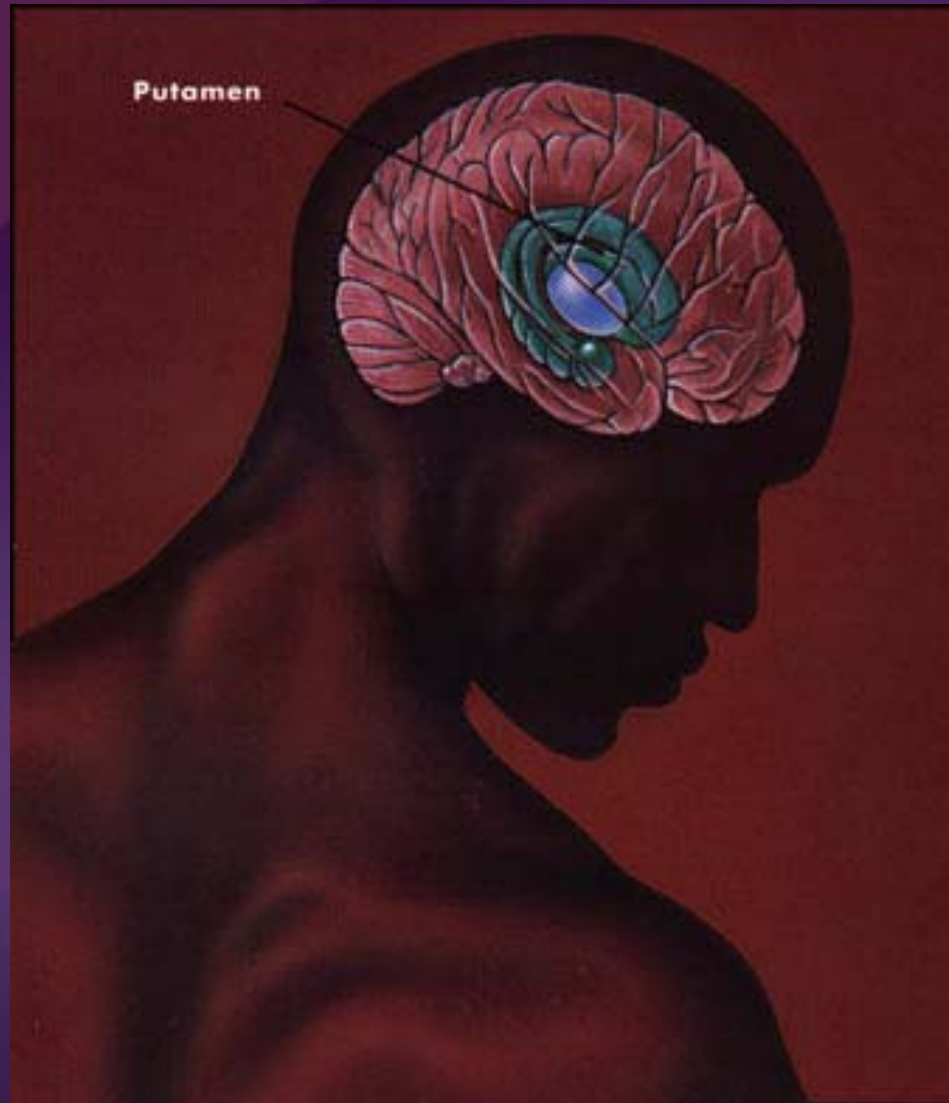
Next Generation Rehabilitation



Next Generation Rehabilitation



Next Generation Rehabilitation



The Challenge

Solutions to complex problems in rehabilitative medicine require retraining of the neuro and neuro-motor system.

We soon will have the tools to repair damage to the brain, but we do not yet have the appropriate systems to do effective retraining.

One approach is to leverage neuroplasticity, using interactive media environments and applying appropriate rehabilitation protocols.



