

Monitoraggio con APP del deterioramento cognitivo in neurologia

Il caso della sclerosi multipla

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LE SFIDE DELLE TECNOLOGIE DIGITALI PER LA SALUTE DEL FUTURO

PISA | 8 luglio 2022

Polo Didattico S. Rossore 1938 – Via Risorgimento 23

Review Article

Seven Capital Devices for the Future of Stroke Rehabilitation

**M. Iosa,¹ G. Morone,¹ A. Fusco,¹ M. Bragoni,² P. Coiro,² M. Multari,² V. Venturiero,²
D. De Angelis,² L. Pratesi,² and S. Paolucci^{1,2}**

¹ *Clinical Laboratory of Experimental Neurorehabilitation, Santa Lucia Foundation I.R.C.C.S., Via Ardeatina 306, 00179 Rome, Italy*

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Received 26 September 2012; Accepted 12 November 2012

- **Brain Computer Interface**
- **Stimolazione cerebrale non invasiva**
- **Neuroprotesi**
- **Dispositivi wearable**
- **Tablet-PC**
- **Robot**
- **Realtà virtuale**

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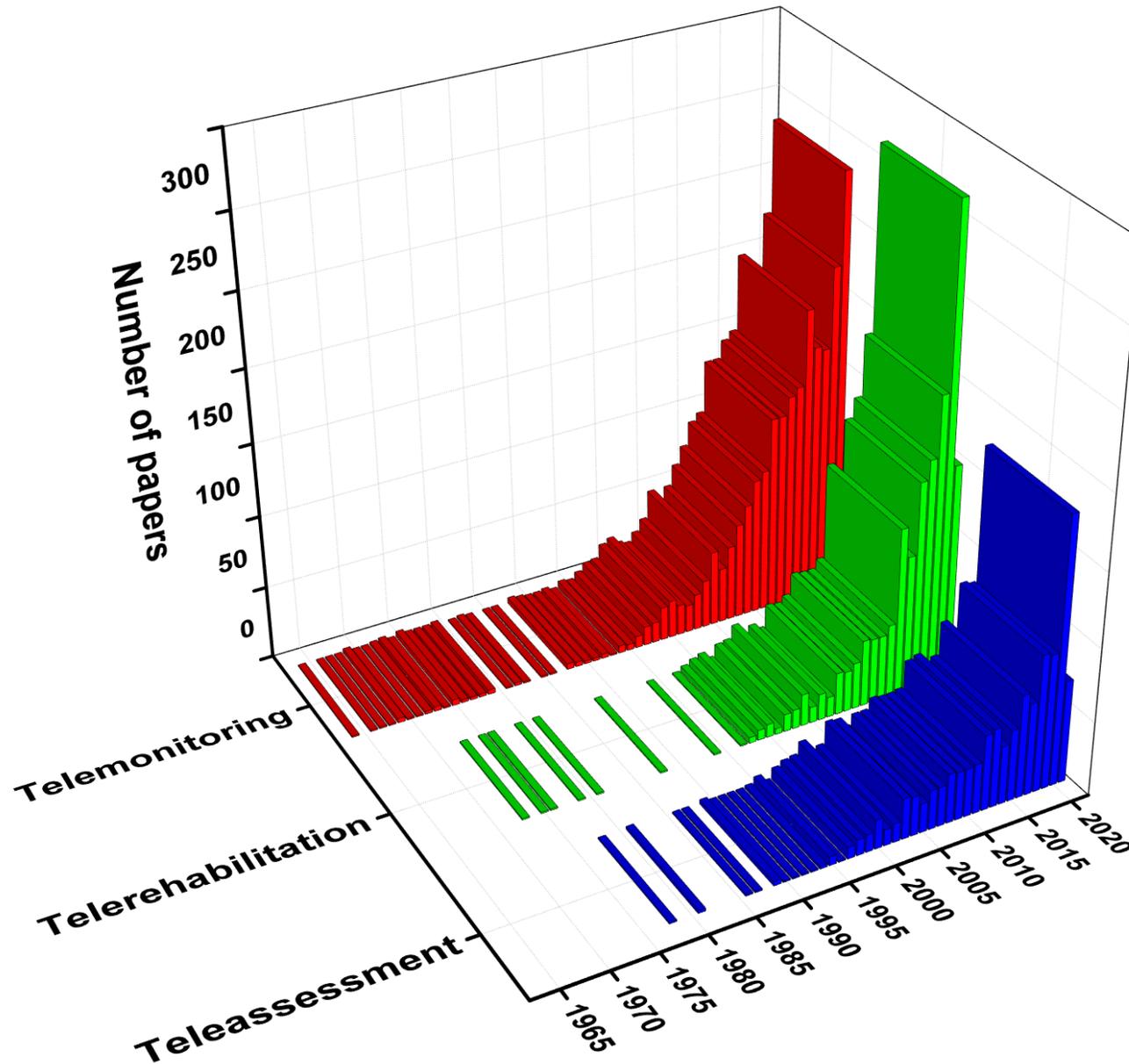
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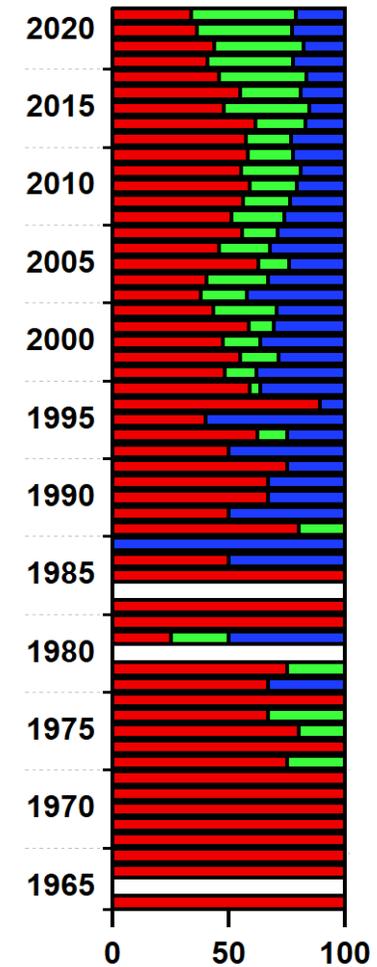
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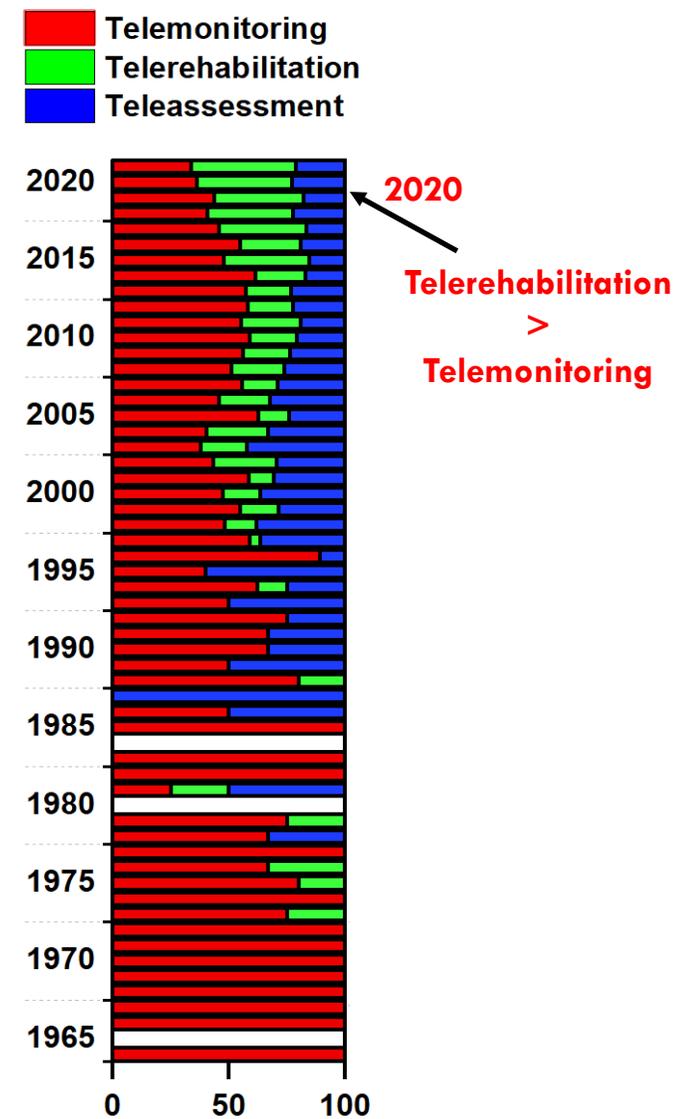
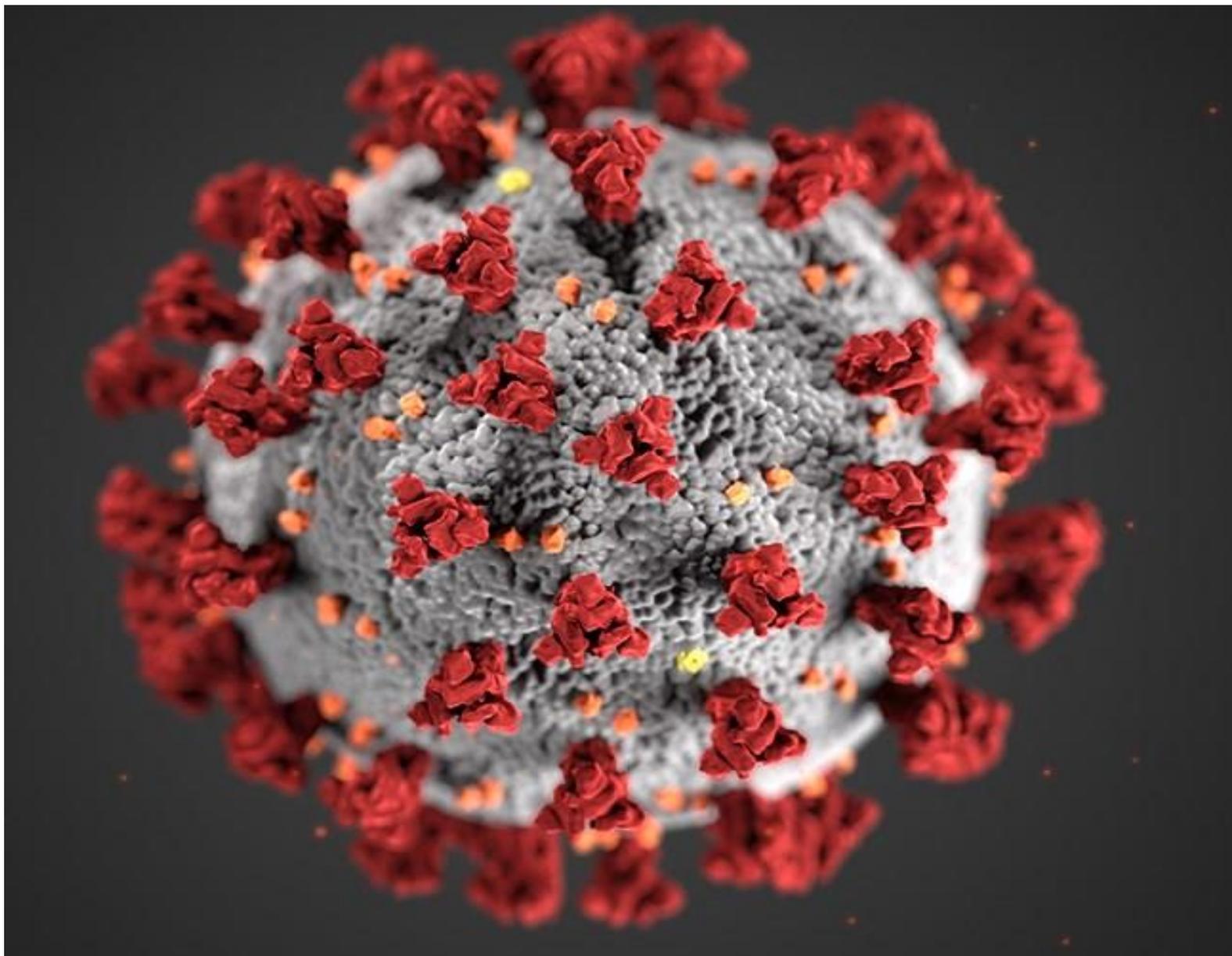
Un po' di numeri dalla letteratura...



