34° CORSO DI AGGIORNAMENTO
IN MEDICINA FISICA E RIABILITATIVA

MALATTIA DI PARKINSON E PARKINSONISMI IN CLINICA DELLA RIABILITAZIONE

Domotica e addestramento dei caregivers

Alberto Marchet, Torino

Ministero della Salute

DIREZIONE GENERALE DELLA PROGRAMMAZIONE SANITARIA

Piano Nazionale della Cronicità

Accordo tra lo Stato, le Regioni e le Province Autonome di Trento e di Bolzano del 15 settembre 2016

MALATTIA DI PARKINSON E PARKINSONISMI

MACRO ATTIVITA'
- Diagnosi precoce e impostazione terapeutica comprese le terapie complesse(infusive e chirurgiche)
- Interventi collegati alla disabilità
- Mantenimento del buon stato di funzionamento e stadiazione dei bisogni per l'autonomia e il massimo livello di partecipazione sociale

MINISTERO DELLA SALUTE
AGENAS
REGIONE
AZIENDA SANITARIA
ASSOCIAZIONI

OBIETTIVI GENERALI
- Migliorare la conoscenza della dimensione multidisciplinare e della complessità della gestione della patologia e ridurre la disomogeneità degli interventi attuati sul territorio nazionale
- Ridare piena autonomia e stabilità clinica al paziente

OBIETTIVI SPECIFICI
- Migliorare la formazione dei professionisti per una gestione multidisciplinare del paziente
- Promuovere un monitoraggio adeguato delle terapie farmacologiche con una personalizzazione della terapia farmacologica per le differenti esigenze dei singoli con particolare attenzione per le condizioni di fragilità e/o esclusione sociale.
- Favorire la realizzazione di strutture con disponibilità di terapie complesse infusive (apomorfina e duodopa) e chirurgiche (stimolazione cerebrale profonda).
- Promuovere l'adozione di PDTA nazionali condivisi, codificati per ogni fase di malattia, sulla base dei bisogni assistenziali
- Promuovere un trattamento riabilitativo appropriato e personalizzato (Progetto Riabilitativo Individuale).

LINEE DI INTERVENTO PROPOSTE
1. Promuovere la formazione degli operatori delle cure primarie (MMG, infermieri) per indirizzare il sospetto diagnostico.
2. Migliorare la formazione dei professionisti sanitari per la gestione multidisciplinare del paziente.
3. Promuovere interventi per omogeneizzare le indicazioni terapeutiche spesso non aderenti alle linee guida.
4. Applicazione dei percorsi riabilitativi.
5. Avviare indagini conoscitive sui dati epidemiologici regionali e sulla consistenza delle proprie strutture dedicate.
6. Migliorare la conoscenza del numero dei soggetti con Parkinson e parkinsonismi
7. Definire criteri obiettivi (numero di pazienti trattati, disponibilità di risorse per diagnosi e cura, aderenza a linee guida, ecc.) per l'individuazione di strutture ospedaliere e strutture ambulatoriali territoriali dedicate e verificare la rispondenza delle strutture
8. Promuovere la revisione dei criteri di "appropriatezza" del processo terapeutico/riabilitativo (ricoveri trattamenti farmacologici, trattamenti riabilitativi) con particolare attenzione ai momenti di cambiamento sintomatologico e all'aggravamento della disabilità
9. Favorire l'adozione di strumenti di gestione condivisi e accessibili ai differenti livelli dagli operatori della Rete.
10. Favorire la realizzazione di strutture con disponibilità di terapie complesse infusive (apomorfina e duodopa) e chirurgiche (stimolazione cerebrale profonda).

RISULTATI ATTESI
- Diagnosi precoce entro i tempi stabiliti dalle linee guida
- Omogeneità dei percorsi diagnostici, di follow-up e riabilitativi

INDICATORI
- % di pazienti con diagnosi entro i tempi previsti dalle linee guida
- % di pazienti inseriti in un PDTA che assicuri l'aderenza alle linee guida e le risposte ai bisogni complessi dei pazienti

SANITÀ DIGITALE

- SISTEMI INFORMATIVI INTEGRATI
- TELEMEDICINA
- WEB E SALUTE

OBIETTIVO

Promuovere l'impiego di modelli, tecniche e strumenti della sanità digitale nella gestione della cronicità al fine di garantire continuità e migliore qualità dell'assistenza, migliore efficacia, efficienza e appropriatezza

LINEE DI INTERVENTO PROPOSTE

1. sperimentare modelli di assistenza che riescano a coniugare soluzioni tecnologiche con i bisogni di salute del paziente (Teleassistenza domiciliare, Teleconsulto specialistico, telemonitoraggio medicale, Telesorveglianza, Telecontrollo, Telesoccorso, Teleallarme);
2. analizzare modelli, processi e modalità di integrazione dei servizi di telemedicina nella pratica clinica;
3. diffondere nei cittadini, nei pazienti, negli operatori e nelle istituzioni la cultura della telemedicina;
4. potenziare percorsi di formazione e aggiornamento continuo per gli operatori dei servizi di telemedicina;
5. produrre studi di fattibilità e di analisi costo-beneficio e condividere le esperienze in telemedicina.

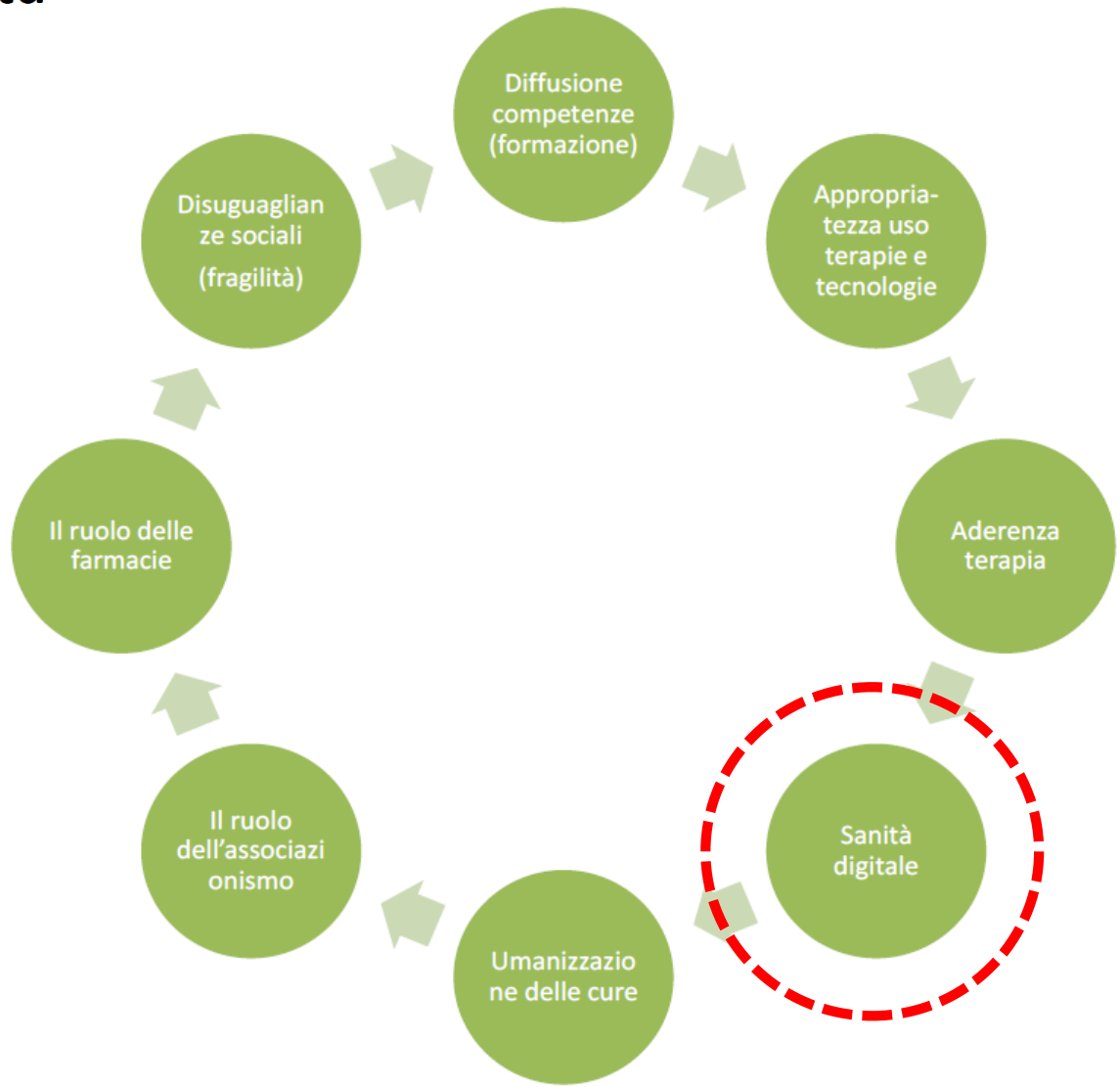
RISULTATI ATTESI
- Implementazione dei servizi di telemedicina;
- Incremento di modelli di assistenza che sappiano coniugare soluzioni tecnologiche con i bisogni di salute del paziente-persona.

OBIETTIVO PROPOSTO

Promuovere l'impiego di modelli, tecniche e strumenti della sanità digitale nella gestione della cronicità al fine di garantire continuità e migliore qualità dell'assistenza, migliore efficacia, efficienza e appropriatezza

Piano Nazionale della Cronicità

Messaggio chiave:
mantenere il più possibile la persona malata al suo domicilio e impedire o comunque ridurre il rischio di istituzionalizzazione



1991

IEEE Trans Biomed Eng. 1991 Mar;38(3):221-9. doi: 10.1109/10.133202.

Methods to assess physical activity with special reference to motion sensors and accelerometers

G A Meijer [1], K R Westerterp, F M Verhoeven, H B Koper, F ten Hoor

Affiliations + expand

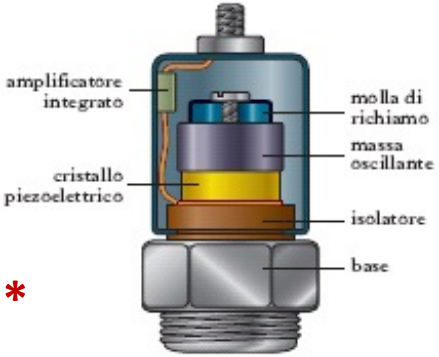
PMID: 2066134 DOI: 10.1109/10.133202

Abstract

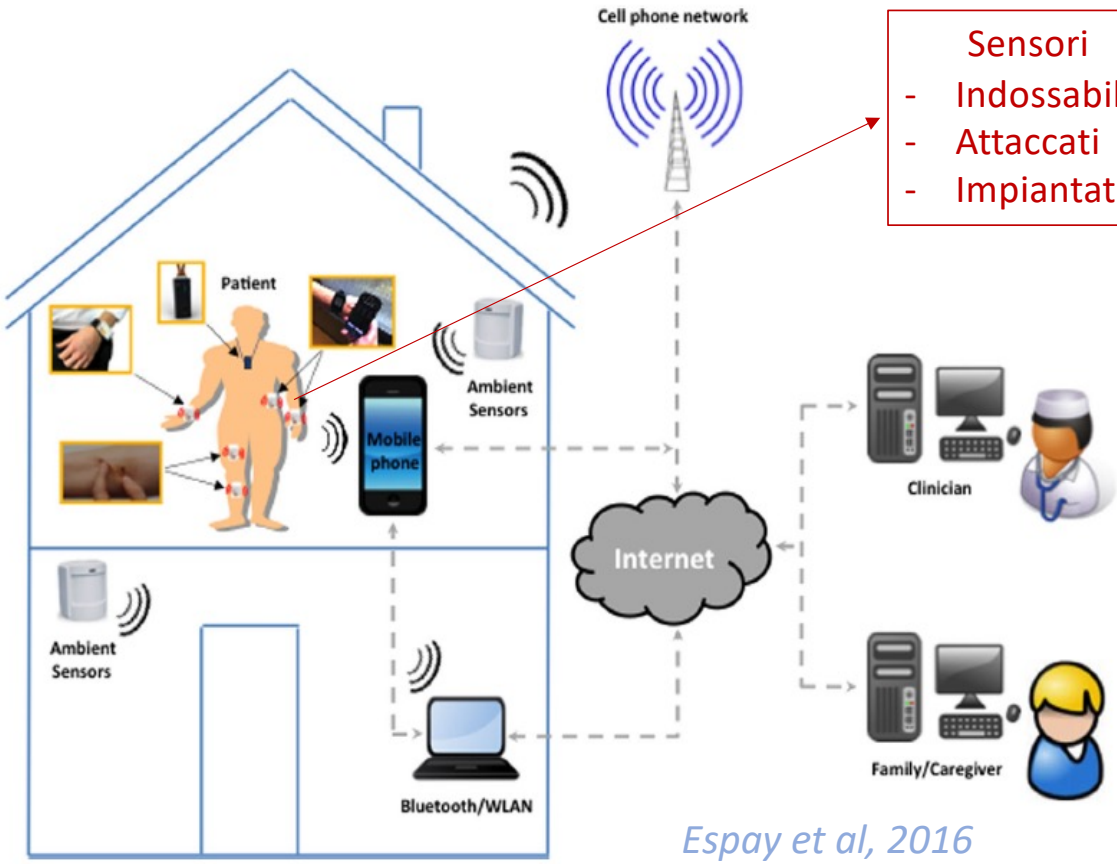
Motion sensors may be applied for the assessment of physical activity. This paper reviews the evolution of these instruments from the mechanical pedometer to the electronic accelerometer. We conclude that for accurate assessment of physical activity under free living conditions the recently introduced accelerometer looks most promising, although little information was available regarding the reliability of these instruments. Subsequently, reliability of an accelerometer with a three-directional sensor was examined. Intrainstrument variation in a bench test was less than 8% during four measurements over a week. Interinstrument variation during treadmill experiments while subjects wore two accelerometers at the same time was on average 22% and was not improved after adjustment for differences found in the bench test. Reproducibility in the treadmill experiment was approximately 76, 85, and 95% at 3, 5, and 7 km/h, respectively. Bench testing revealed that the sensitivity of a piezoelectric element is prone to shifts, probably due to mechanical, electromagnetic, and/or temperature shock, which may be encountered during outdoor application. However, the relevance of the bench test in this study may be questioned, as results did not correspond with the findings in subjects. This needs further investigation.