The Importance Of IM Environments for Rehab

Ability to adjust the speed, complexity, and physical difficulty of the world

Ability to provide functional activities

Ability to objectively index improvement

Ability to stair-case progress

Ability to close the feedback loop

Ability to be patient by providing computer assisted rehab

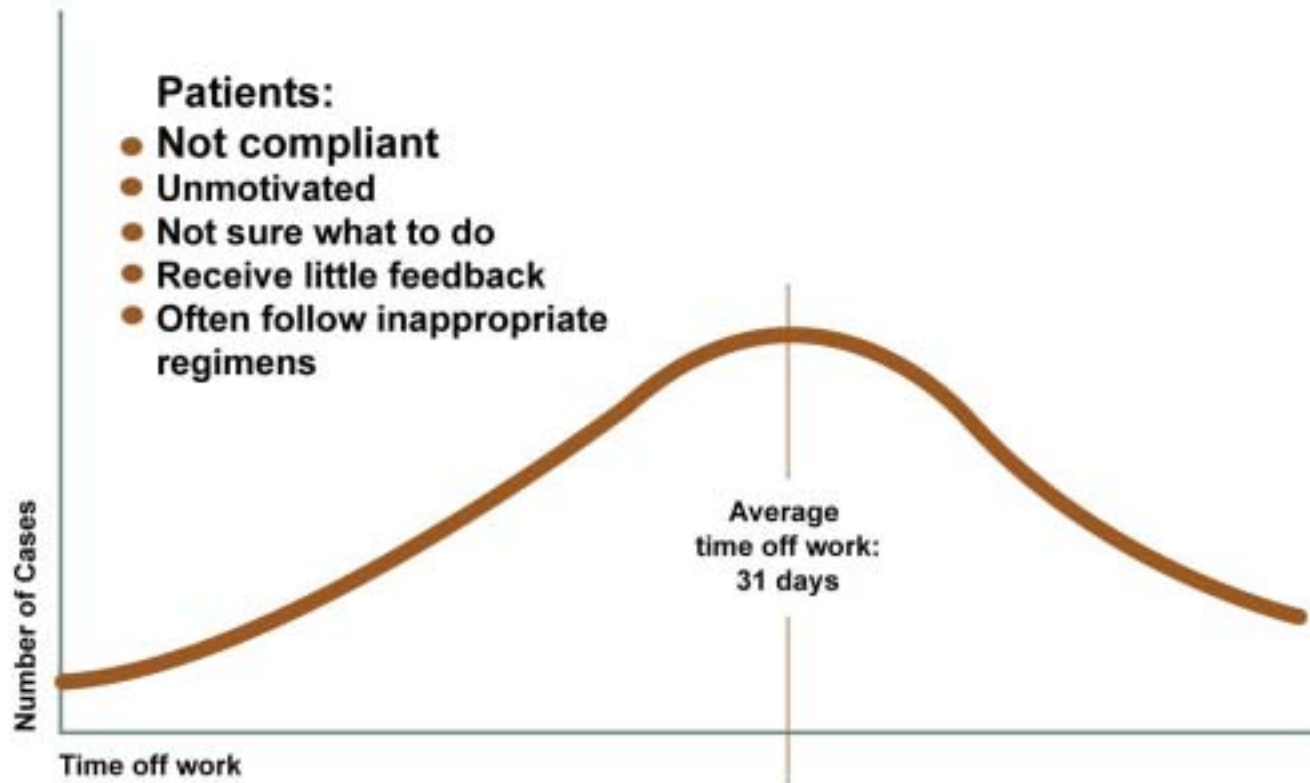
Ability to engage the user cognitively – to make rehabilitation fun, and increase compliance.

