MULTI-DISCIPLINARY APPROACH IN REHABILITATION: HOW CAN DIGITAL HEALTH IMPROVE IT?

Prof. Daphne Kos
Vice President RIMS

KU LEUVEN

ARTESIS PLANTIJN HOGESCHOOL ANTWERPEN

RIMS REHABILITATION IN MULTIPLE SCLEROSIS
European network for best practice and research

OUTLINE

- Rehabilitation
- Use of technology in rehab
- Examples
- Key messages

Vision of RIMS (Rehabilitation in MS)

access to evidence-based rehabilitation

for all people with MS

throughout Europe (and abroad)

when they need it

Rehabilitation

participation

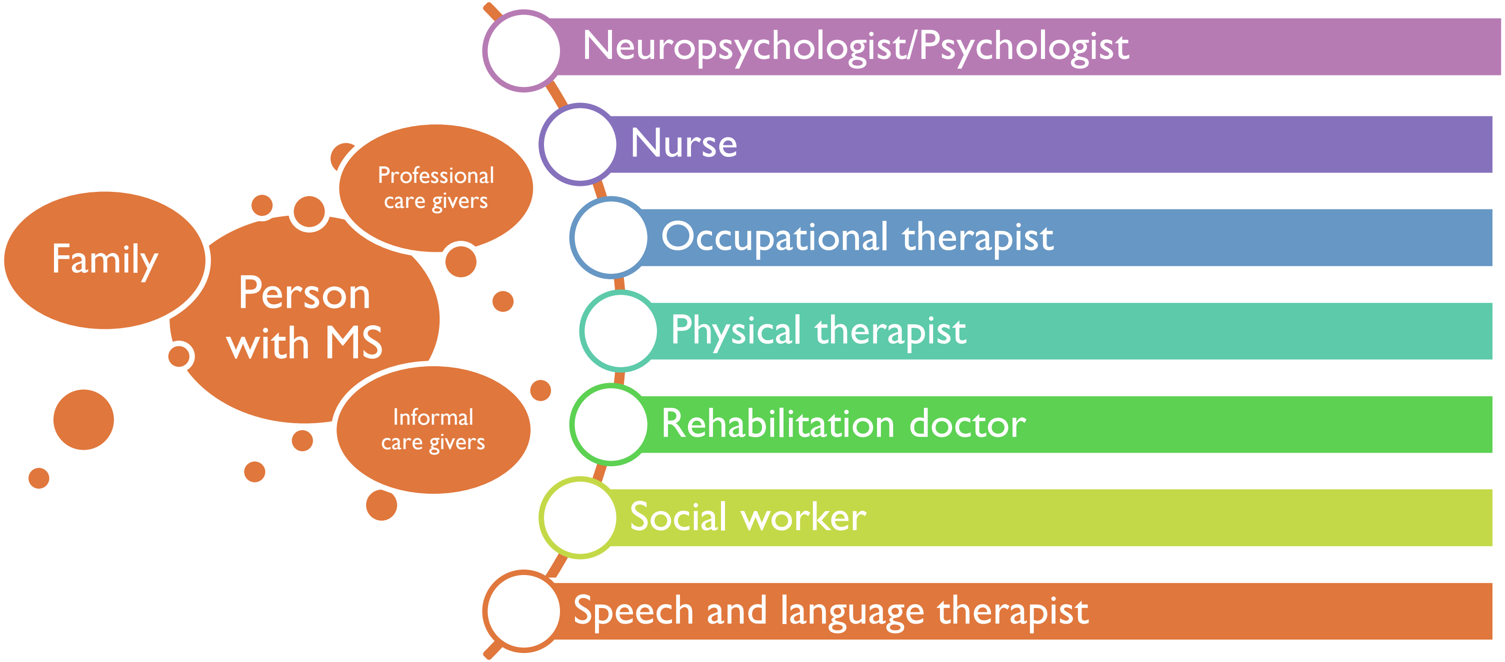
activity

autonomy

RIMS REHABILITATION IN MULTIPLE SCLEROSIS
European network for best practice and research

Pictures: all-free-download.com; www.melbournecitymission.org.au; http://www.michaelleestallard.com