■ Telemonitoring
■ Telerehabilitation
■ Teleassessment



Un po' di numeri dalla letteratura...

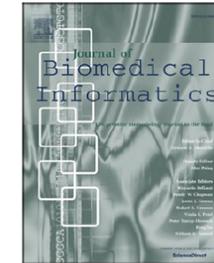




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Journal of Biomedical Informatics

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



Methodological Review

Dementia medical screening using mobile applications: A systematic review with a new mapping model

Fadi Thabtah^{a,*}, David Peebles^b, Jenny Retzler^b, Chanchala Hathurusingha^a

^a Digital Technologies, Manukau Institute of Technology, Auckland, New Zealand

^b Department of Psychology, University of Huddersfield, Huddersfield, UK



Exclusion and Inclusion Criteria Used.

Inclusion Criteria for Apps	Exclusion Criteria for Apps
Focuses on screening	Focuses on simulation therapy
Focuses on dementia, AD, and MCI	Focuses on other cognitive disorders
Available in English language	Not available in English language
Based on a valid medical test	Not based on a valid medical test
	Duplicates found in Android and Apple Stores

App basate:

- su un singolo test di valutazione
- su più test di valutazione
- su test non convenzionali

Summary of all considered AD screening Apps [112].

	App	Downloads	Apple iTunes	Google play Store	Videos	Images	Screening	No of Questions	Time	Free/Paid	Cost	Language
1	MOBI-COG	N/A	X	✓	X	✓	✓	3	3 mins	Paid	N/A	English
2	BrainTest	N/A	✓	✓	✓	✓	✓	Unknown	10–15 mins	Paid	\$39.99	English
3	ACE	N/A	✓	✓	X	✓	✓	24	5–10 mins	Free	N/A	English
4	CAIDE-DRS	1	✓	X	X	X	✓	8	5–10 mins	Free	N/A	English, Finnish, French, German, Russian, Spanish, Swedish
5	DRT	1000+	✓	✓	X	X	✓	8	2–3 mins	Free	N/A	English
6	DementiaScreener	1000+	X	✓	✓	X	✓	11	5 mins	Free	N/A	English
7	MoCA	1	✓	X	X	✓	✓	11	10 mins	Paid	\$10.00	English, Danish, Dutch, Finnish, French, German, Italian, Polish, Portuguese, Spanish, Swedish
8	CDD	N/A	✓	X	X	X	✓	10	10 mins	paid	N/A	English
9	BCI	N/A	✓	X	X	✓	✓	5	10 mins	free	N/A	English, Espanol
10	BrainCheck	N/A	✓	X	X	✓	✓	10	10 mins	Paid	\$4.99	German, English, French, Italian, Spanish and 25 more
11	ALZ	N/A	✓	X	X	✓	✓	100+	30mins –1 hour	Free	N/A	English
12	eSLUMS	N/A	✓	X	X	X	✓	24	7–10 mins	Free	N/A	English and Chinese
13	DTRCD	N/A	✓	X	X	X	✓	11	5 mins	Free	N/A	English, Czech, French, German, Portuguese, Spanish
14	Cognity	500+	✓	✓	✓	✓	✓	30	10–15 mins	Paid	\$8.99	English and Turkce
15	DST	100+	✓	✓	✓	✓	✓	30	10–15 mins	Paid	\$8.49	English
16	MMSE	5000+	X	✓	X	X	✓	10	5 mins	Free	N/A	English
17	DementiaTest	50+	✓	✓	X	X	✓	7	5 mins	Free	N/A	English
18	MMSE	1000+	X	✓	X	✓	✓	13	5 mins	Free	N/A	English
19	6 Cognitive Item Test (6CIT) App	N/A	✓	X	X	X	✓	6	5 mins	Free	N/A	English
20	CognitiveExams	10,000+	X	✓	X	✓	✓	68	45 mins	Paid	\$3.59	English

Number of domains covered by each app and its tests.

No	App	Domains covered						No of Domains Covered
		Complex attention	Executive function	Learning and memory	Language	Perceptual motor	Social cognition	
1	MOBI-COG	X	x	√	x	√	x	2
2	Brain-Test	√	√	√	√	√	x	5
3	ACE	√	x	√	√	√	x	4
4	CAIDE-DRS	X	x	~	x	x	x	0
5	DRT	X	x	~	x	x	x	0
6	Dementia-	√	√	√	√	√	~	5
7	MoCA	√	x	√	√	√	x	4
8	CDD	√	x	√	√	√	x	4
9	BCI	√	√	√	x	x	x	3
10	Brain-Check	X	x	√	x	√	x	2
11	ALZ	√	√	√	√	√	~	5
12	eSLUMS	√	x	√	√	√	x	4
13	DTRCD	√	x	√	√	√	x	4
14	Cognity	X	x	√	x	√	x	2
15	DST	√	√	√	√	x	x	4
16	MMSE	√	x	√	√	√	x	4
17	Dementia	√	x	√	x	x	x	2
18	MMSE	√	x	√	√	√	x	4
19	6CIT	√	x	√	x	x	x	2
20	Cognitive	√	x	√	√	√	~	4

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1	MOBI-COG	X	x	✓	x	✓	x	2
2	Brain-Test	✓	✓	✓	✓	✓	x	5
3	ACE	✓	x	✓	✓	✓	x	4
4	CAIDE-DRS	X	x	~	x	x	x	0
5	DRT	X	x	~	x	x	x	0
6	Dementia-	✓	✓	✓	✓	✓	~	5
7	MoCA	✓	x	✓	✓	✓	x	4
8	CDD	✓	x	✓	✓	✓	x	4
9	BCI	✓	✓	✓	x	x	x	3
10	Brain-Check	X	x	✓	x	✓	x	2
11	ALZ	✓	✓	✓	✓	✓	~	5
12	eSLUMS	✓	x	✓	✓	✓	x	4
13	DTRCD	✓	x	✓	✓	✓	x	4
14	Cognity	X	x	✓	x	✓	x	2
15	DST	✓	✓	✓	✓	x	x	4
16	MMSE	✓	x	✓	✓	✓	x	4
17	Dementia	✓	x	✓	x	x	x	2
18	MMSE	✓	x	✓	✓	✓	x	4
19	6CIT	✓	x	✓	x	x	x	2
20	Cognitive	✓	x	✓	✓	✓	~	4

Number of domains covered by each app and its tests.

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2	Brain-Test	✓	✓	✓	✓	✓	x	5
3	ACE	✓	x	✓	✓	✓	x	4
4	CAIDE-DRS	X	x	~	x	x	x	0
5	DRT	X	x	~	x	x	x	0
6	Dementia-	✓	✓	✓	✓	✓	~	5
7	MoCA	✓	x	✓	✓	✓	x	4
8	CDD	✓	x	✓	✓	✓	x	4
9	BCI	✓	✓	✓	x	x	x	3
10	Brain-Check	X	x	✓	x	✓	x	2
11	ALZ	✓	✓	✓	✓	✓	~	5
12	eSLUMS	✓	x	✓	✓	✓	x	4
13	DTRCD	✓	x	✓	✓	✓	x	4
14	Cognity	X	x	✓	x	✓	x	2
15	DST	✓	✓	✓	✓	x	x	4
16	MMSE	✓	x	✓	✓	✓	x	4
17	Dementia	✓	x	✓	x	x	x	2
18	MMSE	✓	x	✓	✓	✓	x	4
19	6CIT	✓	x	✓	x	x	x	2
20	Cognitive	✓	x	✓	✓	✓	~	4

- **Revisione sistematica delle app nel market** (Google Play, Apple Store)
- **Revisione della letteratura scientifica** (PubMed, Web of Science, Scopus and PsycINFO)

Mobile Health for Traumatic Brain Injury: A Systematic Review of the Literature and Mobile Application Market

Edward Christopher ¹, Kareem W. Alsaffarini ², Aimun A. Jamjoom ³

- 18/53 apps (34.0%) era dedicato a valutazione/screening di funzioni cognitive
- 8 paper...ma solo per intervento e management della malattia

Name	Operating system	Gamification	Downloads	Price (£)
Accident Concussion Scale (ACS)	iOS	-	-	0
BICS	Android	-	1-5	4.92
Concussion Assessment & Response	Android, iOS	-	500-1000	3.10
Concussion Diagnostic Tool	iOS	-	-	0
Concussion Recognition & Response	Android, iOS	-	10000-50000	0
CSx HeadGuard	Android, iOS	-	100-500	0
Don't Pull The Plug!	Android	+	50-100	0
FACT Concussion Test	Android	-	100-500	0
FirstResponder TM Concussion App	Android	-	500-1000	0
Headcheck	iOS	-	-	0
HitCheck: Sideline Concussion Testing	Android, iOS	+	1000-5000	0
King-Devick Test with Mayo Clinic	iOS	-	-	0
MACE Concussion Evaluation	Android	-	50-100	0
Rancho Los Amigos Scale	Android	-	5000-10000	0
SACTool Beta	Android	-	500-1000	0
TBI Prognosis Calculator	Android, iOS	-	1000-5000	0
X2 ICE	iOS	-	-	0
XLNTbrain-mobile	Android	-	500-1000	0

A smartphone sensor-based digital outcome assessment of multiple sclerosis

Xavier Montalban, Jennifer Graves, Luciana Midaglia, Patricia Mulero, Laura Julian, Michael Baker, Jan Schadrack, Christian Gossens, Marco Ganzetti, Alf Scotland, Florian Lipsmeier, Johan van Beek, Corrado Bernasconi, Shibeshih Belachew , Michael Lindemann* and Stephen L Hauser*