Existing Model

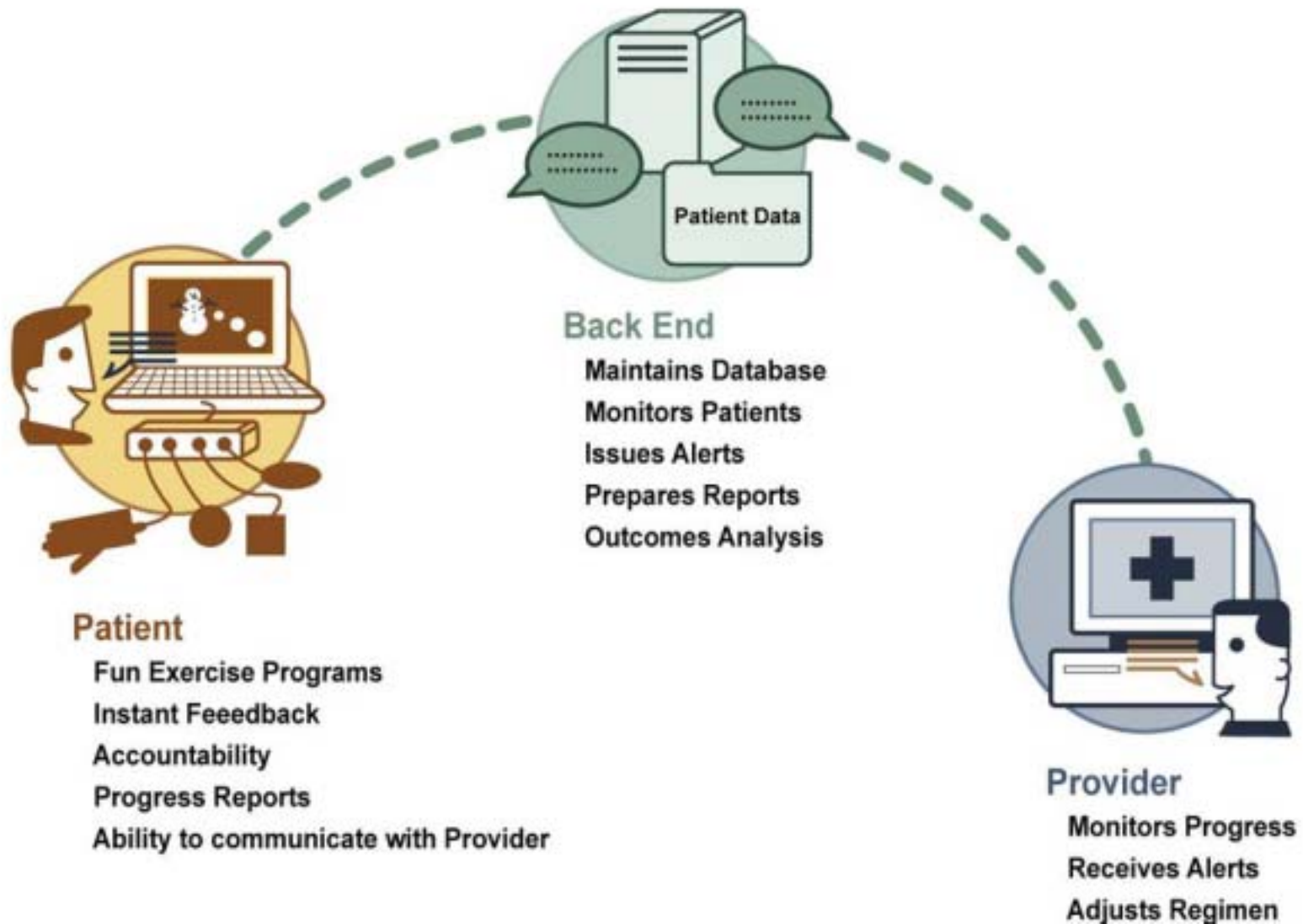
- **Patient is seen by therapist in the clinic**
 - **Given home exercise program**
 - **Xeroxed sheets**
 - **Little-to-no opportunity to contact therapist**
 - **Poor compliance**
 - **Patients come in periodically for treatment / re-evaluation**
 - **Average treatment time 4-8 weeks**