Sensori inerziali:

ACCELEROMETRO*



GIROSCOPIO*



Espay et al, 2016

**Accelerometro+Giroscopio=Unità di Misura Inerziale (IMU) – informazioni di movimento lineare ed angolare*

2016

ADVANCES IN TECHNOLOGIES FOR PD SERIES: REVIEW

Movement Disorders, Vol. 31, No. 9, 2016

Technology in Parkinson's Disease: Challenges and Opportunities

1. SUPPORTO ALLA DIAGNOSI
2. RISPOSTA ALLA TERAPIA – fluttuazioni e discinesie
3. SINTOMI NON MOTORI
4. TRATTAMENTO MEDICO
5. TRATTAMENTO CHIRURGICO
6. RIABILITAZIONE

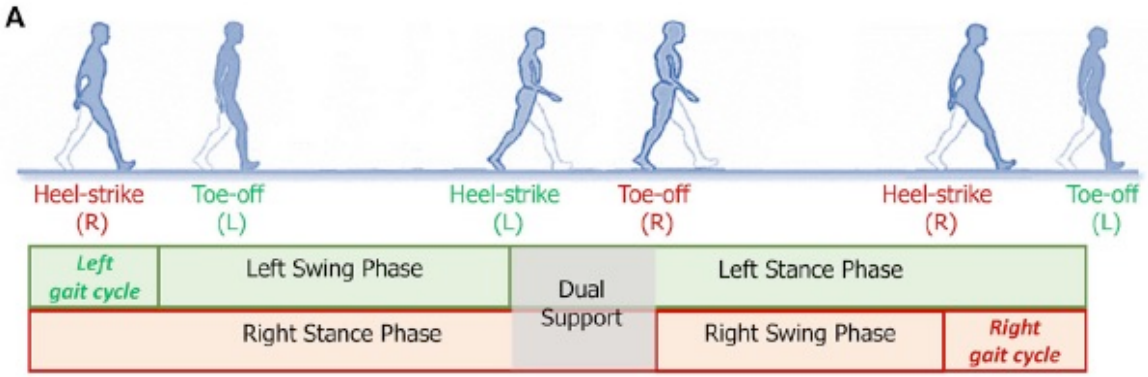
frontiers | Frontiers in Aging Neuroscience

TYPE Review
PUBLISHED 03 August 2022
DOI 10.3389/fnagi.2022.916971

Detection and assessment of Parkinson's disease based on gait analysis: A survey

Yao Guo[1], Jianxin Yang[1], Yuxuan Liu[1], Xun Chen[2]* and Guang-Zhong Yang[1]*

[1]Institute of Medical Robotics, Shanghai Jiao Tong University, Shanghai, China, [2]Department of Electronic Engineering and Information Science, University of Science and Technology of China, Hefei, China



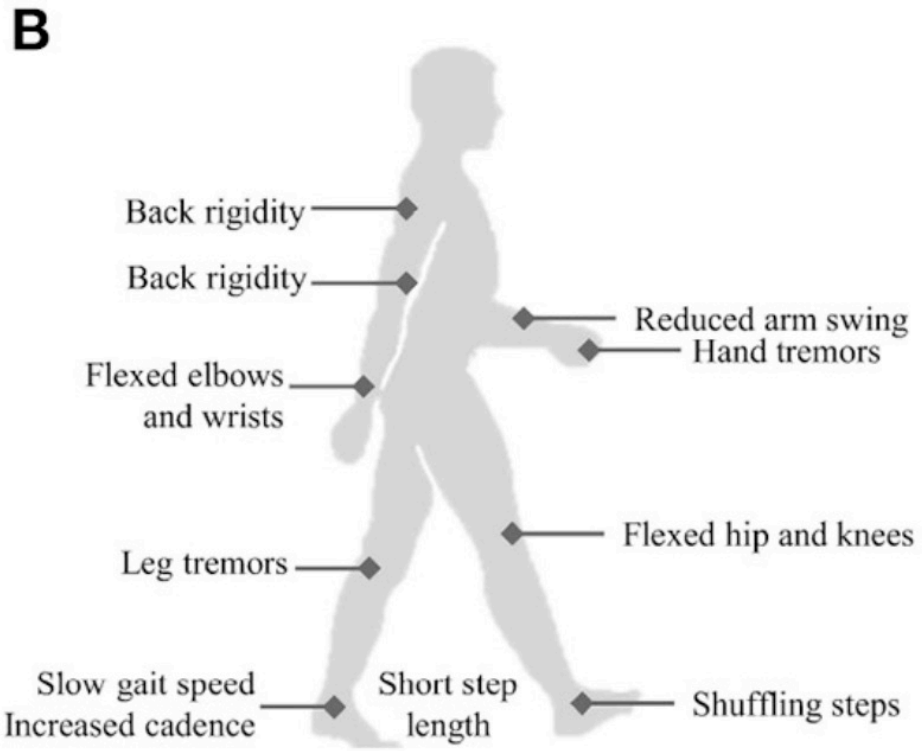
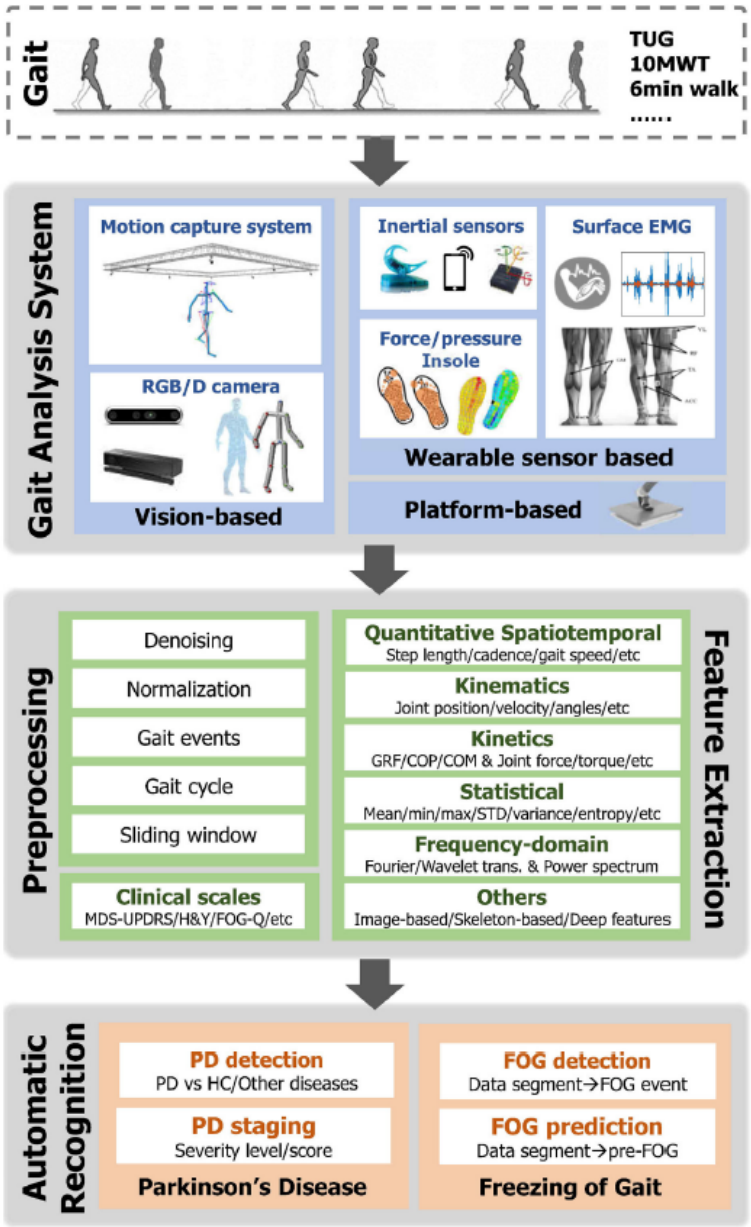


TABLE 1 Typical gait parameters and impairments for PD.

Gait parameters	Indications	Changes with PD
Gait speed	Bradykinesia	Reduced
Step/Stride length	Bradykinesia	Reduced
ROM of lower limb joints	Bradykinesia	Reduced
Cadence	Timing control	Increased
Dual support duration	Timing control	Increased
Initiation	Postural stability and Gait planning	Freezing
Turning	Postural stability and Gait planning	Fragmentation
Gait variability and asymmetry	Postural stability and Gait planning	Increased
Limb coordination	Postural stability and Gait planning	Reduced



	Selected study	Subjects	Data capture	Gait parameters and features	Detection algorithm	Result	Val.
PD Detection	Rehman et al. (2019)	119PD and 184HC	GAITRite	Spatiotemporal	RF	ACC: 97.1%	10-fold
	Ricciardi et al. (2019)	39PD and 7PSP	Mocap system	Spatiotemporal and kinematics	RF	ACC: 86.4%	10-fold
	Park et al. (2021)	77PD and 34HC	Mocap system	Spatiotemporal and kinematics	RF	ACC: 98.1%	5-fold
	Ajay et al. (2018)	16PD and 13HC	Vision-RGB	Spatiotemporal and kinematics	DT	ACC: 93.8%	10-fold
	Guayacán and Martínez (2021)	11PD and 11HC	Vision-RGB	Spatiotemporal saliency maps	3D-CNN	ACC: 94.9%	LOSO
	Caramia et al. (2018)	25PD and 25HC	IMUs×8	Spatiotemporal and kinematics	Ensemble of 6 ML clfs.	ACC: 96.0%	5-fold
	Zhang et al. (2020a)	656PD and 2148HC	IMU (smartphone)	Raw data augmentation	Ensemble of 5 CNNs	AUC: 0.86	5-fold
	Abdulhay et al. (2018)	93PD and 73HC	Force sensors×16 (two feet)	Kinetics: vertical GRF	SVM	ACC: 92.7%	-
	Zhao et al. (2018)				LSTM+CNN	ACC: 98.6%	10-fold
	Xia et al. (2019)				CNN+Attn-BiLSTM	ACC: 99.1%	5-fold
	El et al. (2020)				1D-CNN	ACC: 98.7%	10-fold
	Zeng et al. (2019)				RBF-NN	ACC: 98.8%	LOSO

International Journal of
Environmental Research and Public Health

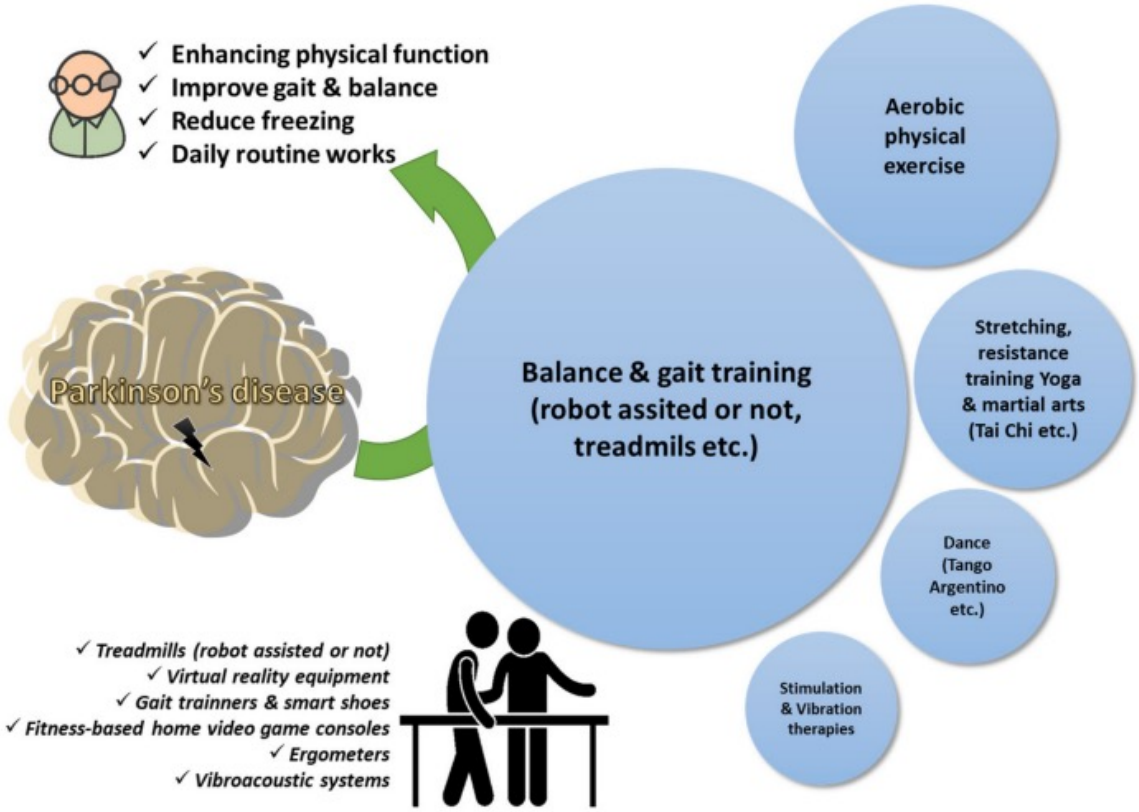
MDPI

Review

A Literature Review of High-Tech Physiotherapy Interventions in the Elderly with Neurological Disorders

Marios Spanakis [1,2,*], Ioanna Xylouri [1], Evridiki Patelarou [1] and Athina Patelarou [1]

Int. J. Environ. Res. Public Health **2022**, *19*, 9233



frontiers in Neuroscience

REVIEW
published: 06 October 2017
doi: 10.3389/fnins.2017.00555

How Wearable Sensors Can Support Parkinson's Disease Diagnosis and Treatment: A Systematic Review

*Erika Rovini[1], Carlo Maremmani[2] and Filippo Cavallo[1]**

[1] *The BioRobotics Institute, Scuola Superiore Sant'Anna, Pontedera, Italy,* [2] *U.O. Neurologia, Ospedale delle Apuane (AUSL Toscana Nord Ovest), Massa, Italy*

2017

Possibili campi di applicazione:

1. **Diagnosi precoce**
2. **Tremore**
3. **Analisi dei movimenti**
4. **Fluttuazioni motorie**
5. **Monitoraggio domiciliare di lunga durata**

DOMOTICA = DOMus + roboTICs

1974: Smart-home di Pierre Sarda

Integrazione di tecnologie e applicazioni pratiche

→ Funzionalità e benessere nell'ambiente domestico
→ Comfort, sicurezza, autonomia
→ Raccolta di dati clinici e intervento terapeutico

Piano Nazionale della Cronicità

«I maggiori vantaggi derivanti dall' uso di sistemi integrati di domotica e ambient-intelligence riguardano un elevato livello di sicurezza e controllo dell'abitazione e possono migliorare in modo davvero significativo la qualità della vita dei malati cronici disabili che, utilizzando le facili interfacce rese disponibili dai sistemi intelligenti, riescono a gestire la propria abitazione e le apparecchiature presenti in un modo che non sarebbe diversamente possibile»

Journal of Parkinson's Disease 11 (2021) S55–S63
DOI 10.3233/JPD-202398
IOS Press

Review

Domotics, Smart Homes, and Parkinson's Disease

Cristina Simonet[a] and Alastair J. Noyce[a,b,*]
[a]*Preventive Neurology Unit, Wolfson Institute of Preventive Medicine, Queen Mary University of London, London, UK*
[b]*Department of Clinical and Movement Neurosciences, Institute of Neurology, University College London, London, UK*

Abstract. Technology has an increasing presence and role in the management of Parkinson's disease. Whether embraced or rebuffed by patients and clinicians, this is an undoubtedly growing area. Wearable sensors have received most of the attention so far. This review will focus on technology integrated into the home setting; from fixed sensors to automated appliances, which are able to capture information and have the potential to respond in an unsupervised manner. Domotics also have the potential to provide 'real world' context to kinematic data and therapeutic opportunities to tackle challenging motor and non-motor symptoms. Together with wearable technology, domotics have the ability to gather long-term data and record discrete events, changing the model of the cross-sectional outpatient assessment. As clinicians, our ultimate goal is to maximise quality of life, promote autonomy, and personalise care. In these respects, domotics may play an essential role in the coming years.