Multiple Sclerosis Journal
2022, Vol. 28(4) 654–664

DOI: 10.1177/
13524585211028561

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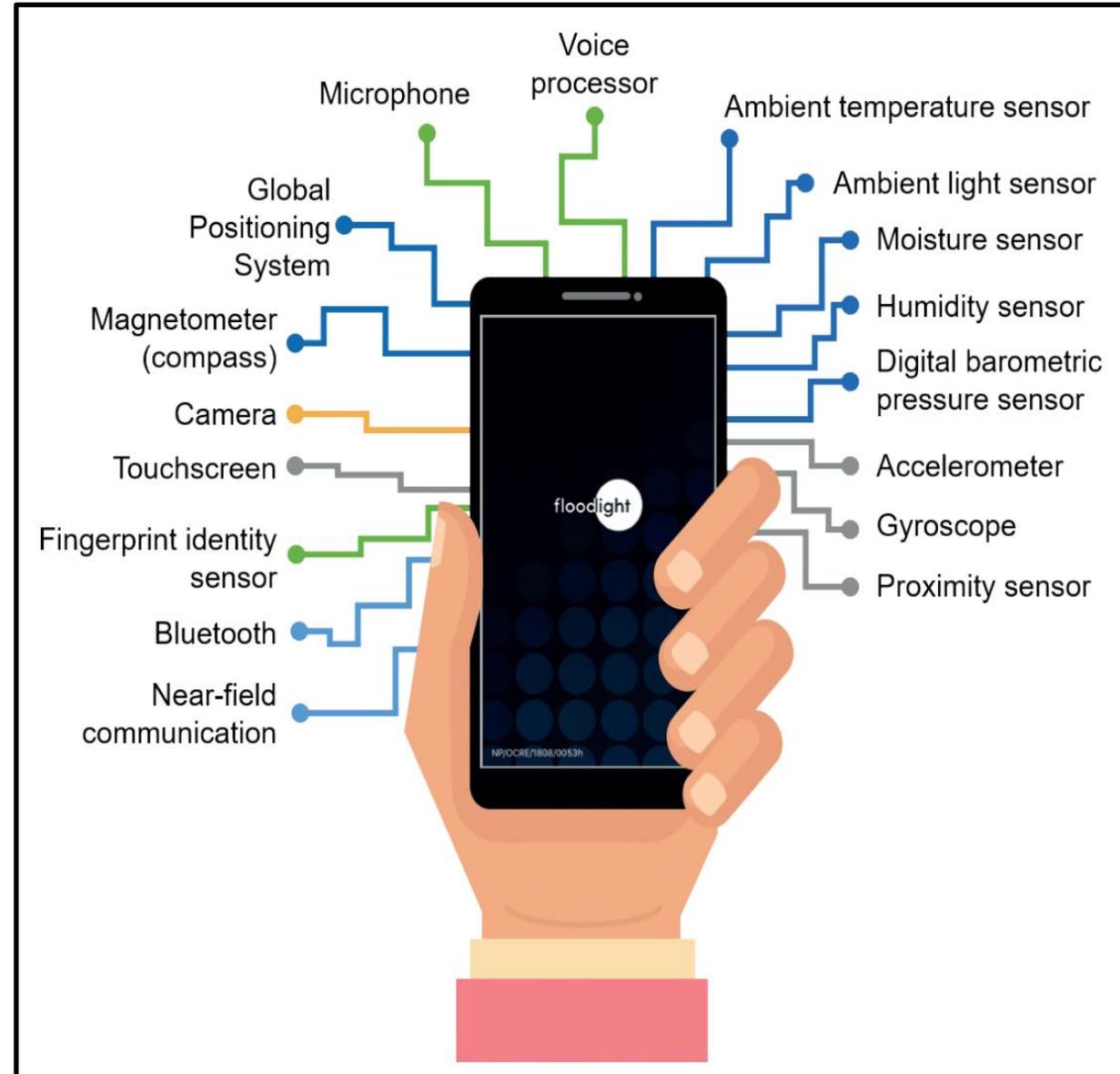
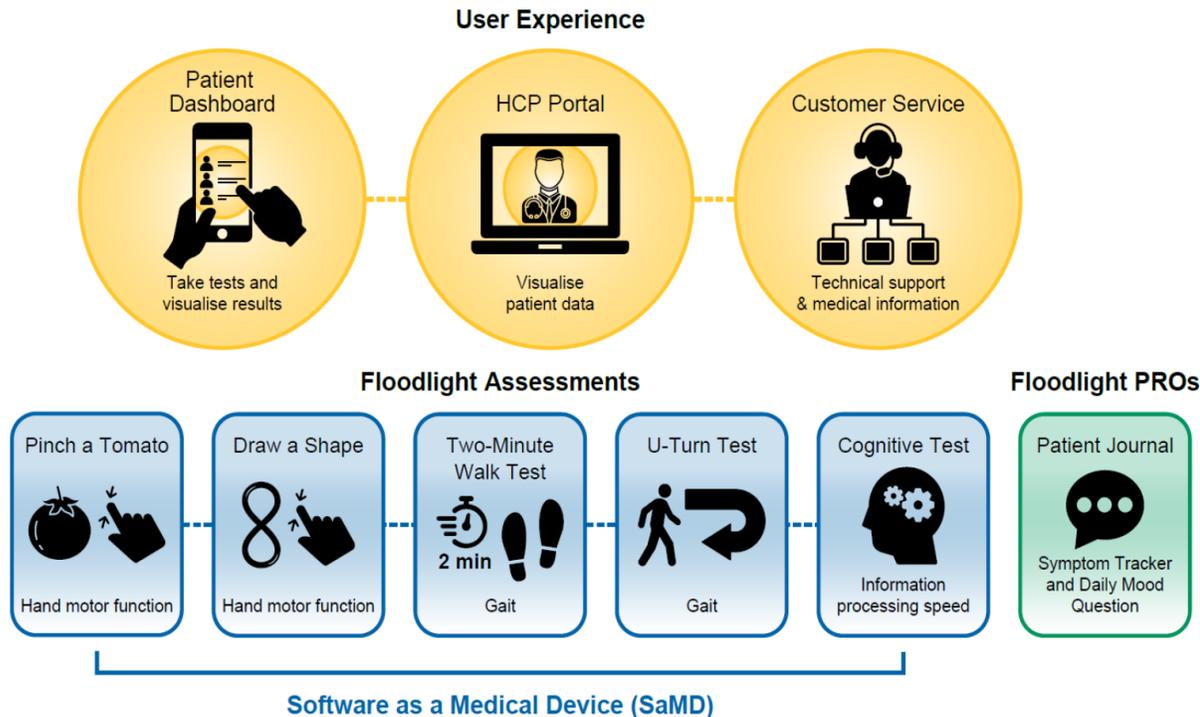


Table 3. Test–retest reliability in PwMS and HC and age- and sex-adjusted Spearman’s rank correlation analysis of the Floodlight PoC app in PwMS.