Results of Traditional Rehab



Integrated Telerehabilitation Program



One Solution - computer assisted TeleRehabilitation

Treatment approaches designed to generate optimal recovery:

- Guarded rehabilitation activities
- Graduated short term milestones and goals
- Real-time visual feedback of rehab progress
- Cognitive distracters (from pain, fear, boredom)
- Daily clinical oversight and therapist-provided feedback
- Collaborative Rehabilitation



Daily evaluation of rehabilitation progress

Feedback loop closed

Quantitative and qualitative assessment

Improved *compliance* with home programs

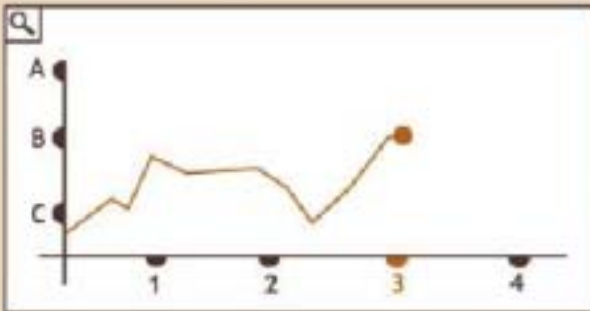


Mary You have EMail from the Chat Group

Please repeat this exercise program 1 time every day: (average time 15 min)

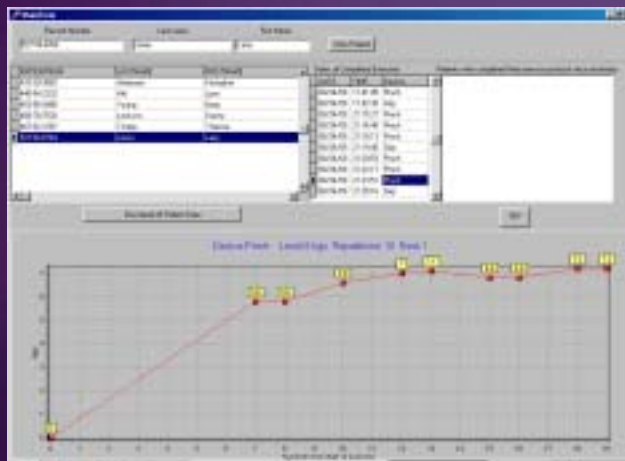
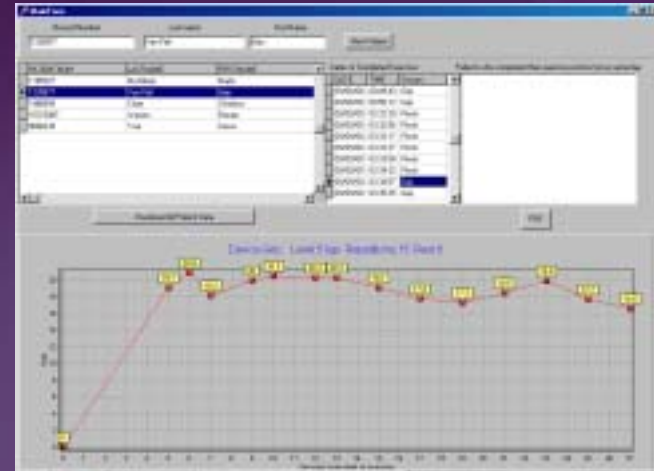
- use the glove with the left index finger and rotate the finger 100 degrees.

move the index finger up and down in a 80 degree range for 10 times.