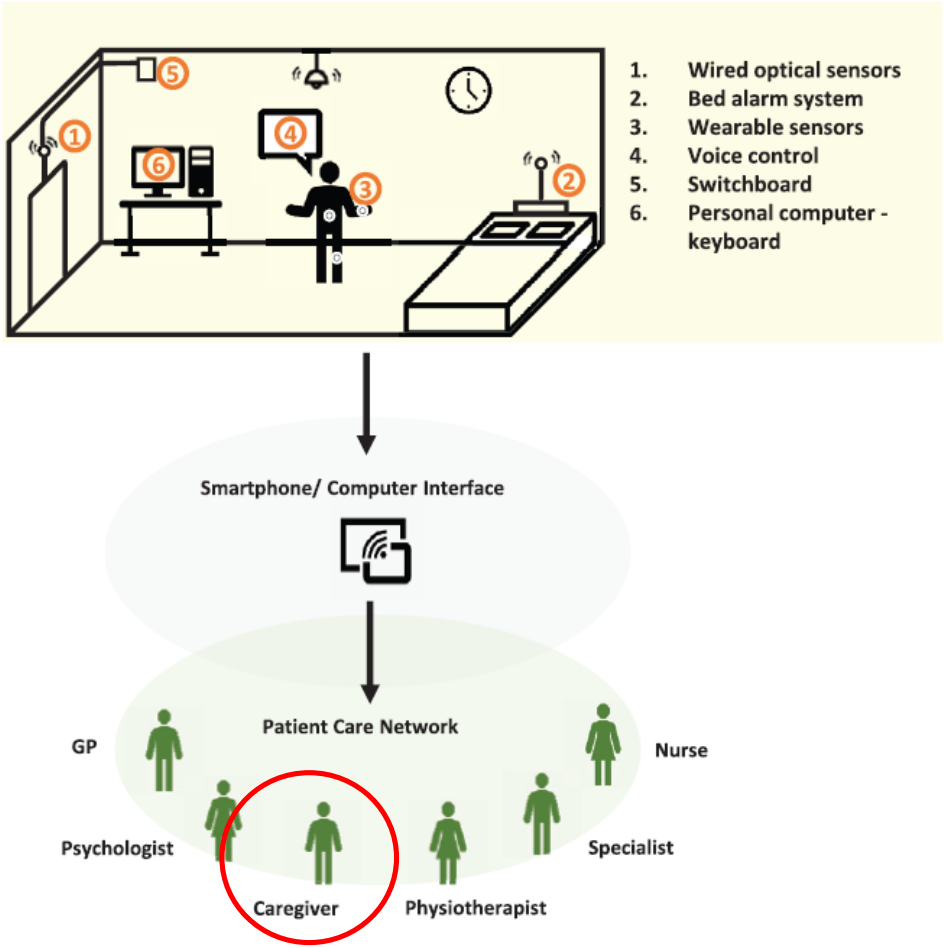
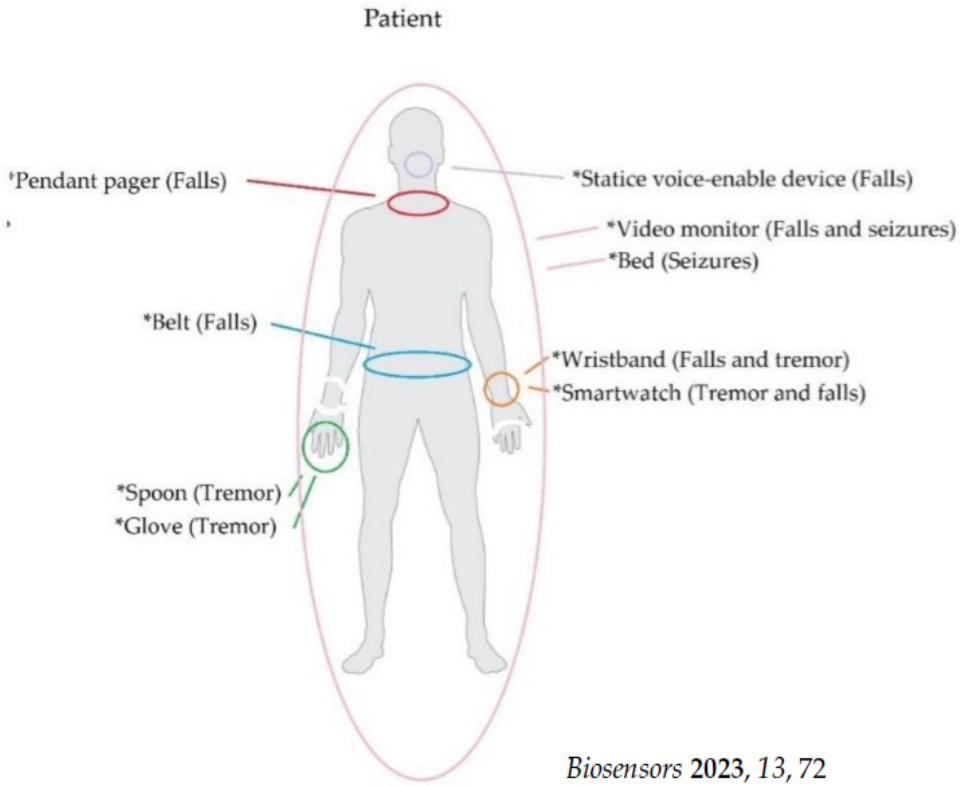
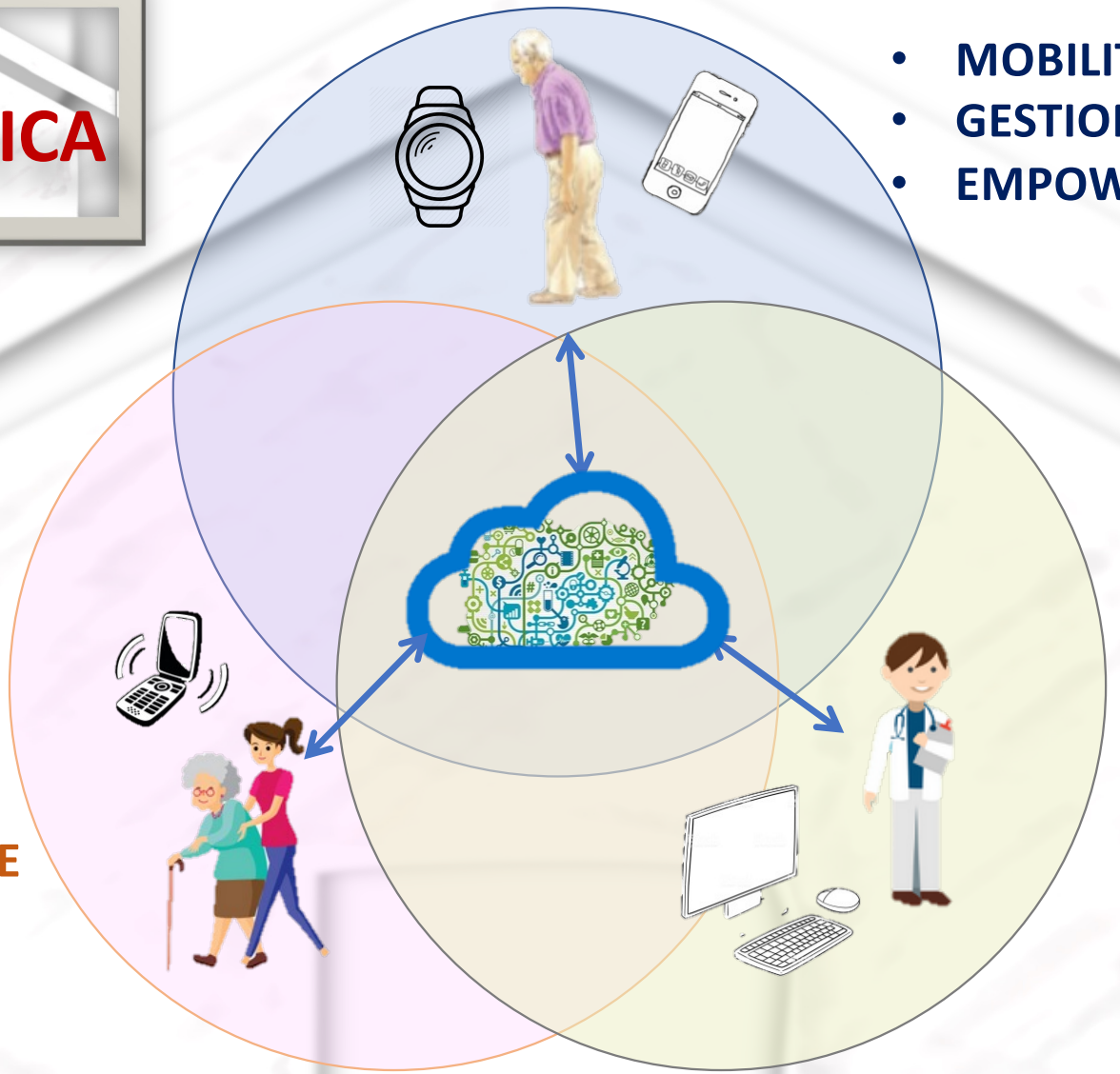


Fig. 1. Multi-sensor system integrated at home connecting people with PD with their health-care network. 1) Wired optical sensors able to detect patient interaction with home environment and request switchboard access to emergency contacts. 2) Bed alarm system connected to a pressure sensor able to detect vigorous movements during sleep (RBD), time spent in bed (apathy/depression), or wandering at night. 3) Wearable sensors interconnected with (1), (2), (5), and (6). 4) Voice control to home appliances. 5) Switchboard when fall is detected by (1) or voice operated (4). 6) Patient interaction with computer: typing (bradykinesia) and internet browsing or shopping (ICD).



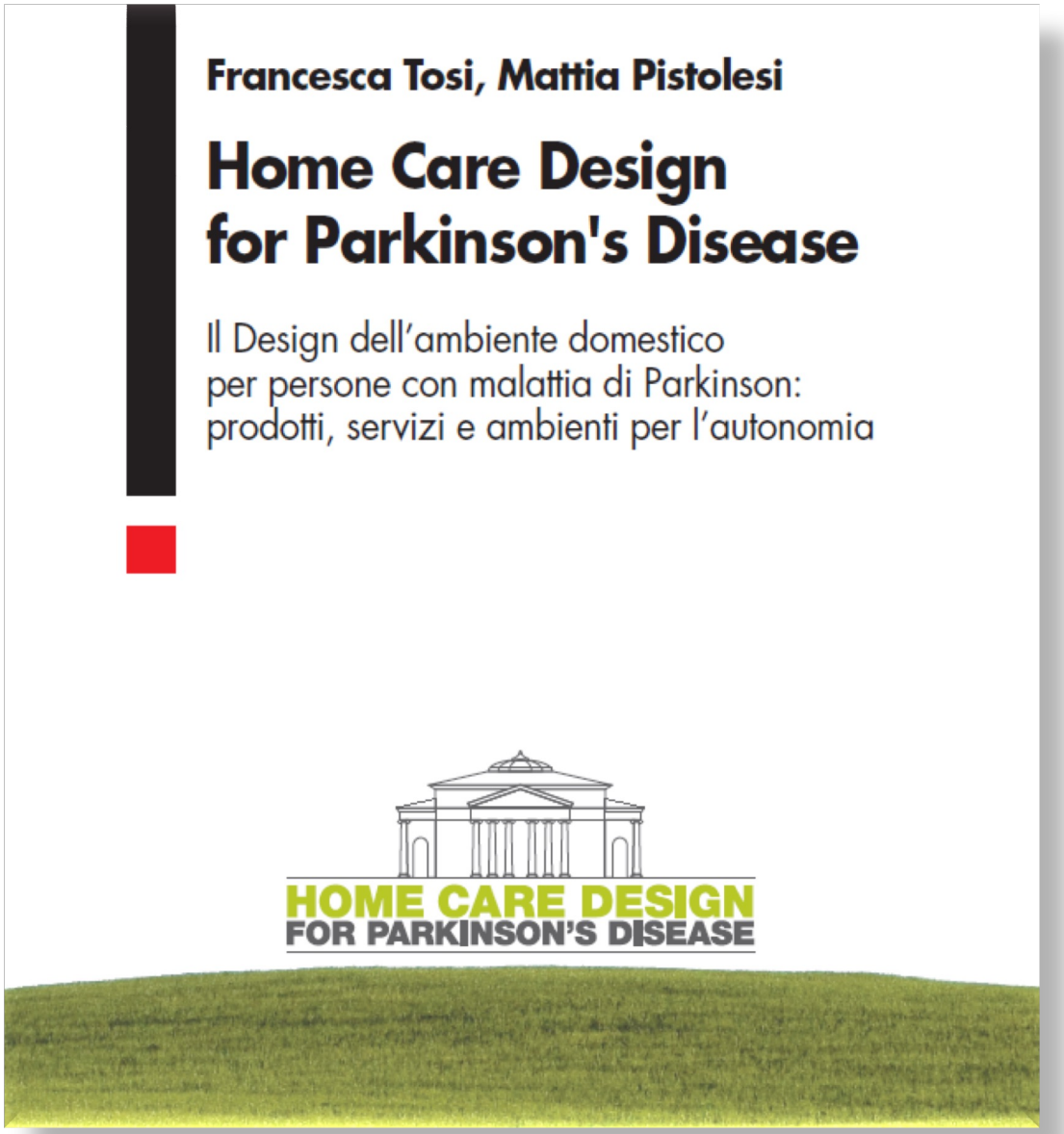
DOMOTICA

- MOBILITÀ
- GESTIONE TERAPIA
- EMPOWERMENT



- CONTATTI
- PREVENZIONE
- SICUREZZA
- AUTONOMIA

- DIAGNOSI
- ON/OFF
- MONIT. TERAPIA
- RIABILITAZIONE
- SINTOMI NON-MOTORI


Francesca Tosi, Mattia Pistolesi
Home Care Design
for Parkinson's Disease
Il Design dell'ambiente domestico
per persone con malattia di Parkinson:
prodotti, servizi e ambienti per l'autonomia
HOME CARE DESIGN
FOR PARKINSON'S DISEASE

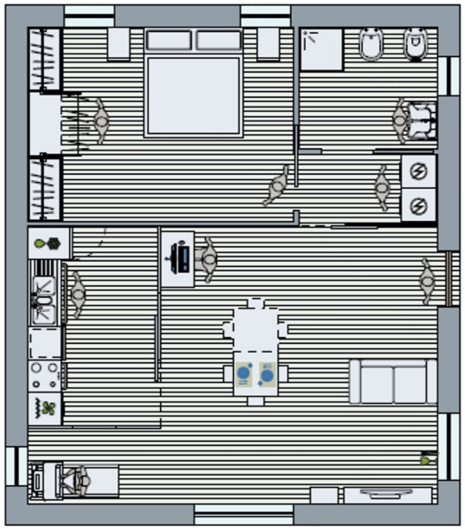
2022

 ISBN 9788835139195

Ipotesi: abitazione per 2 persone

Dimensioni
7.40m X 8.60m = **63.64mq**

Livello di sintomatologia **LIEVE**



Planimetria 2D | Scheda **13.02**

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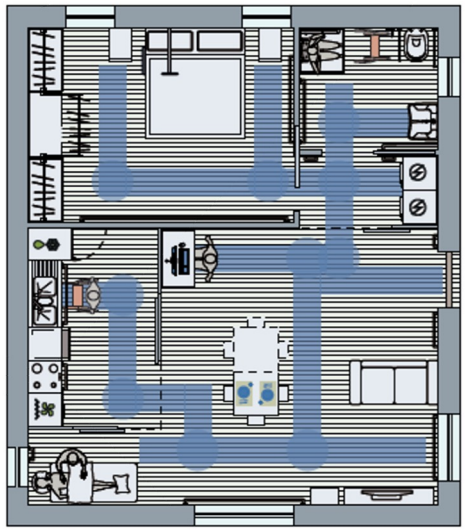
Ipotesi: abitazione per 2 persone

Dimensioni
7.40m X 8.60m = **63.64mq**

Livello di sintomatologia **MODERATO**

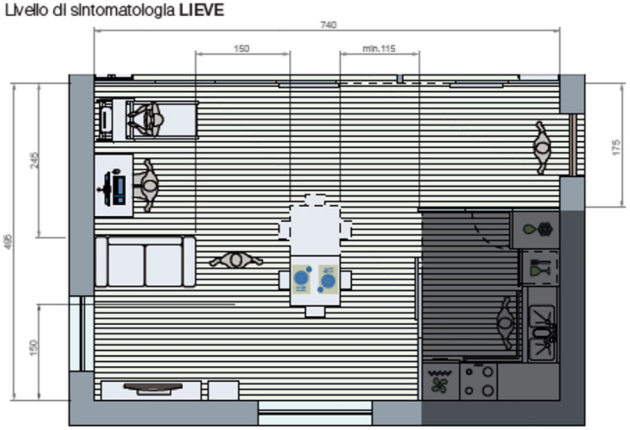


Planimetria 2D | Scheda **13.02**

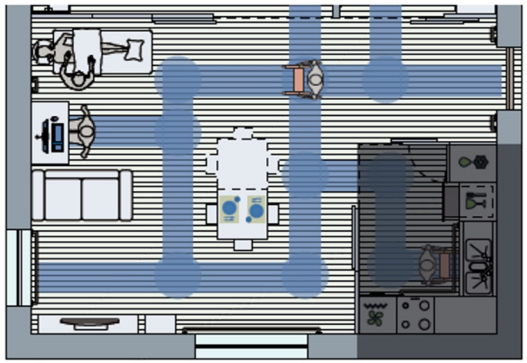
Soggiorno

Dimensioni
circa 37.00 mq.