Domain	Test	Feature	Test–retest reliability ICC (2,1) (95% CI)		Spearman’s rank correlations for PwMS						
			HC	PwMS	Domain-specific standard clinical measure	EDSS	MSIS-29 subscale/ items ^a	T2 FLAIR lesion volume (mL)	Normalized brain volume (mL)		
Cognition		e-SDMT	Number of correct responses (<i>n</i>)	0.55 (0.34–0.80) ^b	0.85 (0.76–0.91) ^c	Oral SDMT	0.82***	−0.43***	−0.52***	−0.42***	0.54***
Upper extremity function		Pinching Test	Double touch asynchrony (s)	0.72 (0.53–0.90) ^d	0.71 (0.62–0.80) ^c	9HPT	0.64***	0.30*	0.35**	0.17	−0.26*
		Pinching Test	Number of successful pinches (<i>n</i>)	0.81 (0.65–0.94) ^d	0.72 (0.61–0.82) ^c	9HPT	−0.52***	−0.26*	−0.33**	−0.12	0.32**
Gait and balance		Draw a Shape Test	Overall mean trace accuracy	0.53 (0.32–0.79) ^b	0.85 (0.79–0.90) ^e	9HPT	−0.48***	−0.40***	−0.40***	−0.26*	0.33**
		Draw a Shape Test	Overall mean trace celerity (s ^{−1})	0.45 (0.25–0.73) ^b	0.81 (0.73–0.87) ^e	9HPT	−0.40***	−0.08	0.03	−0.26*	0.24*
		SBT	Sway path (m/s ²)	0.40 (0.20–0.73) ^f	0.71 (0.61–0.80) ^g	BBS	−0.20	0.24*	0.31**	0.21	−0.05
		UTT	Turn speed (rad/s)	0.45 (0.24–0.75) ^d	0.83 (0.76–0.89) ^h	T25FW	−0.52***	−0.45***	−0.39***	−0.13	0.27*
Gait and balance		Walk Test	Step power	0.85 (0.70–0.95) ^f	0.78 (0.70–0.86) ⁱ	T25FW	−0.31**	−0.28*	−0.24*	0.04	−0.02
		Passive Monitoring	Turn speed (rad/s)	0.66 (0.42–0.89) ^j	0.72 (0.61–0.82) ^k	T25FW	−0.25*	−0.27*	−0.12	−0.11	0.14
		Passive Monitoring	Step power	0.63 (0.39–0.88) ^j	0.61 (0.48–0.74) ^k	T25FW	−0.33**	−0.19	−0.22	0.09	0.00

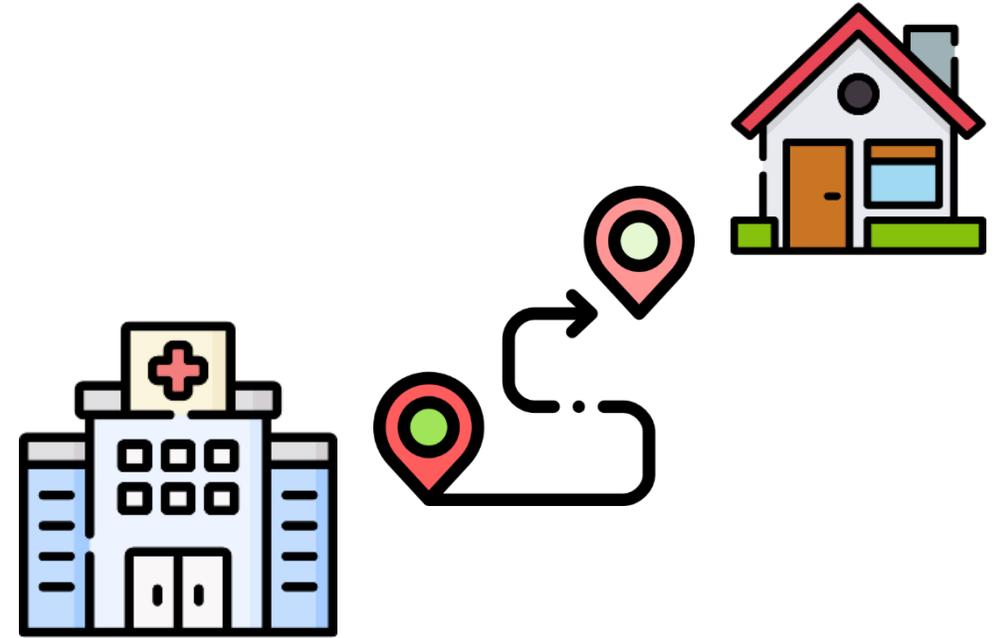
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		UTT	Turn speed (rad/s)	0.45 (0.24–0.75) ^d	0.83 (0.76–0.89) ^h	T25FW	–0.52***	–0.45***	–0.39***	–0.13	0.27*
Gait and balance		Walk Test	Step power	0.85 (0.70–0.95) ^f	0.78 (0.70–0.86) ⁱ	T25FW	–0.31**	–0.28*	–0.24*	0.04	–0.02
		Passive Monitoring	Turn speed (rad/s)	0.66 (0.42–0.89) ^j	0.72 (0.61–0.82) ^k	T25FW	–0.25*	–0.27*	–0.12	–0.11	0.14
		Passive Monitoring	Step power	0.63 (0.39–0.88) ^j	0.61 (0.48–0.74) ^k	T25FW	–0.33**	–0.19	–0.22	0.09	0.00



Telemedicina

modalità di erogazione di servizi di assistenza sanitaria, tramite il ricorso a tecnologie innovative in situazioni in cui **il clinico e il paziente non si trovano nella stessa località.**