Rehabilitation partners



Other relevant health care professionals

Content of rehabilitation

Intervention	No studies, participants	Inpatient	Community	Long-term survivorship	GRADE*
Multidisciplinary rehabilitation	9 RCTs, 1 CCT, 954				Moderate
Physical therapy	76 trials (45 RCTs)				High
Progressive resistance training	6 RCTs, 6 non-RCTs, 289				Low
Strength training	5 RCTs, 2 CCTs 249				Moderate
Exercise therapy (walking)	35 RCTs, 1255				High
Exercise therapy (fatigue)	60 RCTs, 2952				High
Physical therapy (balance)	11 RCTs, 340				Low
Exercise therapy (depression)	15 RCTs, 591				Low
Exercise therapy (cognition)	8 RCTs, 644				Low
Respiratory muscle training	15 trials (6 RCTs)				Low
Energy conservation	4 RCTs, 2 CCTs, 494				Moderate
HBOT	9 RCTs, 504				Low
WBV	11 RCTs, 314				Low
Electrical stimulation	1 RCT, 40				Very low
Hippotherapy	3 non-RCTs, 36				Very low
OT	96 trials				Low
Neuropsychological	20 RCTs, 986				Low
Cognitive rehabilitation	32 RCTs, 1527				Low
Cognitive Behavioural Therapy	7 RCTs				Moderate
Memory rehabilitation	8 RCTs, 521				Low
Dietary intervention (PUFAs)	6 RCTs, 794				Low
Dietary intervention (Vitamin D)	1 RCT, 49				Very low
Vocational rehabilitation	1 RCT, 1 CCT, 80				Low
Telerehabilitation	9 RCTs, 531				Low
Fatigue management programs	18 trials, 895				High
Upper limb rehab	41 trials (16 RCTs)				Low
Spasticity management interventions	9 RCTs, 341				Low

Khan F, Amatya B (2017). Rehabilitation in Multiple Sclerosis: A Systematic Review of Systematic Reviews. *Archives of Physical Medicine and Rehabilitation*, 98(2), 353-367.

Telerehabilitation

Cochrane Library
Cochrane Database of Systematic Reviews

Telerehabilitation for persons with multiple sclerosis (Review)

Khan F, Amatya B, Kesselring J, Galea M.
Telerehabilitation for persons with multiple sclerosis.
Cochrane Database of Systematic Reviews 2015, Issue 4. Art. No.: CD010508.
DOI: 10.1002/14651858.CD010508.pub2.

Approach

- Exercises
- Education

Outcomes

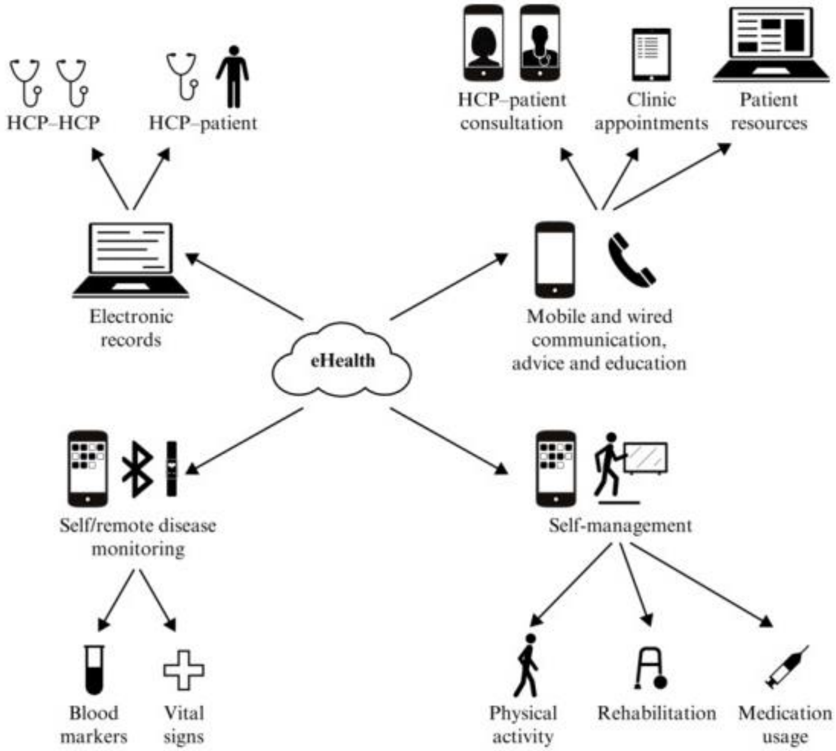
- Fatigue
- Physical functioning (balance, postural control, physical activity, arm/hand function)
- Quality of Life
  Depression & Anxiety

Technology

- Virtual Reality
- Video
- Telephone
- Internet

Effectiveness

- Low quality evidence for short- and long term effects
- Improvement of function, activity & QoL
- No cost-effectiveness studies