Livello di sintomatologia **LIEVE**



Livello di sintomatologia **MODERATO**



Planimetria 2D | Scheda **5.03**

Soggiorno

Dimensioni
circa 37.00 mq.

Livello di sintomatologia **GRAVE**

NOTA:
Il soggiorno può essere utilizzato come zona pranzo, zona relax e zona per il telelavoro/attività fisica/riabilitazione.

Livello di sintomatologia **LIEVE:**
Questo spazio è stato pensato per poter svolgere, contemporaneamente, 2 attività, come il telelavoro e l'attività fisica.

Livello di sintomatologia **MODERATA:**
Questo spazio è stato pensato per poter svolgere, contemporaneamente, 2 attività, come il telelavoro e la riabilitazione.

Livello di sintomatologia **GRAVE:**
Questo spazio è stato pensato per poter svolgere la riabilitazione.

A qualsiasi livello di sintomatologia della mP, sarà comunque a discrezione della PcP scegliere come organizzare e utilizzare lo spazio ausiliario.

Planimetria 2D | Scheda **5.03**

Sistemi di gestione e controllo

Domo Connexa (Cisa spa) (In alto), https://www.cisa.com/it/prodotti/serrature/smart-lock/-domo-connexa-smart-door-porte-blindate.html.
Emotiv Insight Brainware, dispositivo in grado di gestire alcuni dispositivi elettronici della casa attraverso comandi cerebrali, vocali e oculari (Royal Philips e Accenture) (In basso), www.emotiv.com/insight/.

Riferimenti: Accessori | Scheda **10**

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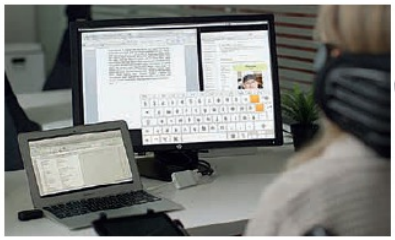
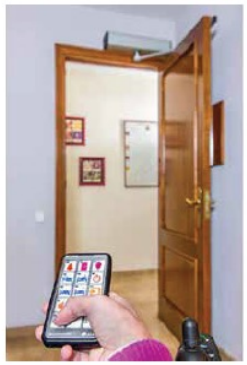
Sistemi di gestione e controllo





Sensore a soffio Quha Pufo Puff (Quha) (In alto), www.quha.com/products-2/quha-pufo/.
BJ Control Pro (Helpicare), telecomando universale domotico in grado di accogliere massimo 81 funzioni, tra cui gestire e controllare porte e finestre, e TV (In basso a sinistra), https://www.helpicare.com/prodotto/bj-control-pro/.
Telecomando universale BJ Control Pro (Leonardo Ausili) (In basso a destra), www.leonardoausili.com/controllo-ambiente/220-bj-control-pro-controllo-ambientale-personalizzato-con-scansione.html.

Riferimenti: Accessori | Scheda **10**

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Sistemi di gestione e controllo

Cintura comprensiva di airbag con attivazione automatica Hip'Safe (Helite Italia) (In alto), www.italia.helite.com/anziani/.
STAT-ON HOLTER dispositivo indossabile per il rilevamento delle cadute (Sense4Care) (In basso), www.sense4care.com/parkinson-disease-2/.

Riferimenti: Accessori | Scheda **10**

PIEMONTE

FONDI STRUTTURALI E DI INVESTIMENTO EUROPEI 2014/2020

fondo europeo sviluppo regionale

Senior Care

PROGETTO SENIOR CARE

UNIONE EUROPEA

REGIONE PIEMONTE

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www.regione.piemonte.it/europa2020

INIZIATIVA CO-FINANZIATA CON FESR

Apprendimento delle abitudini: il pattern abituale

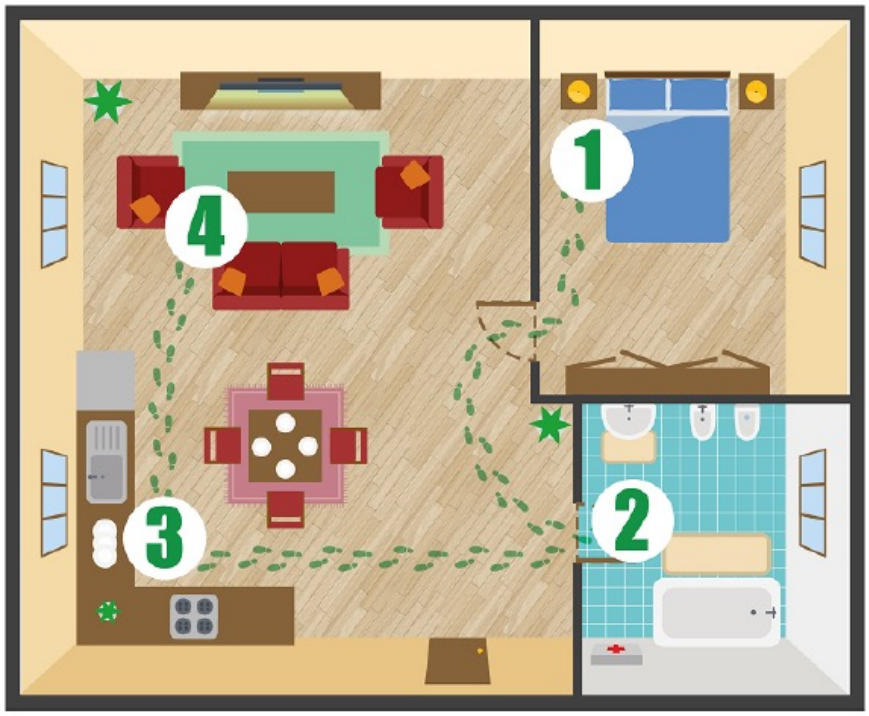
Situazione di Normalità

ASSISTENZA

APPLICAZIONE

MAIL – SMS

PATTERN RISPETTATO



Pattern anomalo: Attenzione

ASSISTENZA

APPLICAZIONE

MAIL - SMS

ATTENZIONE

Parametri anomali: Attenzione

ASSISTENZA

APPLICAZIONE

MAIL – SMS

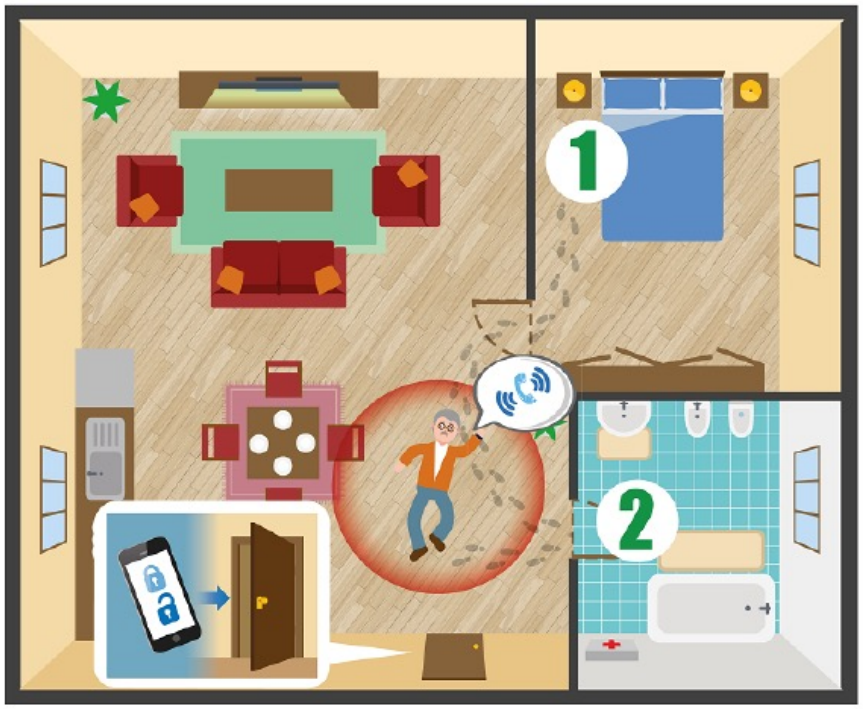
Persona a terra: Emergenza

ASSISTENZA

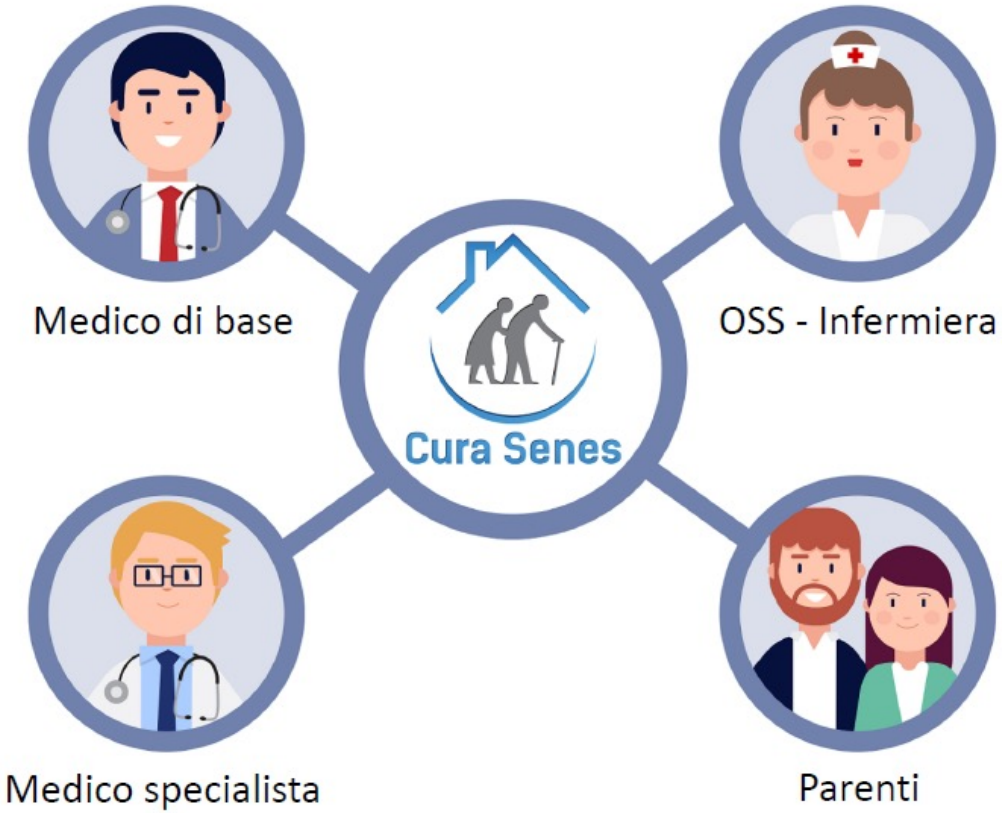
APPLICAZIONE

MAIL – SMS

EMERGENZA



Gli interlocutori di Cura Senes



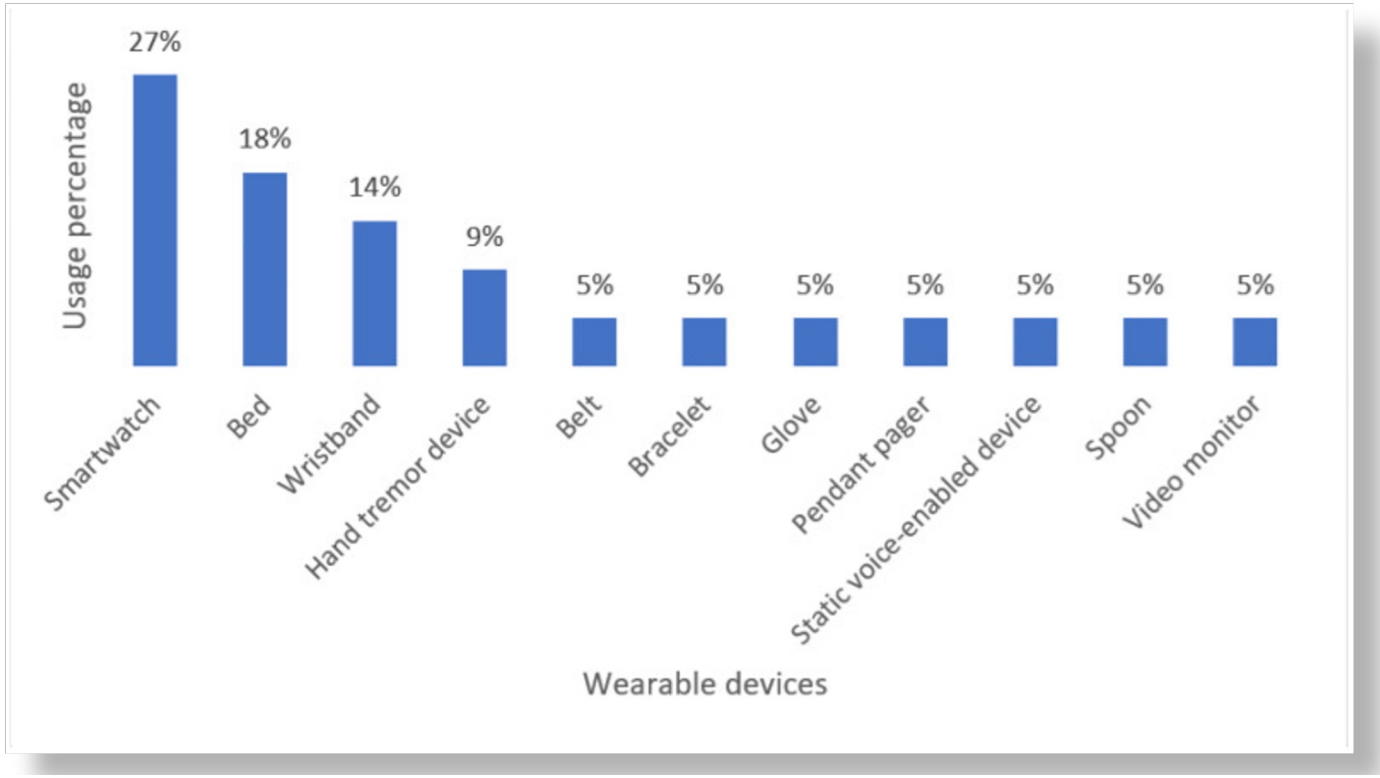
APPLICAZIONI: SINTOMI MOTORI

- Sensori indossabili, hardware domestici, sensori ambientali e video
- Controllo vocale
- Dispositivi «smart»
- Rilevazione delle cadute
- Identificazione delle fasi off e del freezing della marcia
- Realtà virtuale e gaming per la riabilitazione

Review > Biosensors (Basel). 2022 Dec 31;13(1):72. doi: 10.3390/bios13010072.

A Review of Commercial and Non-Commercial Wearables Devices for Monitoring Motor Impairments Caused by Neurodegenerative Diseases

Guillermo Prieto-Avalos [1], Laura Nely Sánchez-Morales [2], Giner Alor-Hernández [1], José Luis Sánchez-Cervantes [2]



IEEE Trans Neural Syst Rehabil Eng. 2023 ; 31: 456–463. doi:10.1109/TNSRE.2022.3226368.