Equità di accesso alle cure



Efficienza dei servizi erogati



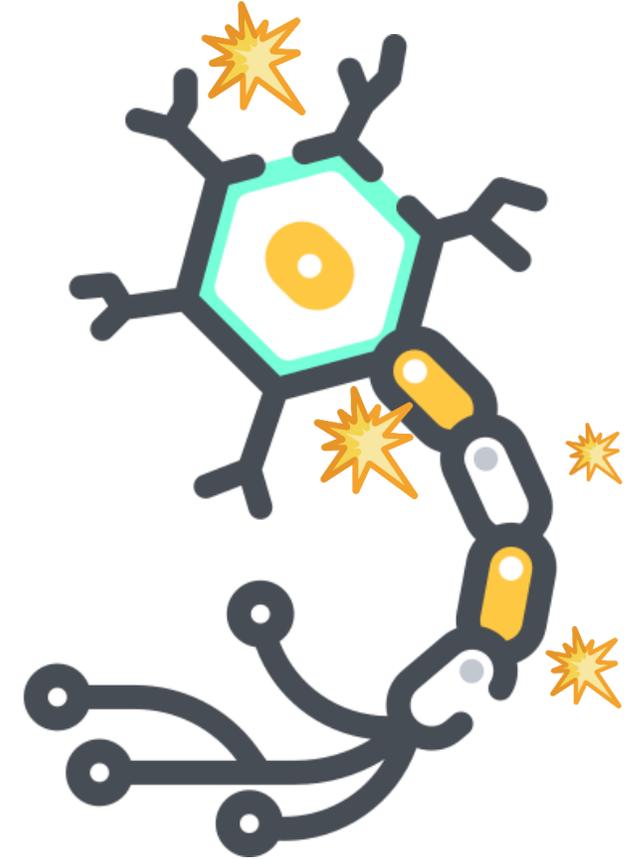
Contenimento della spesa sanitaria

**Rivoluzione
tecnologica e
culturale**

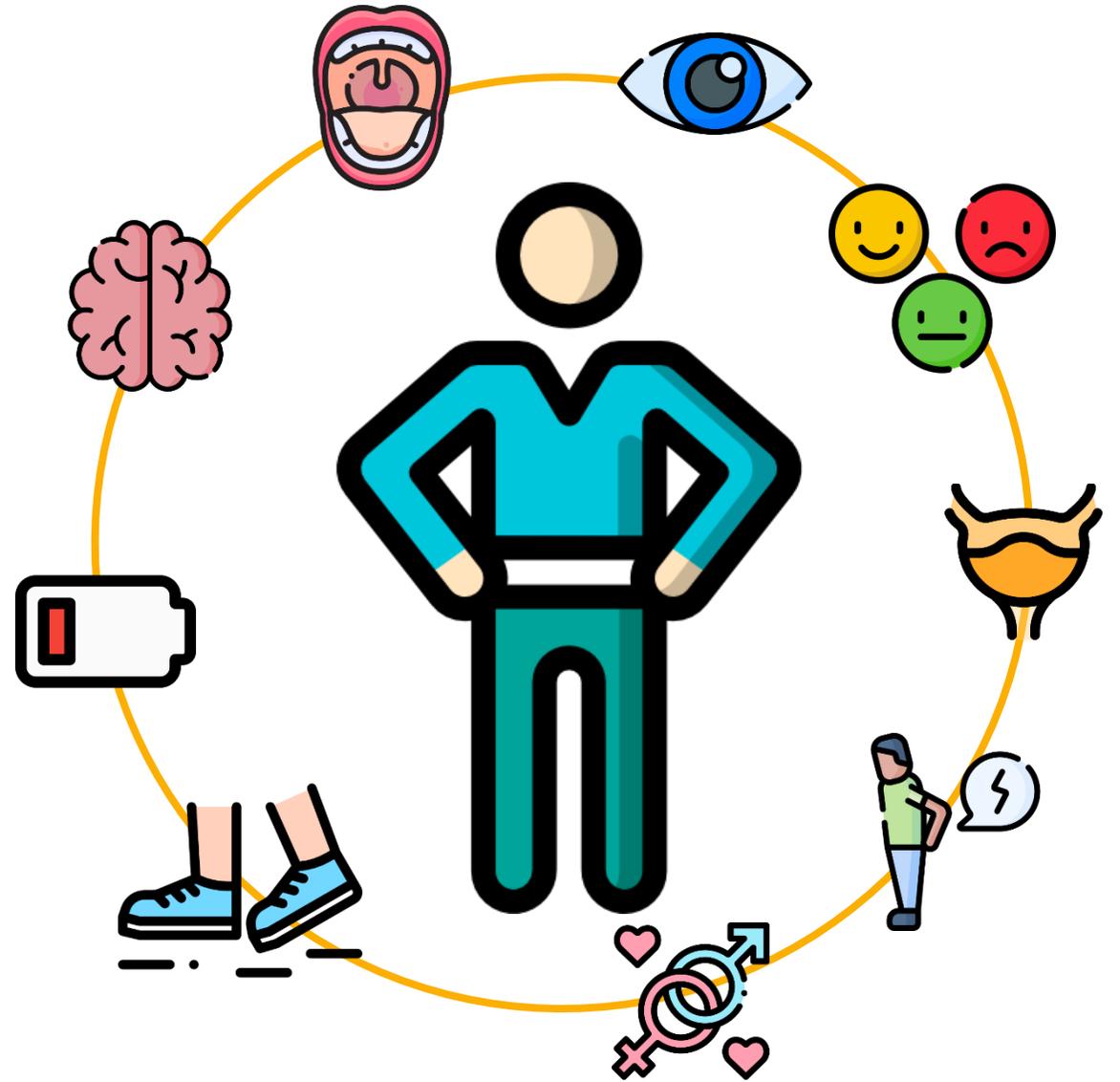


Sclerosi Multipla (SM)

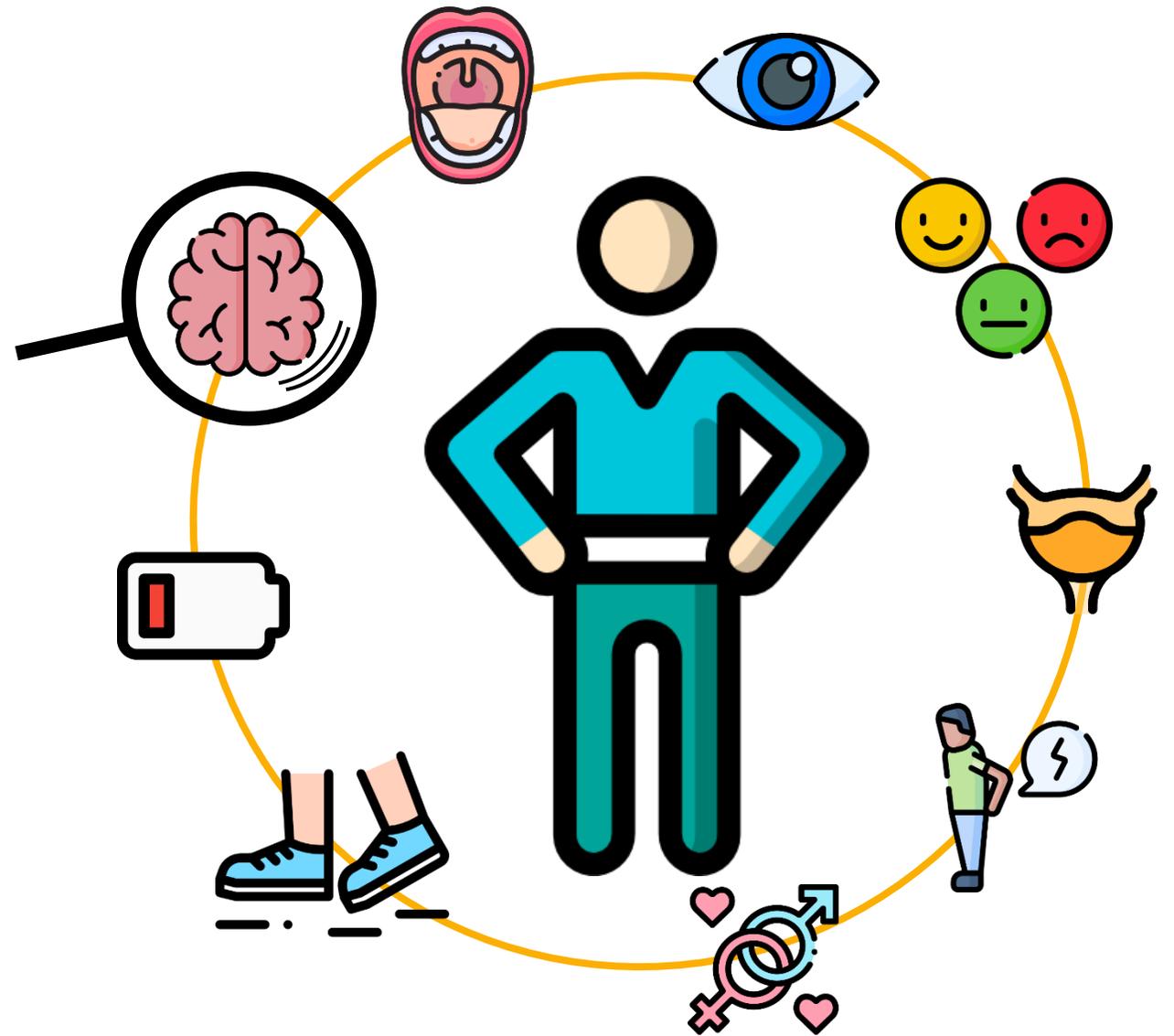
- Neurodegenerativa
- Autoimmune
- Infiammatoria demielinizzante



**Una sindrome,
tanti sintomi.**



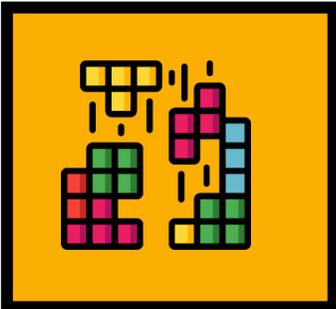
**Una sindrome,
tanti sintomi,
alcuni invisibili.**