Patient video	Clinic video	status
		 12.6 lbs

Guarded rehabilitation activities

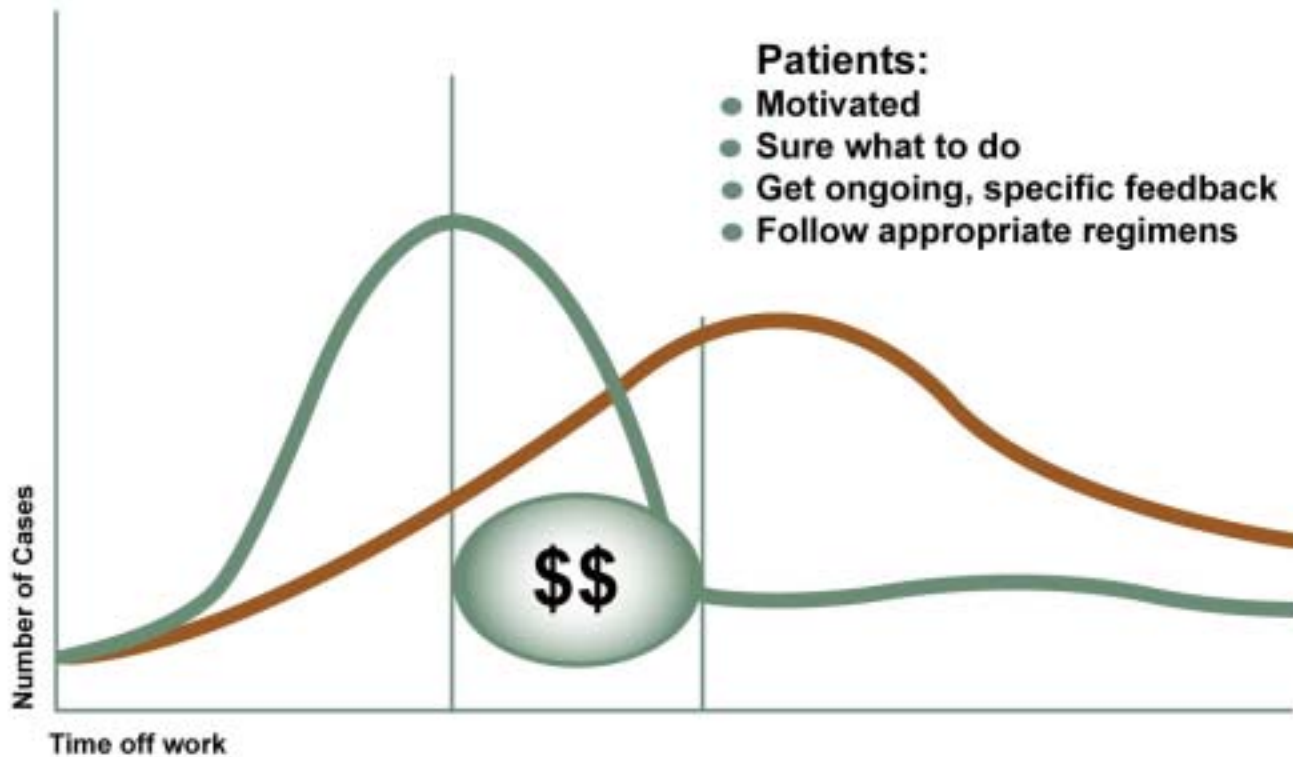


Cognitive Rewards



Distraction from pain, fear.
Removal of boredom.
Increased cognitive attention.