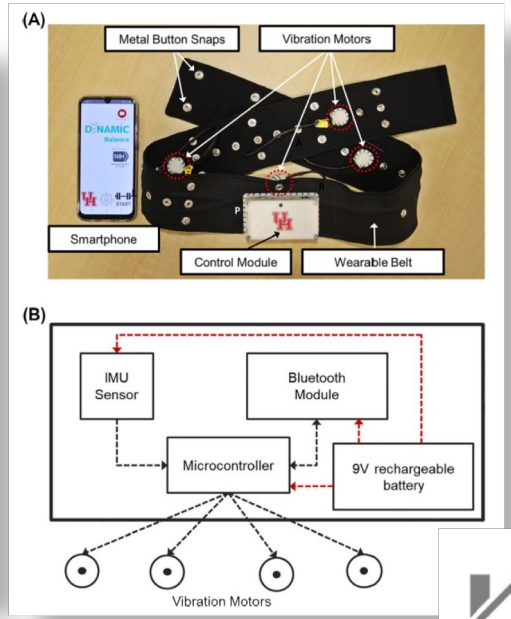
Performing Dynamic Weight-Shifting Balance Exercises With a Smartphone-Based Wearable Telerehabilitation System for Home Use by Individuals With Parkinson's Disease: A Proof-of-Concept Study

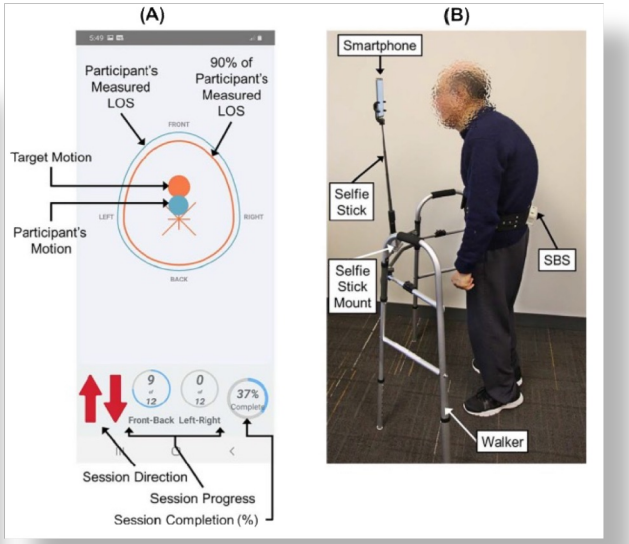
Beom-Chan Lee [Member IEEE],
Department of Health and Human Performance, University of Houston, Houston, TX 77204 USA

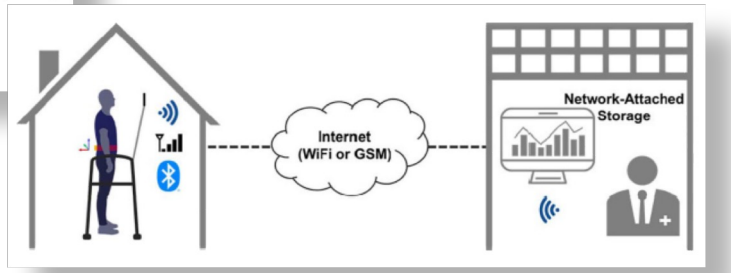
Junmo An [Member IEEE],
Department of Health and Human Performance, University of Houston, Houston, TX 77204 USA

Jiyeon Kim,
Department of Health and Human Performance, University of Houston, Houston, TX 77204 USA

Eugene C. Lai
Department of Neurology, Houston Methodist Neurological Institute, Houston, TX 77030 USA







Most people with PD benefit from daily (once a week at a minimum) exercises. Smartphone telerehabilitation systems with built-in biofeedback guidance as described in this proof-of-concept study will be advantageous both for the exercisers and their off-site therapists.

SENSE4CARE

REAL-TIME MONITORING AND REPORTING:

- Bradykinesia Index based on fluidity movements.
- Dyskinesia
- Freezing of Gait
- On and Off states
- Gait Parameters (speed of stride, cadence, time walking, step length, number of steps).
- Number of falls
- Energy expenditure and postures.

PARKINSON'S DISEASE HOLTER

Personalised and long-term monitoring device

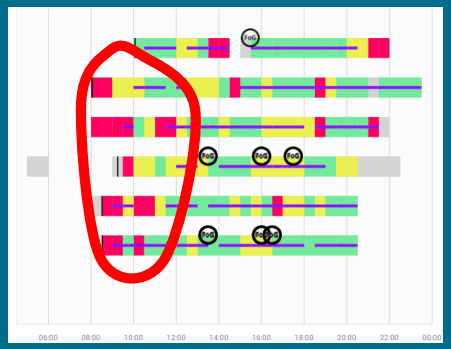
STAT·ON

AUTOMATIC GENERATION OF REPORTS

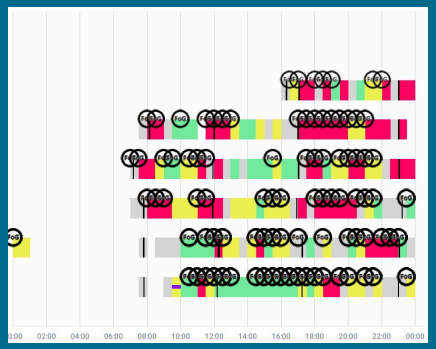
ON-OFF STATES		DYSKINESIA		BRADYKINESIA		FREEZING OF GAIT	
SENSITIVITY	SPECIFICITY	SENSITIVITY	SPECIFICITY	SENSITIVITY	SPECIFICITY	SENSITIVITY	SPECIFICITY
92%	94%	93%	95%	88%	81%	85%	85%

Wearing- OFF
Effetto di “fine dose”

Prime fluttuazioni-
mattina in OFF

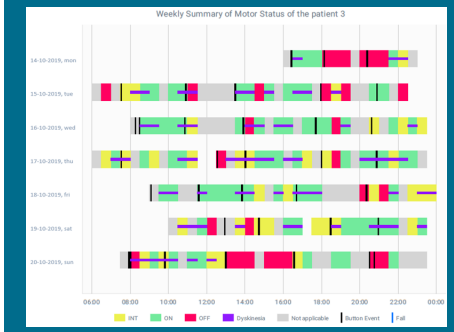


Freezing of gait e cadute



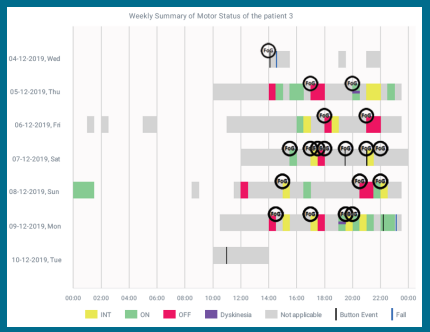
Individuazione di sintomi
avanzati

Primo rilevamento della
discinesia

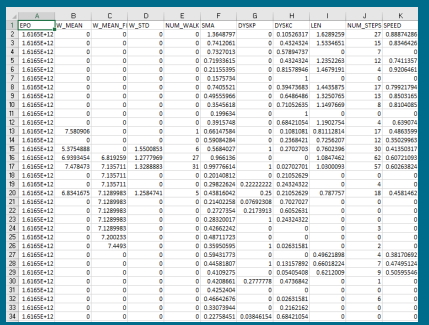


Verificare la gravità delle fluttuazioni

Problemi di sedentarietà



Studi clinici



pdmonitor®

scan to learn more

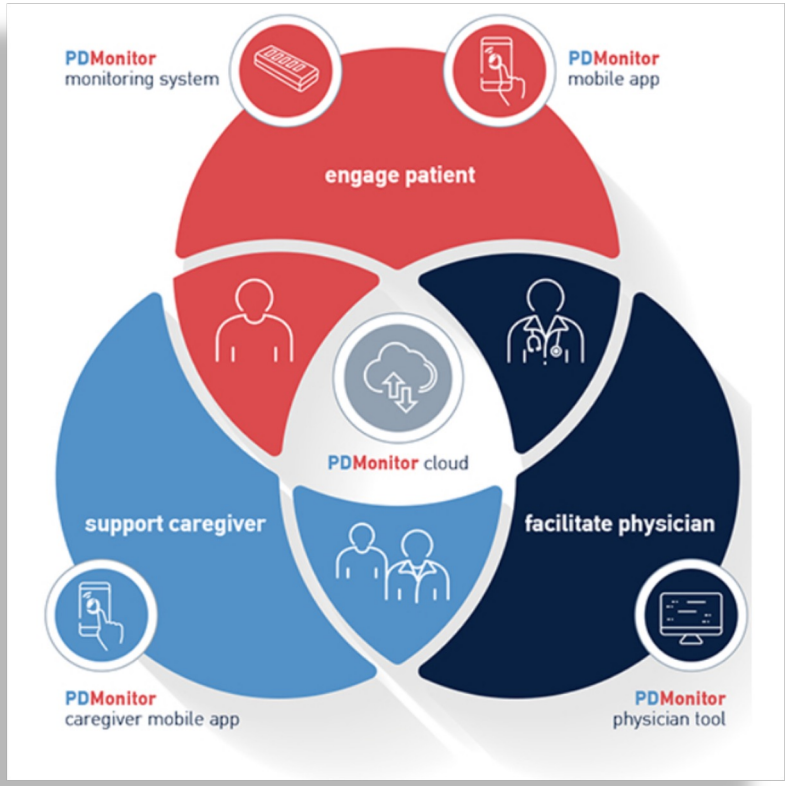
Standing by you, at every move you make!

A non-invasive continuous monitoring system, for patients with Parkinson's disease

powered by

pd neurotechnology®
medical solutions

www.pdneurotechnology.com



Symptoms monitored:

- ✓ Bradykinesia
- ✓ Dyskinesia
- ✓ Tremor
- ✓ Freezing of Gait
- ✓ Gait Disturbances
- ✓ Postural Instability
- ✓ ON/OFF Conditions
- ✓ Activity
- ✓ Fluctuations

Kinesia™ one

Tremor

Bradykinesia

Dyskinesia

Kinesia one

Kinesia One Symptom Severity Report

Patient Name: Sample Patient
Patient ID: 103-129
Institution: Sample Hospital
Birthdate: 09/18/1949

	Time	Rest Tremor	Postural Tremor	Kinetic Tremor	Finger Taps Speed	Finger Taps Amplitude	Finger Taps Rhythm	Hand Movements Speed	Hand Movements Amplitude	Hand Movements Rhythm	Rapid Alternating Movements Speed	Rapid Alternating Movements Amplitude	Rapid Alternating Movements Rhythm	Dyskinesia
01/15/2015	9:52 AM	3.0	1.2	1.2	2.3	2.5	1.1	2.4	2.3	0.9	2.1	1.4	1.3	0.0
	12:52 PM	1.2	0.2	1.1	2.4	2.7	2.0	2.3	2.2	1.7	2.1	0.7	1.3	0.4
	Mean	2.1	0.7	1.1	2.4	2.6	1.5	2.4	2.3	1.3	2.1	1.1	1.3	0.2
	Fluctuation	0.9	0.5	0.1	0.0	0.1	0.5	0.1	0.1	0.4	0.0	0.3	0.0	0.2
01/31/2015	7:00 AM	3.1	2.3	1.6	2.0	1.6	0.9	1.9	1.0	0.8	1.9	0.9	0.9	0.0
	8:00 AM	3.4	2.8	1.5	1.9	1.6	1.2	1.7	0.9	1.0	1.7	0.9	0.9	0.0
	9:00 AM	3.4	1.4	1.4	1.7	1.2	1.2	1.7	0.8	0.6	1.7	0.9	1.1	0.0
	10:01 AM	3.4	2.2	1.7	1.9	1.6	1.4	1.7	1.0	0.9	1.7	0.6	0.7	0.0
	11:01 AM	3.2	1.6	1.6	1.5	0.3	0.6	1.6	0.5	0.7	1.8	0.7	0.8	0.0
	12:00 PM	0.0	0.0	1.2	1.6	0.9	1.1	1.4	0.6	0.7	1.7	0.6	0.4	1.4
	1:00 PM	2.6	0.6	1.3	1.8	1.5	1.0	1.7	1.3	1.0	1.6	0.5	0.6	0.0
	2:00 PM	2.3	0.7	1.6	2.0	2.0	1.1	1.7	1.4	1.0	1.8	0.7	0.8	0.0
	3:01 PM	2.9	1.6	1.4	1.7	2.0	0.8	1.6	1.8	0.8	1.7	0.6	0.6	0.0
	4:00 PM	3.5	1.9	1.5	1.8	1.4	1.2	1.8	1.4	1.0	1.8	0.8	0.7	0.0
	5:00 PM	3.1	1.5	1.6	1.6	1.2	1.2	1.5	1.2	1.0	1.7	0.8	0.7	0.0
	6:00 PM	3.3	1.6	1.8	1.7	1.3	1.4	1.7	1.2	1.2	1.8	0.8	0.7	0.0
	7:00 PM	2.9	1.4	1.8	1.8	1.7	1.5	1.6	1.1	0.9	1.9	0.8	1.1	0.0
	8:00 PM	3.0	1.0	1.5	1.9	1.2	1.3	1.7	1.3	1.2	1.9	0.8	0.7	0.0
	9:00 PM	3.0	1.5	1.7	1.7	0.8	1.4	1.4	0.4	0.5	1.8	0.7	0.8	0.0
	10:00 PM	2.9	0.8	1.3	2.0	1.8	1.0	1.6	0.6	0.6	1.9	0.7	0.6	0.0
	11:00 PM	3.2	0.0	1.5	1.6	0.8	0.9	1.8	1.1	1.0	1.9	0.7	1.0	0.7
	Mean	2.9	1.3	1.5	1.8	1.3	1.1	1.6	1.0	0.9	1.8	0.7	0.8	0.1
	Fluctuation	0.8	0.7	0.2	0.1	0.5	0.2	0.1	0.4	0.2	0.1	0.1	0.2	0.4

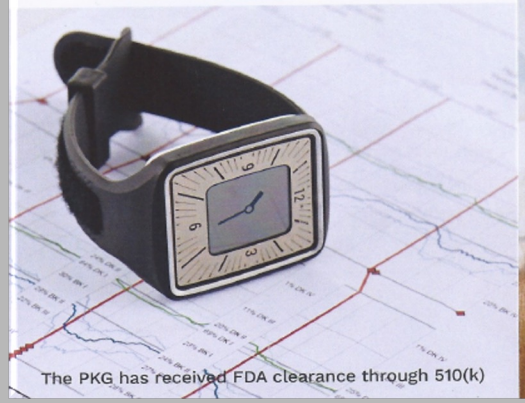
GREAT LAKES NEUROTECHNOLOGIES

pkg
by Global Kinetics

Objective, ambulatory assessment of motor complications associated with movement disorders.

The PKG® provides:

- Assessment of bradykinesia, dyskinesa and tremor
- Ability to correlate symptom fluctuations and their severity with respect to levodopa dosage
- A record of daytime sleepiness and immobility
- Assessment of the risk Impulse Control Disorders

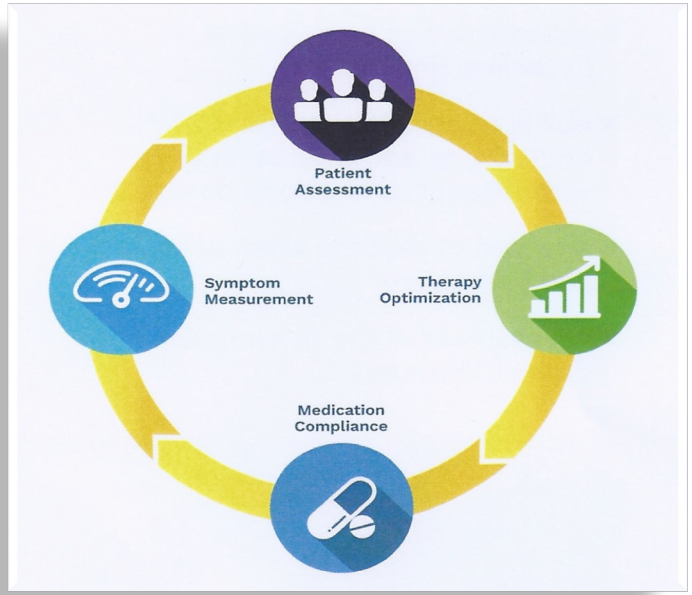


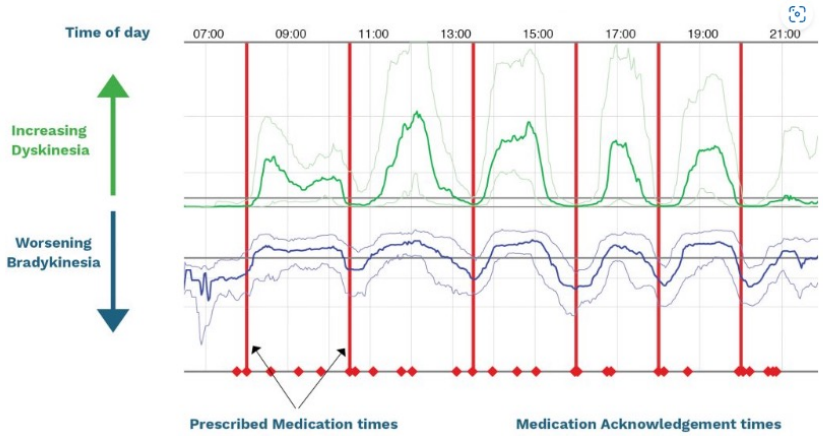
The PKG has received FDA clearance through 510(k)

pkg
by Global Kinetics

The Personal KinetiGraph® (PKG®) and You

Information for those living with Parkinson's disease





Could an Apple smart watch track your Parkinson's disease symptoms?