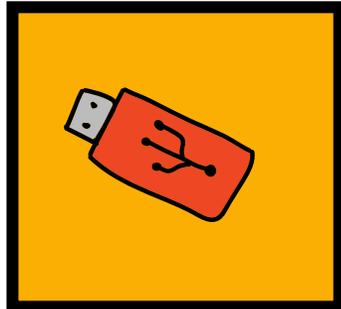
Disturbi cognitivi e SM

Amato et al., 2019; Chiaravalloti et al., 2008; Grzegorski & Losy, 2017; Podda et al., 2021

Elaborazione
informazioni



Apprendimento e
memoria



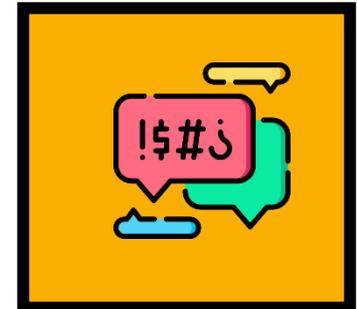
Attenzione e
concentrazione



Funzioni
esecutive



Linguaggio





*“Il corpo faccia quello che vuole,
io sono la mente.”*

(Rita Levi-Montalcini)

Validity of a computerized version of the Symbol Digit Modalities Test in multiple sclerosis

Nadine Akbar · Kimia Honarmand ·
Nancy Kou · Anthony Feinstein

Multiple Sclerosis and Related Disorders 38 (2020) 101479



Contents lists available at ScienceDirect

Multiple Sclerosis and Related Disorders

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



Clinical trial

Introducing Multiple Screener: An unsupervised digital screening tool for cognitive deficits in MS

L. van Dongen^a, B. Westerik^a, K. van der Hiele^b, L.H. Visser^{c,d}, M.M. Schoonheim^a, L. Douw^a, J.W.R. Twisk^e, B.A. de Jong^f, J.J.G. Geurts^a, H.E. Hulst^{a,*}



iCAMS

Assessing the Reliability of a Brief International Cognitive Assessment for Multiple Sclerosis (BICAMS) Tablet Application

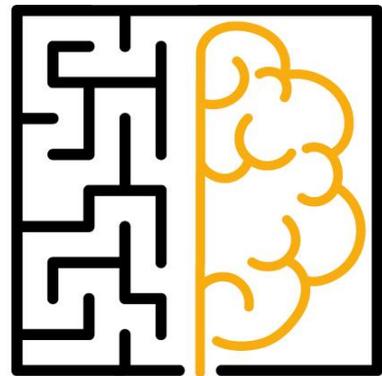
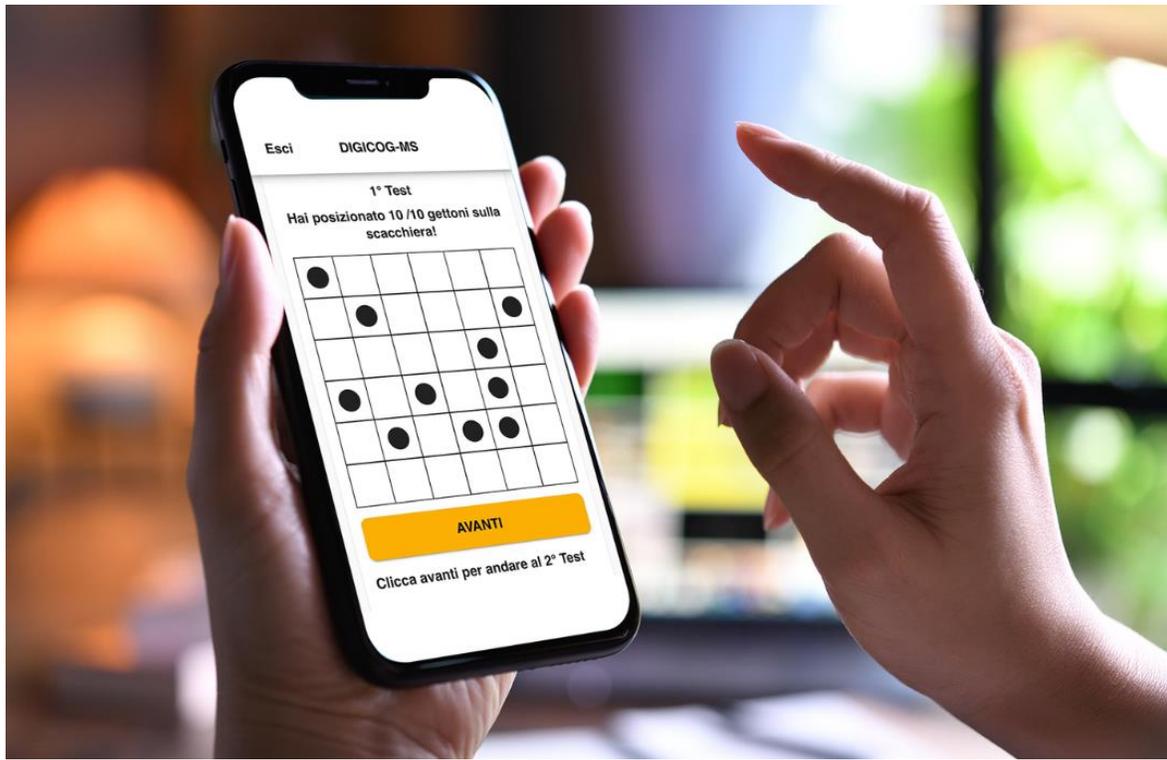
Meghan Beier, PhD; Kevin Alschuler, PhD; Dagmar Amtmann, PhD; Abbey Hughes, PhD;
Renee Madathil, PhD; Dawn Ehde, PhD

MULTIPLE
SCLEROSIS
JOURNAL | MSJ

Original Research Paper

A smartphone sensor-based digital outcome assessment of multiple sclerosis

Xavier Montalban, Jennifer Graves, Luciana Midaglia, Patricia Mulero, Laura Julian, Michael Baker, Jan Schadrack, Christian Gossens, Marco Ganzetti, Alf Scotland, Florian Lipsmeier, Johan van Beek, Corrado Bernasconi, Shibeshih Belachew^{ID}, Michael Lindemann* and Stephen L Hauser*



DIGI
COG
ms

SCLE
ROSI
MULT
IPLA
associazione
italiana
un mondo
libero dalla SM

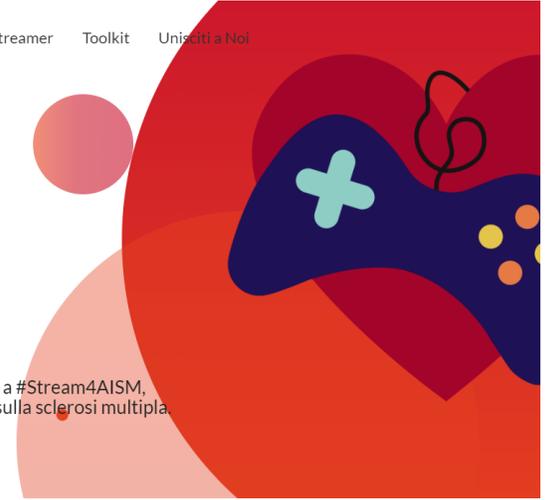
#Stream4AISM Progetto Eventi Streamer Toolkit Unisciti a Noi

#Stream4AISM

Sosteniamo la ricerca, una live alla volta!

Che tu sia un pro di Twitch o alla prima live dedica una tua diretta a #Stream4AISM, la maratona di live-streaming a sostegno della ricerca scientifica sulla sclerosi multipla.