Benefits of Dynamic Rehab



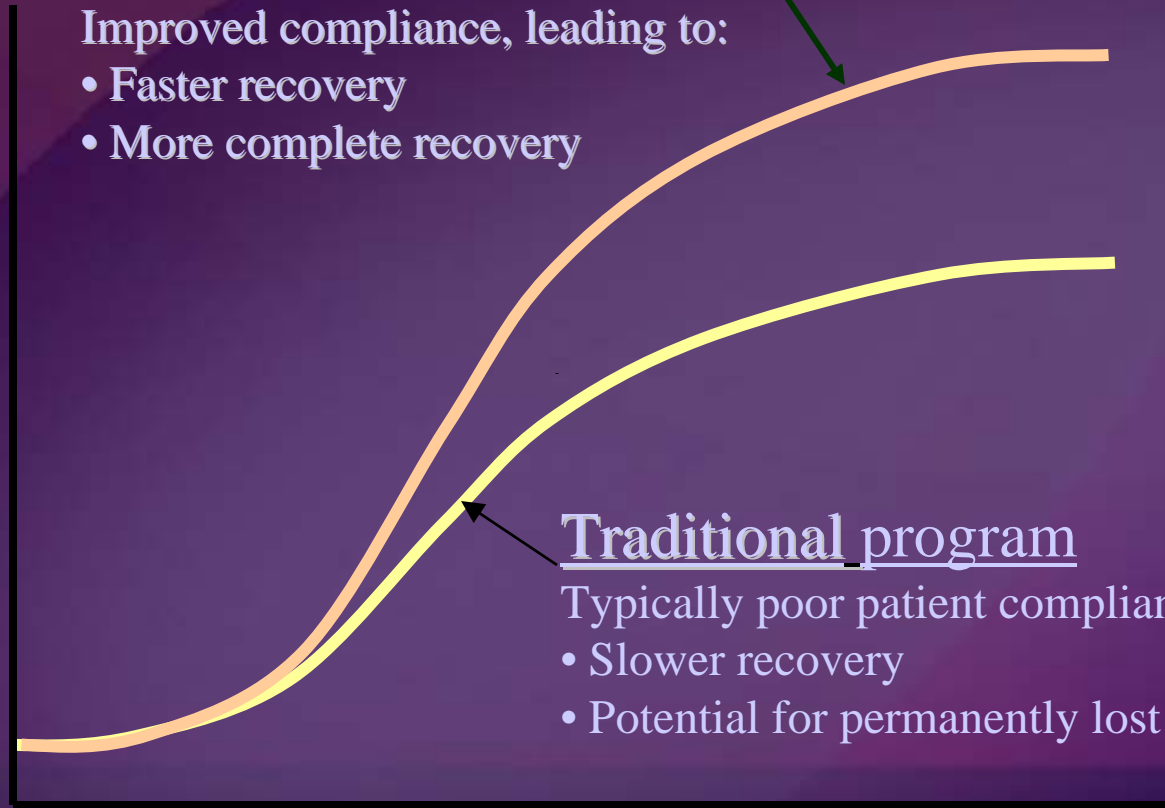
Patient Benefits

Technology-assisted program

Improved compliance, leading to:

- Faster recovery
- More complete recovery

Functional Improvement



Traditional program

Typically poor patient compliance:

- Slower recovery
- Potential for permanently lost function

Time

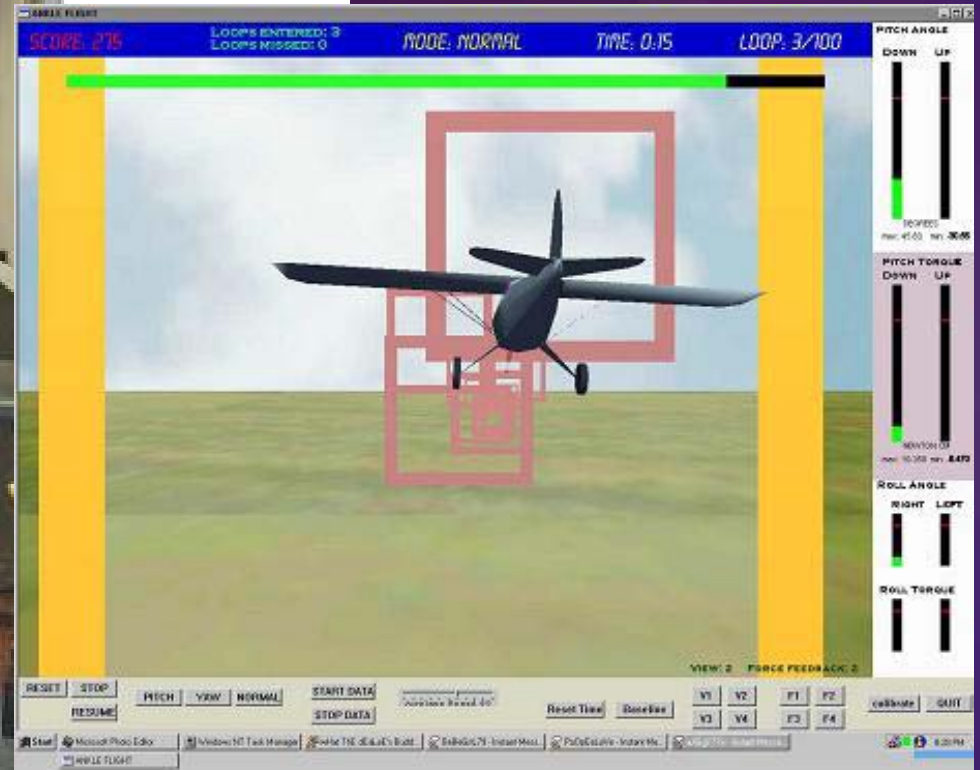


Figure 4. Exercise screen showing the airplane piloted by the patient's ankle

Figure 5. Stroke patient exercising on the Rutgers Ankle system

(Burdea et al.)

Vivid IREX System for OT/PT after Stroke/TBI/SCI (Weiss et al.)



An Electronic Scrapbook for Patients With Progressive Memory Loss, Such As Alzheimer's Disease



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Ability to stair-case progress

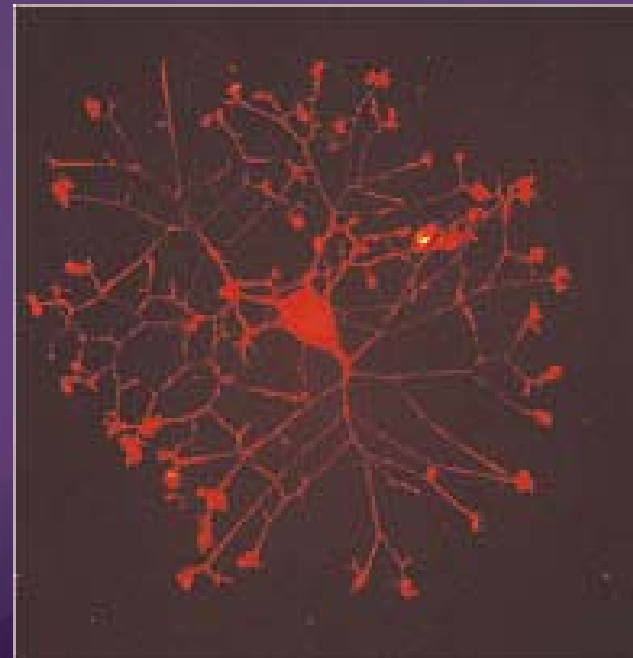
Ability to close the feedback loop

Ability to be patient by providing computer assisted rehab

Ability to engage the user cognitively – to make rehabilitation fun, and increase compliance.

Next Generation Rehabilitation

Recent findings (Merzenich et al) indicate that manipulation of neurotransmitters, combined with intensive rehab, can facilitate the repair of serious cognitive and neuromotor deficits.



Next Generation Rehabilitation

Recent findings (Wolf et al) indicate that with patient cooperation and intense repetition, cortical reorganization can be facilitated.

This has been indexed using transcranial magnetic stimulation and functional MRI.

Progress in rehabilitation will require an integrated approach, involving neuropharmacology, IM environments, and rehabilitative therapy

Technology Can Address The Problem

Occupational and Physical Therapy

Neuro Rehabilitation

Closed Head Injury, Spinal Injury, Stroke

Cognitive Rehabilitation

This Approach Can Be Used Preventively

Preservation of Cognitive Function

Memory

Attention span

Concentration

Reaction time

Visual-spatial learning

Language skills

Preservation of Cognitive Function

Executive functions

inhibition

planning

time perception

internal ordering

working memory

self-monitoring

verbal self-regulation

motor control

regulation of emotion

motivation

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