ADVANCES Author: Saskia Mair Published: 18 February 2021

Researchers at tech giant Apple are testing out a new app that can help monitor Parkinson's symptoms as the condition progresses

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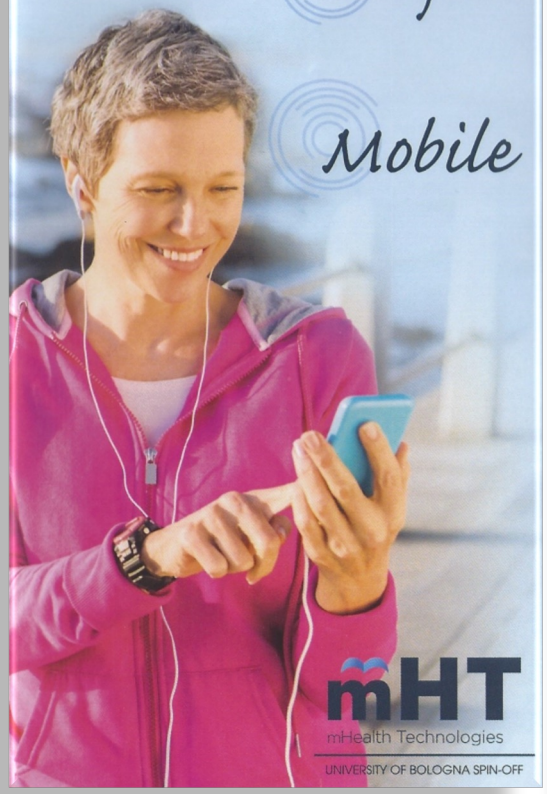
GAIT TUTOR GT

Wearable system to monitor,
measure and train the **walking performance**

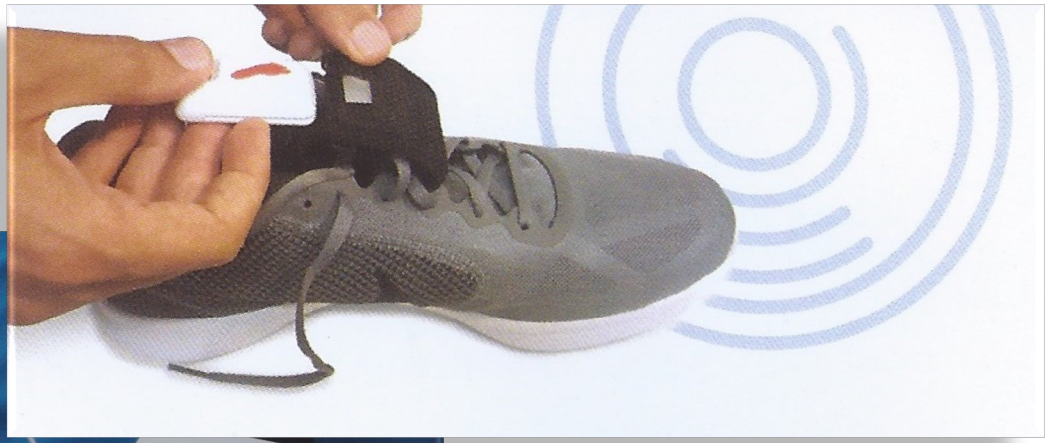
Easy

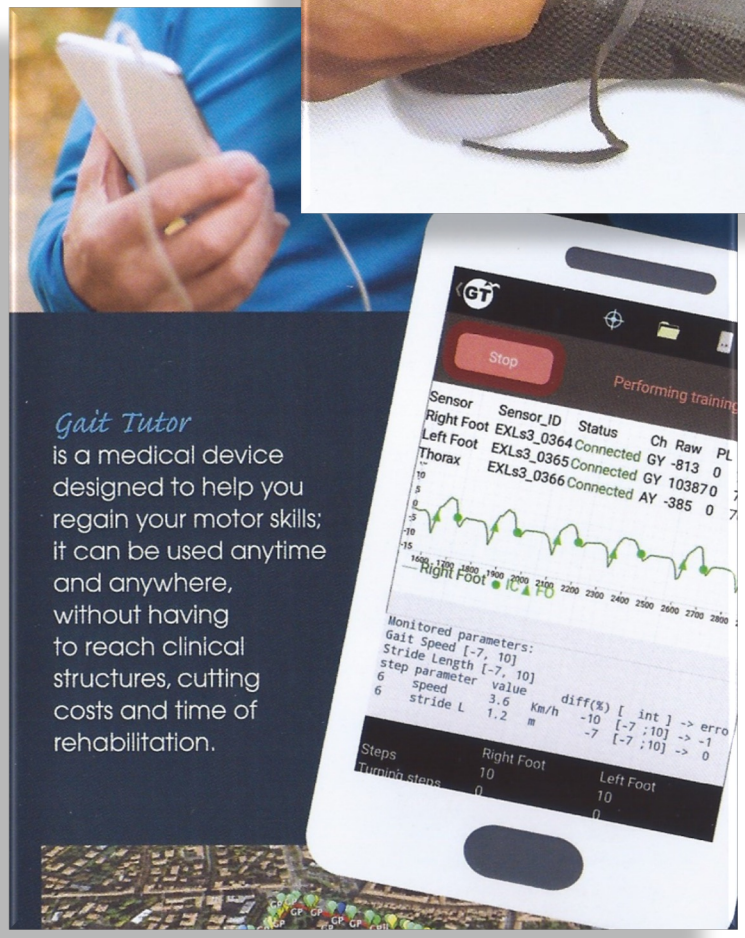
Certified

Mobile

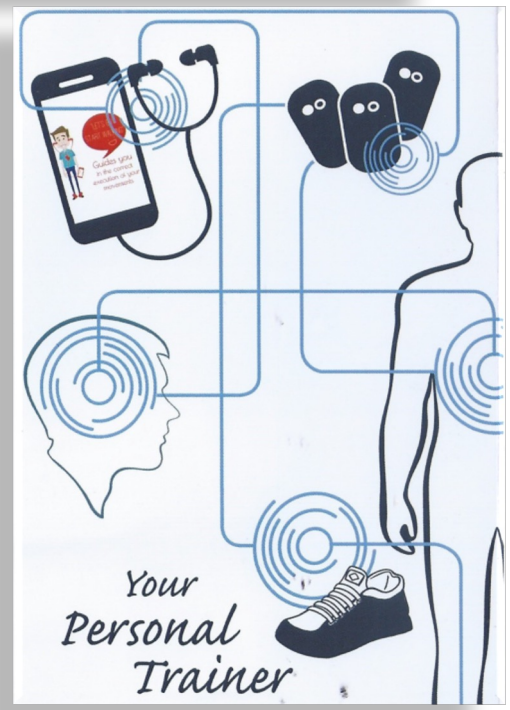


mHT
mHealth Technologies
UNIVERSITY OF BOLOGNA SPIN-OFF





Gait Tutor
is a medical device
designed to help you
regain your motor skills;
it can be used anytime
and anywhere,
without having
to reach clinical
structures, cutting
costs and time of
rehabilitation.



SENSE4CARE

FALL DETECTION

Personal and unique device

ANGEL4

The Angel4 fall detector is a personal device that provides very sensitive and automatic fall detection using a triaxial accelerometer and a new specific algorithm.

The system consists of a small sensor that is placed at the waist using a clamping clip, or a comfortable specially designed belt. This sensor, connects to the telecare system, to the health center, or to the mobile phone using Bluetooth, and is handled with an Android application that is easy to use and personalize.

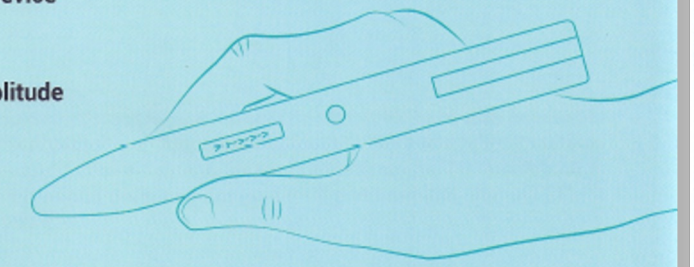

NOTCH

Tremipen®

Tremitas

Measuring tremor – easy, fast, reliable

- CE certified **medical device**
- measures **tremor amplitude & tremor frequency** in just 30 seconds
- as **easy to use** as a clinical thermometer



Areas of use

Diagnosis

The objective parameters for the frequency and the amplitude generated by the Tremipen® can give hints during the first assessment of tremor or in diagnostic processes because different tremor diseases develop different frequencies.

Monitoring

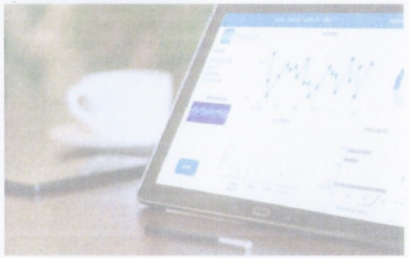
Due to regular measurements with the Tremipen®, a curve of the tremor can be created and the effects of a medication on the tremor can be evaluated. Due to that it is possible for the first time to monitor tremor regularly and objectively.

Optimisation

Single measurement results can be compared more easily, e.g. it is possible to demonstrate different effects of medications after a change of medication. Due to that, therapies can be adjusted more individually and more quickly.

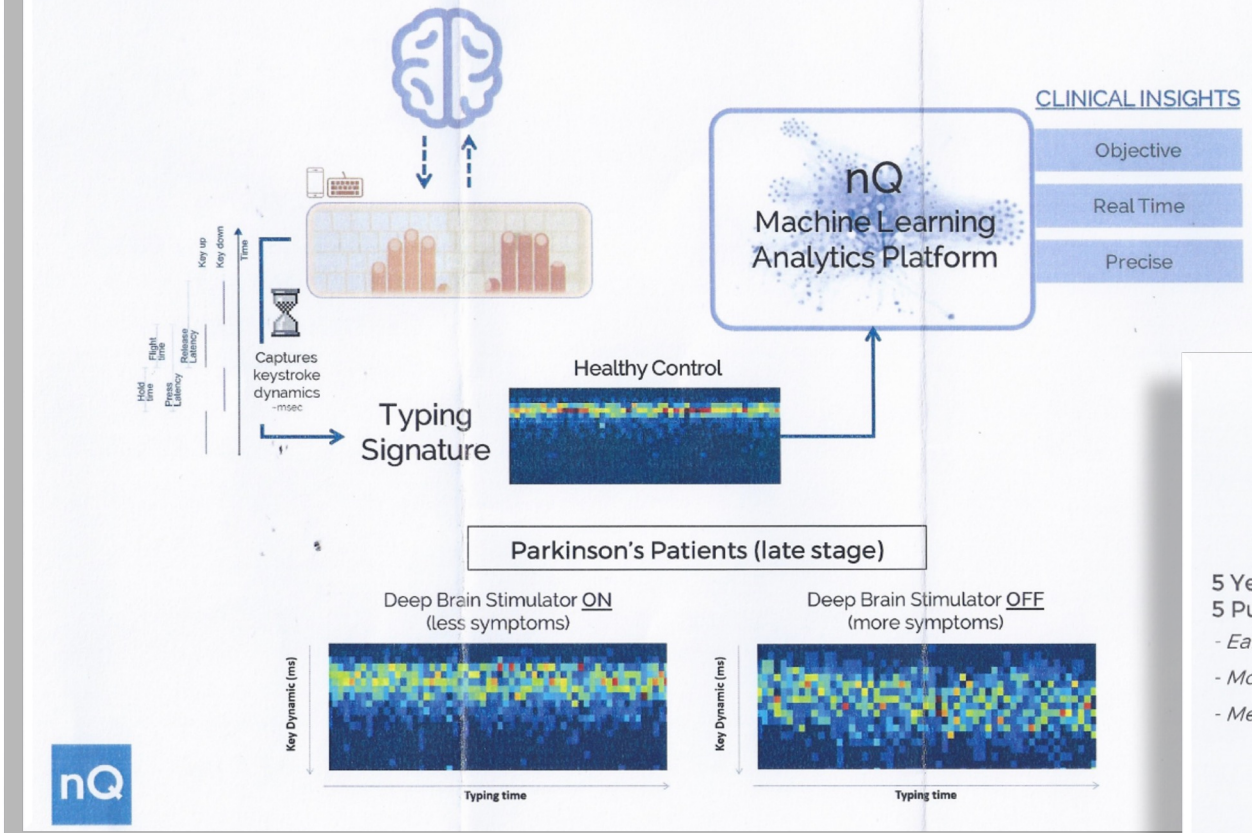
nQ Medical™

Transforming Parkinson's Disease Management with Computational Biomarkers



KYomed INNOV

A Solution to Measure the Impact of your Therapy



5 Years of Clinical Trials /
5 Published Papers demonstrating

- *Early Detection*
- *Monitoring Disease Progression*
- *Measuring Impact of Therapy*

Gait & Posture 39 (2014) 1062–1068

Contents lists available at ScienceDirect

Gait & Posture

journal homepage: www.elsevier.com/locate/gaitpost

Accuracy of the Microsoft Kinect sensor for measuring movement in people with Parkinson's disease

ier[b],

Disability and Rehabilitation: Assistive Technology

ISSN: 1748-3107 (Print) 1748-3115 (Online) Journal homepage: https://ww

Kinect4FOG: monitoring and improving mobility in people with Parkinson's using a novel system incorporating the Microsoft Kinect v2