UNISCITI A NOI



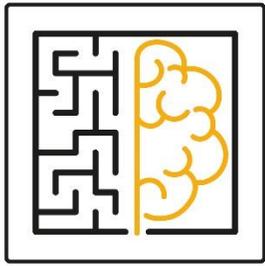
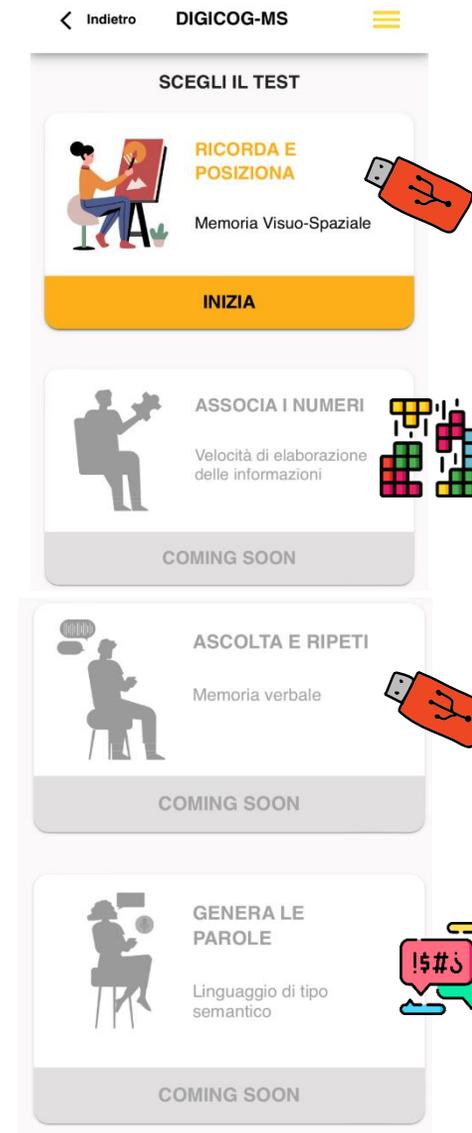
SCLE
ROSI
MULT
IPLA
ONLUS
fondazione
italiana
un mondo
libero dalla SM

Partner tecnico

ESolution

DIGICOG-MS è Digitale e Innovativa

Test digitali ispirati a quelli carta e matita
utilizzati per misurare le funzioni cognitive più
frequentemente colpite dalla SM

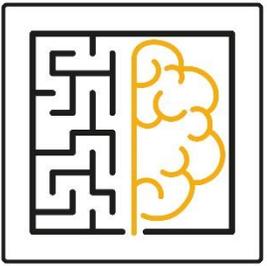


DIGICOG-MS è

Ibrida

Scelta tra due modalità di assessment:

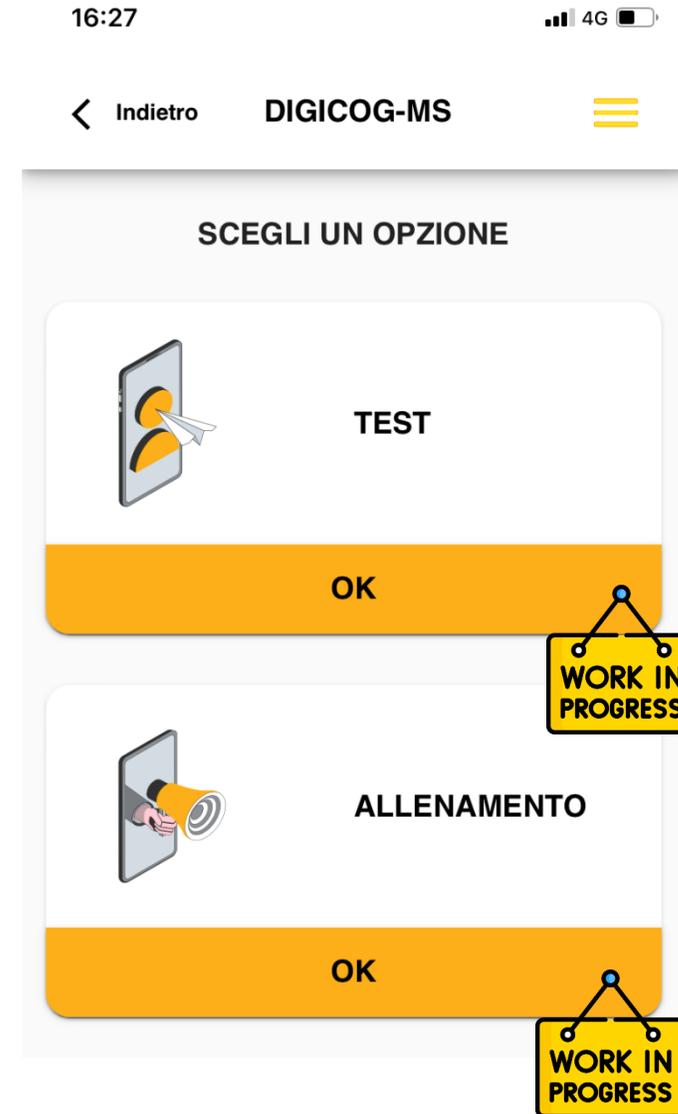
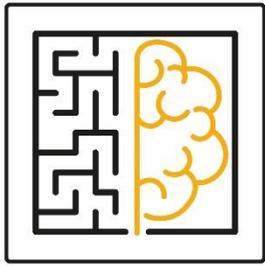
- Autonoma (ie, senza supporto del clinico)
- Guidata (ie, con l'aiuto del clinico tramite videocall)



DIGICOG-MS è Modulare

Intervento globale focalizzato sul funzionamento cognitivo:

- Test (ie, valutazione)
- Allenamento (ie, riabilitazione)



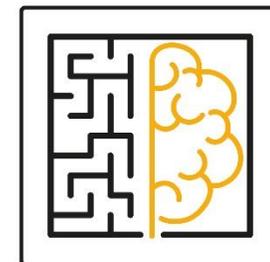


Da giugno 2022

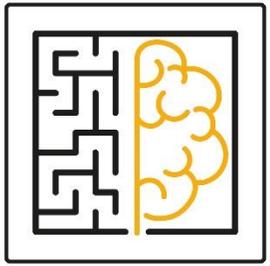
Da settembre 2022

Da agosto 2022

Da agosto 2022



Prossimi step



1



Completamento
sviluppo, usabilità e
validazione app

2



Rilascio su store

3



Valutazione della conformità
come dispositivo medico e
marchiatura CE



Valutazione cognitiva a domicilio

Personalizzazione sui bisogni e caratteristiche individuali

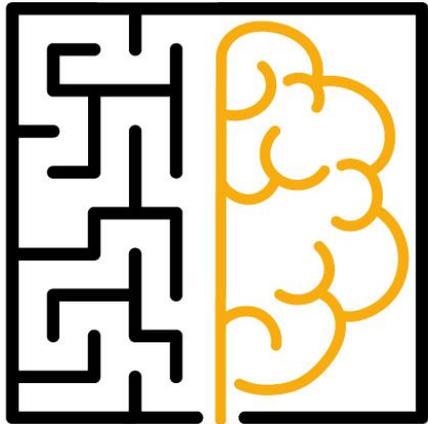
Supporto al caregiver nella gestione del familiare con SM



Accuratezza in fase di valutazione e scoring

Monitoraggio continuo nel tempo della persona con SM

Screening a più persone con SM contemporaneamente



DIGI
COG

ms

***per le persone con SM
con le persone con SM***



Grazie per l'attenzione



<https://digicog-ms.aism.it/>

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LE SFIDE DELLE TECNOLOGIE DIGITALI PER LA SALUTE DEL FUTURO

PISA | 8 luglio 2022

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