Amin Amini, Konstantinos Banitsas & William R. Young

NOI PARKINSON

Made by PALS

NOI PARKINSON

Conoscere la malattia

Sintomi motori

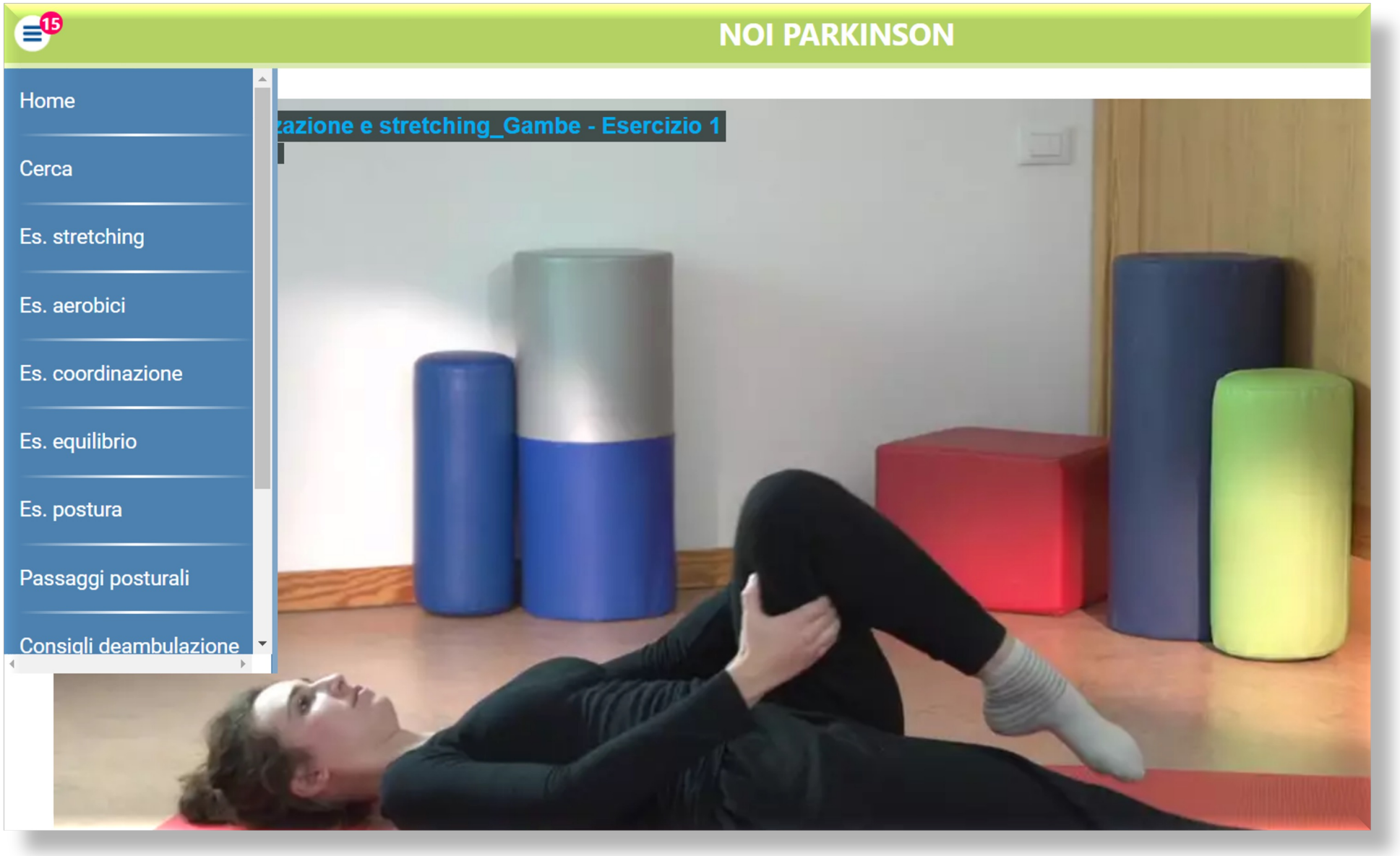
Sintomi non motori

Terapia

Nutrizione

Riabilitazione

Visita

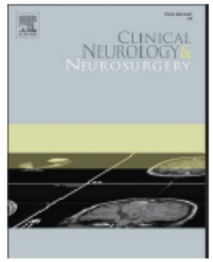

15
NOI PARKINSON
Home
Cerca
Es. stretching
Es. aerobici
Es. coordinazione
Es. equilibrio
Es. postura
Passaggi posturali
Consigli deambulazione
zazione e stretching_Gambe - Esercizio 1

Clinical Neurology and Neurosurgery 225 (2023) 107579

Contents lists available at ScienceDirect

Clinical Neurology and Neurosurgery

journal homepage: www.elsevier.com/locate/clineuro



Review article

The effect of mobile application-based rehabilitation in patients with Parkinson's disease: A systematic review and meta-analysis

Fatih Özden [1,*]

Muğla Sıtkı Koçman University, Köyceğiz Vocational School of Health Services, Department of Health Care Services, Muğla, Turkey

Conclusion: Mobile application-based rehabilitation is not superior to standard treatments in balance and disease severity. However, mobile technologies could be preferred to increase patient adherence and quality of life. The limited study and the low number of cases in the review may reduce the level of evidence for the results.

APPLICAZIONI: SINTOMI NON MOTORI E NEUROPSICHIATRICI

- Monitoraggio delle attività quotidiane quali primi indici di declino cognitivo
- Analisi dei pattern comportamentali (episodi confusionali, wandering, eccessivo stazionamento, apatia, disturbi del controllo degli impulsi)
- Analisi del sonno con sensori di movimento (insonnia, RBD, RLS)
- Analisi della voce

sensors

MDPI

Review

Wearable Solutions for Patients with Parkinson's Disease and Neurocognitive Disorder: A Systematic Review

Asma Channa *, Nirvana Popescu and Vlad Ciobanu

Computer Science Department, University POLITEHNICA of Bucharest, RO-060042 Bucharest, Romania; nirvana.popescu@upb.ro (N.P.); vlad.ciobanu@upb.ro (V.C.)

* Correspondence: asma.channa@stud.acs.upb.ro

Received: 9 April 2020; Accepted: 6 May 2020; Published: 9 May 2020

Randomized Controlled Trial > Assist Technol. 2022 Jul 4;34(4):423-428.
doi: 10.1080/10400435.2020.1846095. Epub 2021 Apr 6.

Effects of domotics on cognitive, social and personal functioning in patients with Parkinson's disease: A pilot study

Desiree Latella [1], Maria Grazia Maggio [1], Giuseppa Maresca [1], Adriana Andaloro [1], Smeralda Anchesi [1], Valentina Pajno [1], Rosaria De Luca [1], Giuseppe Di Lorenzo [1], Alfredo Manuli [1], Rocco Salvatore Calabrò [1]

Affiliations + expand

PMID: 33337294 DOI: 10.1080/10400435.2020.1846095

Abstract

Home automation (HA) is either a "smart" house or a supportive environment, which enables the patients to regain an active role in daily life. HA could allow people affected by Parkinson Disease (PD) to better manage their daily lives. This study aims to evaluate the effects of domotics on quality of life, and personal/social autonomy in PD patients. We enrolled 40 with PD undergoing neurorehabilitation, who were randomized into either the control (CG) or the experimental group (EG). Two different rehabilitative approaches were used: the CG was submitted to a traditional training, whilst the EG underwent HA training, in which the activities were carried out through the use of assistive technologies. In both the training, the exercises were performed in small samples of 3-5 patients. Results showed that both CG and EG had a significant improvement in global cognitive functioning, executive functions, and instrumental autonomy. However, only in the EG, we observed a significant increase in social adaptation, activities of daily living and quality of life. This pilot study suggests that HA training could be a useful tool for the rehabilitation of patients with PD, improving social and cognitive functioning, personal autonomy and quality of life.

APPLICAZIONI: EMPOWERMENT DEL PAZIENTE

- Feedback dei sintomi, strategie di biofeeback
- Facilitazione del contatto con familiari e sanitari
- Maggiore senso di sicurezza per paziente e caregiver
- Accesso alle informazioni

sensors

MDPI

Article

Prediction of Freezing of Gait in Parkinson's Disease Using Wearables and Machine Learning

Luigi Borzì [1,*], Ivan Mazzetta [2], Alessandro Zampogna [3], Antonio Suppa [3,4], Gabriella Olmo [1] and Fernanda Irrera [2]

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[3] Department of Human Neurosciences, Sapienza University of Rome, 00185 Rome, Italy; alessandro.zampogna@uniroma1.it (A.Z.); antonio.suppa@uniroma1.it (A.S.)
[4] IRCCS NEUROMED Institute, 86077 Pozzilli, Italy
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Abstract: Freezing of gait (FOG) is one of the most troublesome symptoms of Parkinson's disease, affecting more than 50% of patients in advanced stages of the disease. Wearable technology has been widely used for its automatic detection, and some papers have been recently published in the direction of its prediction. Such predictions may be used for the administration of cues, in order to prevent the occurrence of gait freezing. The aim of the present study was to propose a wearable system able to catch the typical degradation of the walking pattern preceding FOG episodes, to achieve reliable FOG prediction using machine learning algorithms and verify whether dopaminergic therapy affects the ability of our system to detect and predict FOG. Methods: A cohort of 11 Parkinson's disease patients receiving (on) and not receiving (off) dopaminergic therapy was equipped with two inertial sensors placed on each shin, and asked to perform a timed up and go test. We performed a step-to-step segmentation of the angular velocity signals and subsequent feature extraction from both time and frequency domains. We employed a wrapper approach for feature selection and optimized different machine learning classifiers in order to catch FOG and pre-FOG episodes. Results: The implemented FOG detection algorithm achieved excellent performance in a leave-one-subject-out validation, in patients both on and off therapy. As for pre-FOG detection, the implemented classification algorithm achieved 84.1% (85.5%) sensitivity, 85.9% (86.3%) specificity and 85.5% (86.1%) accuracy in leave-one-subject-out validation, in patients on (off) therapy. When the classification model was trained with data from patients on (off) and tested on patients off (on), we found 84.0% (56.6%) sensitivity, 88.3% (92.5%) specificity and 87.4% (86.3%) accuracy. Conclusions: Machine learning models are capable of predicting FOG before its actual occurrence with adequate accuracy. The dopaminergic therapy affects pre-FOG gait patterns, thereby influencing the algorithm's effectiveness.

Keywords: wearable sensors; machine learning; freezing of gait (FOG); FOG prediction; levodopa; Parkinson's disease; degradation of gait pattern

Citation: Borzì, L.; Mazzetta, I.; Zampogna, A.; Suppa, A.; Olmo, G.; Irrera, F. Prediction of Freezing of Gait in Parkinson's Disease Using Wearables and Machine Learning. *Sensors* **2021**, *21*, 614. https://doi.org/10.3390/s21020614

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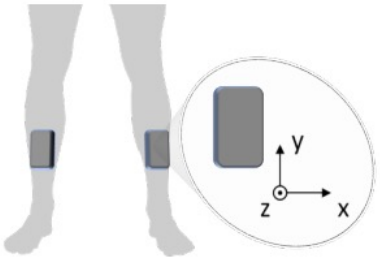
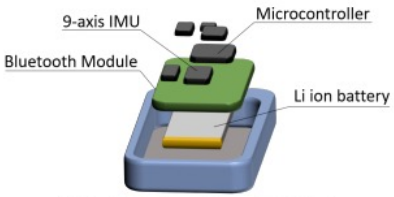


(**a**) Sketch of wearable device positioning and inertial reference frame.



(**b**) Exploded view of the neMEMSi device.

Table 10. The algorithm's performance in pre-FOG detection after training with Parkinson's disease patients receiving dopaminergic therapy (ON) and testing on PD patients not receiving dopaminergic therapy (OFF), and vice versa.

Training Set	Test Set	Sensitivity	Specificity	Accuracy	PPV	NPV	F-Score	Yuden Index
ON	OFF	84.0 %	88.3 %	87.4 %	66.7 %	95.2 %	74.4 %	72.3 %
OFF	ON	56.6 %	92.5 %	86.3 %	77.9 %	88.2 %	65.6 %	49.1 %

Neurological Sciences (2020) 41:3643–3651
https://doi.org/10.1007/s10072-020-04485-4

ORIGINAL ARTICLE

Wearable haptic anklets for gait and freezing improvement in Parkinson's disease: a proof-of-concept study

Simone Rossi[1] · Tommaso Lisini Baldi[2] · Marco Aggravi[2] · Monica Ulivelli[1] · David Cioncoloni[3] · Viola Niccolini[1] · Lorenzo Donati[1] · Domenico Prattichizzo[2]

Received: 23 July 2019 / Accepted: 21 May 2020 / Published online: 1 June 2020

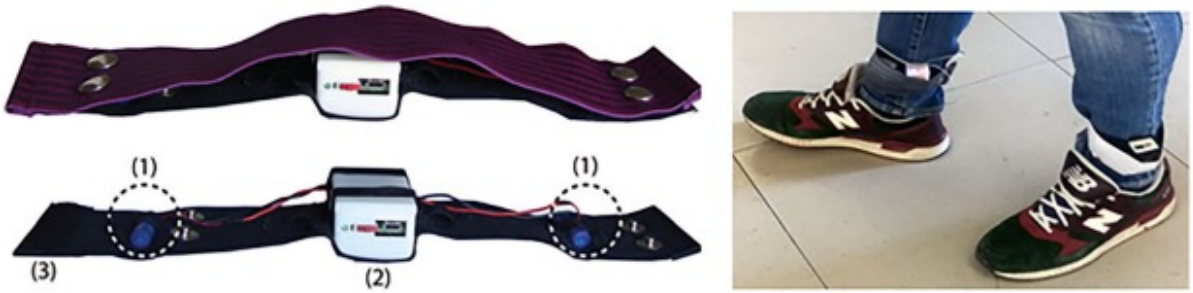
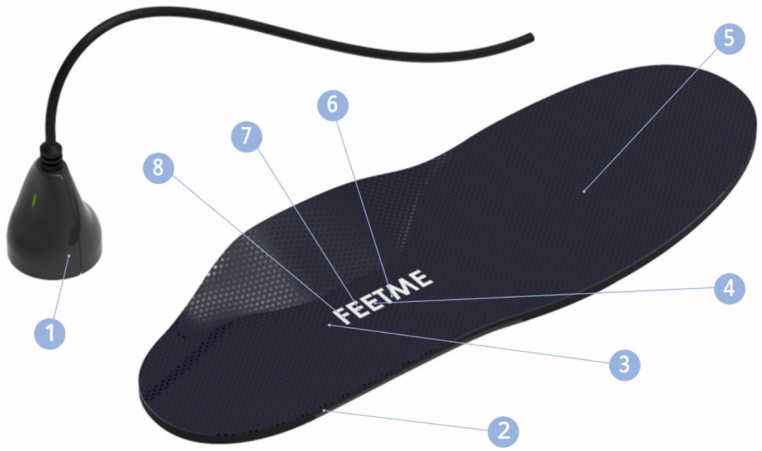
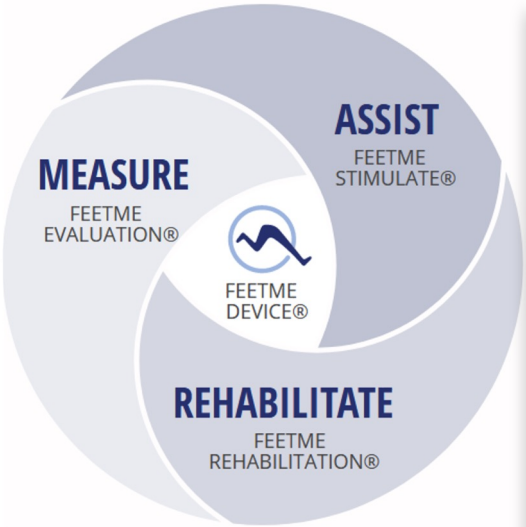


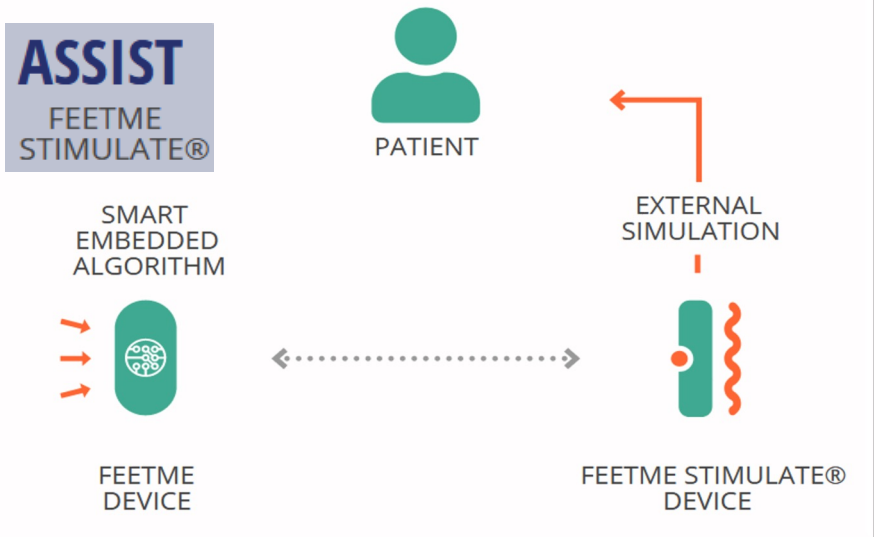
Fig. 1 The WEARHAP-PD device. The anklets are composed of two vibrating motors (1) attached to an elastic band (3). A Li-Ion battery and an Arduino board are in (2). When the device is engaged, its motors vibrate at a frequency of 250 Hz. The effective vibration frequency range is 100–280 Hz (the maximal human's sensitivity is achieved around 200–300 Hz)

FEETME

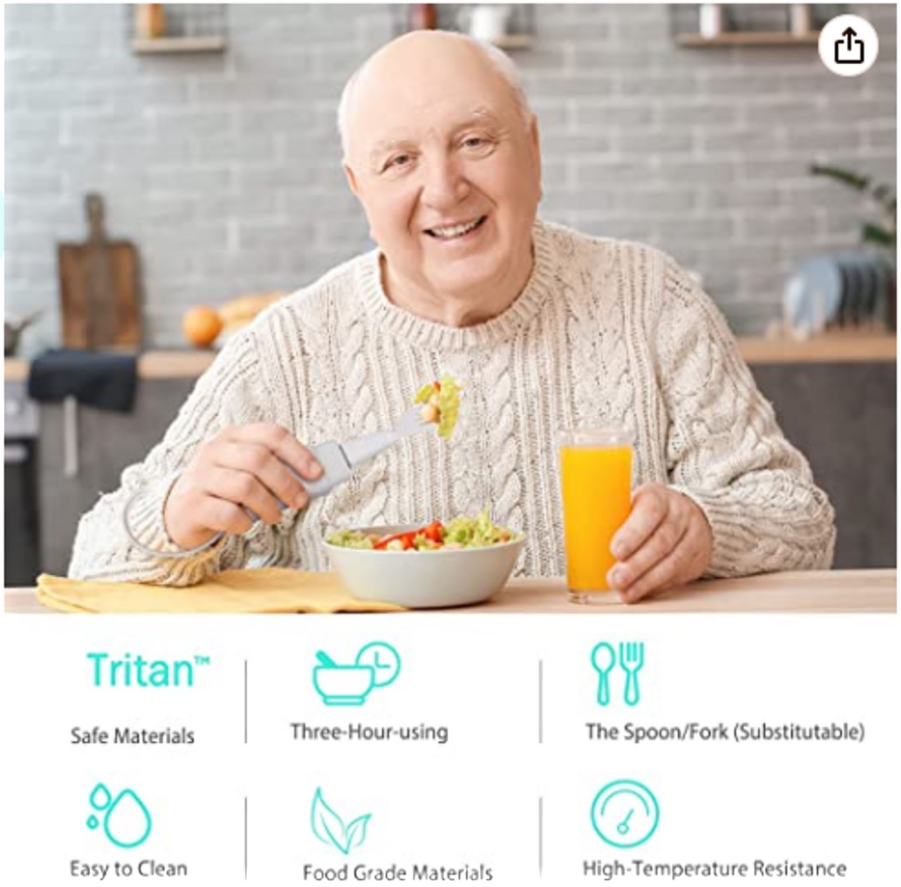


1. Wireless charging
2. Sizes
   9 Sizes (from size 37 to size 45)
   Thickness 4 mm
   Weight 80 g
3. Extended autonomy
   Battery life 24hrs
4. Embedded calculation power
   Embedded metrics calculation
5. Pressure sensors
   Sample rate 100 HZ pressure
6. Motion sensors
   Gyroscope, accelerometer, magnetometer
   Sample rate 150 Hz IMU
7. Standalone device with internal storage
   Data storage 16 days
8. Wireless communication
   Communication Bluetooth Low Energy
9. Warrant
   1 year





Emma Watch, il progetto di Microsoft per aiutare i malati di Parkinson a contrastare i tremori alle mani



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- Gyenno Brava Twist is suibable for the people with hand tremor tange within 2.7inch (7CM)
- Build-in Battery design low failure rate,2.5h for charging 180 minutes for running.
- Fork and spoon replaceable attachments for all kind of meals. Magnetic connector design Much easier for replacing the attachments.
- Porbale carrying case design,157g only ,convenient for travelling

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parkinson's europe

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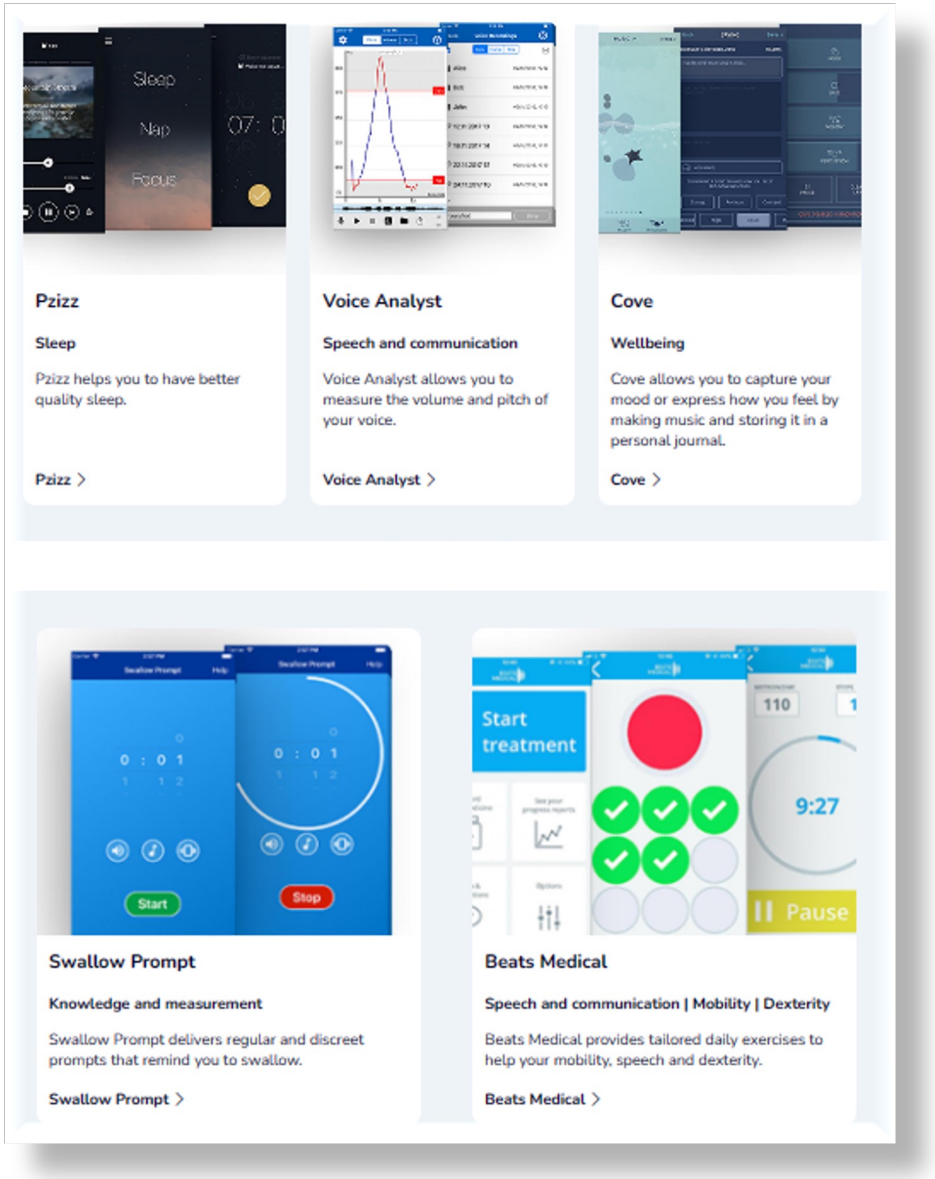
Apps and devices for Parkinson's

Apps and devices can help with the day to day management of Parkinson's.



Parkinson's innovation

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LIMITAZIONI

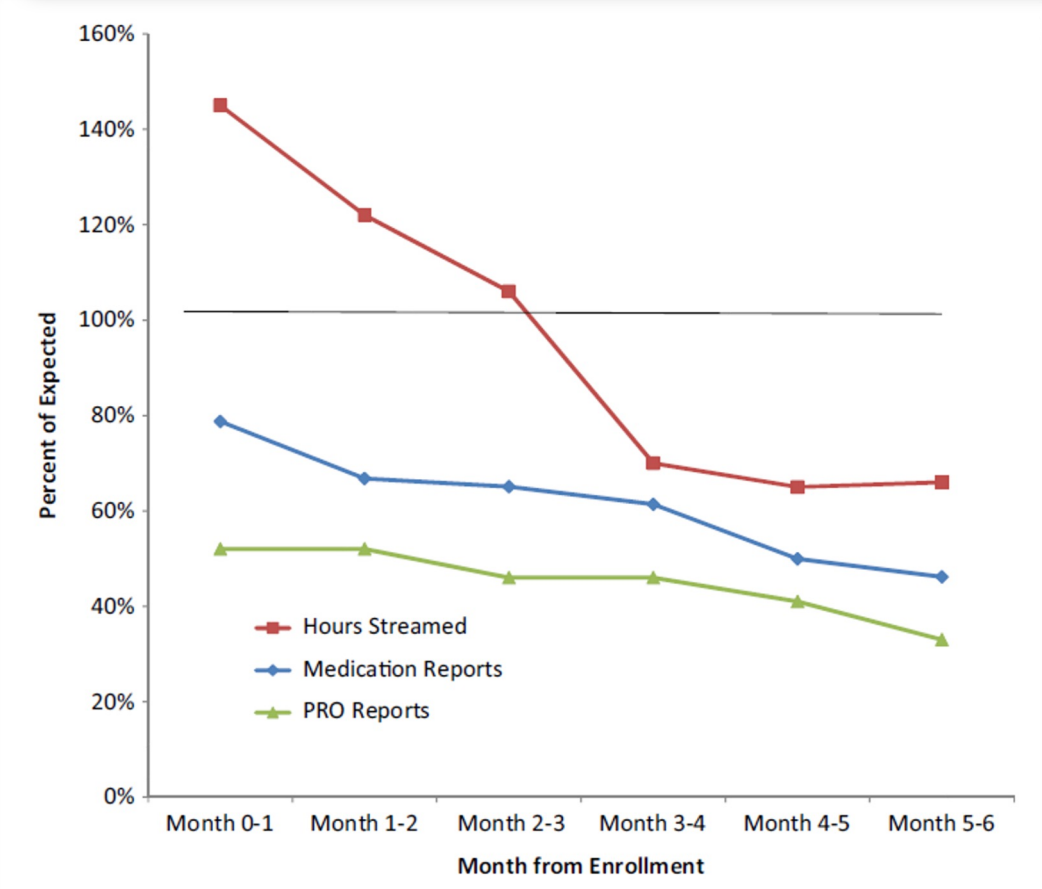
- Interpretazione di task complessi e simultanei e degli stati ipocinetici
- Data privacy e condivisione dei dati
- Perdita di autonomia e percezione di «intrusione» nello spazio privato
- Rischi correlati con guasti tecnici
- Validazione e accesso ai dispositivi
- Per ora molti sensori e pochi studi

Feasibility and utility of a clinician dashboard from wearable and mobile application Parkinson's disease data

Jordan J. Elm[1], Margaret Daeschler[2], Lauren Bataille[2], Ruth Schneider[3], Amy Amara[4], Alberto J. Espay[5], Michal Afek[6], Chen Admati[6], Abeba Teklehaimanot[1] and Tanya Simuni[7]

2019

npj Digital Medicine (2019)2:95



Problemi di compliance:

- Perdita di motivazione
- Minore attrattiva della "novità" tecnologica
- Problemi legati ai dispositivi
- Limiti tecnici

2019

MDS COMMISSIONED REVIEW

Movement Disorders, Vol. 34, No. 5, 2019

A Roadmap for Implementation of Patient-Centered Digital Outcome Measures in Parkinson's Disease Obtained Using Mobile Health Technologies

Alberto J. Espay, MD, MSc,[1*] Jeffrey M. Hausdorff, PhD,[2,3,4] Álvaro Sánchez-Ferro, MD, MSc,[5] Jochen Klucken, MD,[6,7] Aristide Merola, MD, PhD,[1] Paolo Bonato, PhD,[8] Serene S. Paul, PhD, BAppSc(Phty)(Hons),[9] Fay B. Horak, PhD, PT,[10,11] Joaquin A. Vizcarra, MD,[1] Tiago A. Mestre, MD, MSc,[12] Ralf Reilmann, MD, PhD,[13,14,15] Alice Nieuwboer, PhD,[16] E. Ray Dorsey, MD, MBA,[17] Lynn Rochester, PhD,[18,19] Bastiaan R. Bloem, MD, PhD,[20] and Walter Maetzler, MD[21] on behalf of the Movement Disorder Society Task Force on Technology

2019

MDS COMMISSIONED REVIEW

Movement Disorders, Vol. 34, No. 5, 2019

A Roadmap for Implementation of Patient-Centered Digital Outcome Measures in Parkinson's Disease Obtained Using Mobile Health Technologies

- Meno sensori possibili
- Minor peso/fastidio/ingombro possibile
- Facilità d'uso, con ridotte esigenze di conoscenze tecniche e di interventi manuali complessi
- Utilizzo continuativo senza necessità di interventi e controllo
- Scarsa necessità di supervisione
- Vantaggi tecnologici (batterie di lunga durata, ricarica rapida e semplice, aggiornamenti automatici e rapidi, impermeabilità e sicurezza del sistema, dimensioni e peso ridotti)
- Validazione scientifica con scale di qualità della vita

Review

Evidence for the Efficacy of Commercially Available Wearable Biofeedback Gait Devices: Consumer-Centered Review

Kedar K V Mate[1], BSc, PT, MSc, PhD; Ahmed Abou-Sharkh[1], PT, PhD; Maedeh Mansoubi[2], PhD; Aeshah Alosaimi[3], MSc; Helen Dawes[2], PT, PhD; Wright Michael[1], MSc, PT; Olivia Stanwood[1], MSc, PT; Sarah Harding[1], MSc, PT; Daniel Gorenko[1], MSc, PT; Nancy E Mayo[1], BSc, PT, PhD

[1]Faculty of Medicine and Health Sciences, McGill University, Montreal, QC, Canada
[2]Medical School, University of Exeter, Exeter, United Kingdom
[3]King Faisal Specialized Hospital and Research Centre, Riyadh, Saudi Arabia

JMIR Rehabil Assist Technol 2023 | vol. 10 | e40680 | p. 1

Results: The search strategy for this consumer-centered review yielded 17 biofeedback devices that claim to target gait quality improvement through various sensory feedback mechanisms. Of these 17 devices, 11 (65%) are commercially available, and 6 (35%) are at various stages of research and development. Of the 11 commercially available devices, 4 (36%) had findable evidence for efficacy potential supporting the claims. Most of these devices were targeted to people living with Parkinson disease. The reporting of key information about the devices was inconsistent; in addition, there was no summary of research findings in layperson's language.

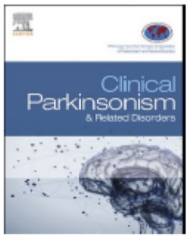
Conclusions: The amount of information that is currently available to the general public to help them make an informed choice is insufficient, and, at times, the information presented is misleading. The evidence supporting the effectiveness does not cover all aspects of technology uptake. Commercially available technologies help to provide continuity of therapy outside the clinical setting, but there is a need to demonstrate effectiveness to support claims made by the technologies.

PRDOA 8 (2023) 100188

Contents lists available at ScienceDirect

Clinical Parkinsonism & Related Disorders

journal homepage: www.sciencedirect.com/journal/clinical-parkinsonism-and-related-disorders



Review

Successful implementation of technology in the management of Parkinson's disease: Barriers and facilitators

Arjonne Laar [a,b], Ana Ligia Silva de Lima [a,b], Bart R. Maas [a,b], Bastiaan R. Bloem [a,b], Nienke M. de Vries [a,b,*]

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Category:

- Cueing
- Exergaming
- Remote monitoring using wearable sensors
- Telerehabilitation
- Remote consultation

IL RUOLO DELLE NUOVE TECNOLOGIE

QUALI ASPETTATIVE?

PUNTO DI VISTA:

- **PAZIENTE**
- **MEDICO SPECIALISTA**
- **CURE TERRITORIALI**
- **FAMIGLIE E CAREGIVER**
- **SOCIETÀ**

IPOTESI:

- **AUTONOMIA**
- **PRECISIONE**
- **GESTIONE**
- **SICUREZZA**
- **RISPARMIO?**

GRAZIE