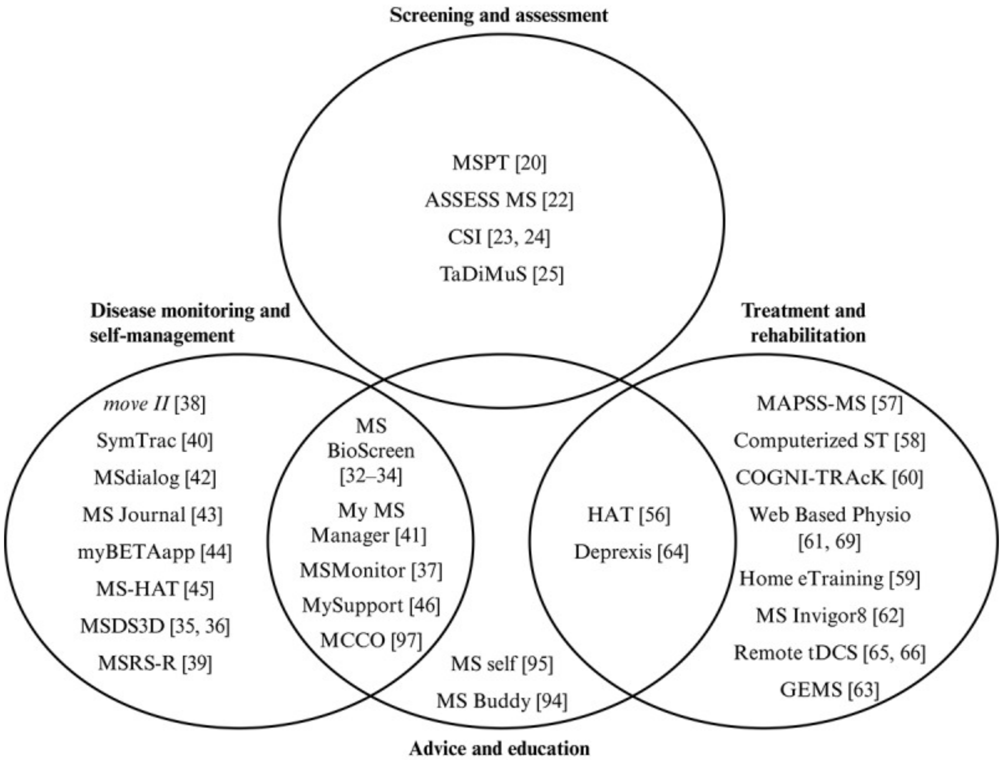


Viewpoint

The Use of Digital and Remote Communication Technologies as a Tool for Multiple Sclerosis Management: Narrative Review

Martin Marziniak[1], MD, PhD; Giampaolo Brichetto[2], MD, PhD; Peter Feys[3], PhD; Uta Meyding-Lamadé[4], MD, PhD; Karen Vernon[5], RGN, PGDip; Sven G Meuth[6], MD, PhD

eHealth technologies in MS



Marziniak et al., 2018

Monitoring: biosensors

MULTIPLE SCLEROSIS JOURNAL | MSJ

Topical Review

e-Health and multiple sclerosis: An update

Luigi Lavorgna, Francesco Brigo, Marcello Moccia, Letizia Leocani, Roberta Lanzillo, Marinella Clerico, Gianmarco Abbadessa, Klaus Schmierer, Claudio Solaro, Luca Prosperini, Gioacchino Tedeschi, Gavin Giovannoni and Simona Bonavita

Multiple Sclerosis Journal
2018, Vol. 24(13) 1657–1664
DOI: 10.1177/1352458518799629

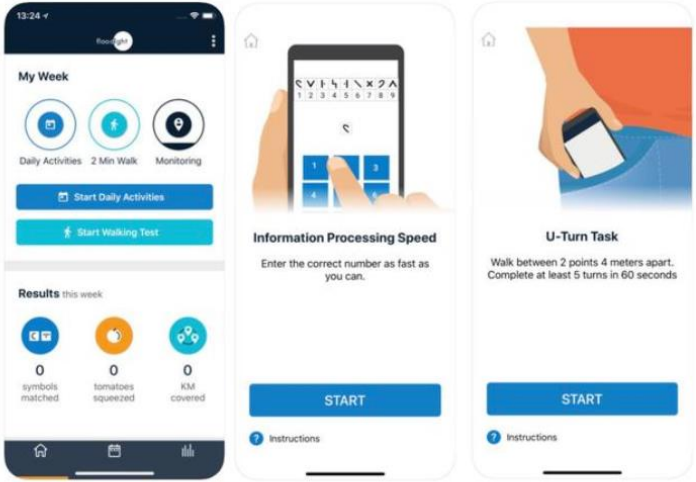
Table 2. Function and possible application of different biosensors in multiple sclerosis.

Biosensor	Function	Potential applications in MS
Accelerometer	Measure linear acceleration in one axis (uni-axial accelerometers) or in tridimensional field (tri-axial accelerometers)	Analysis of gait patterns Measurement of total step count Identification and quantification of falls Development of algorithms to predict fall risk Gait training
Gyroscope	Measure angular velocity, record orientation and postural changes. Record movement, collect data on acceleration and angle of force.	Identification of falls Identification of movement of climbing and descending stairs Analysis of gait patterns Analysis of static balance Identification and measurement of tremor Identification and measurement of ataxia Gait training Development of assistive technology (e.g. eating utensils)
Eye-tracking through near infrared light	Measurement of pupil center and corneal reflection	Assessment of function and responsiveness of cornea and pupil
Heart rate monitors	Measure heart rate	Assessment of heart reactivity during movement or postural changes
Body temperature monitors	Measure body temperature	Identification of pseudorelapses by correlating heat-related disability
Actigraphy	Measure body movements	Identification and characterization of sleep abnormalities, measurement of sleep duration and assessment of sleep efficiency

MS: multiple sclerosis.

Monitoring using mobile phone & wearables

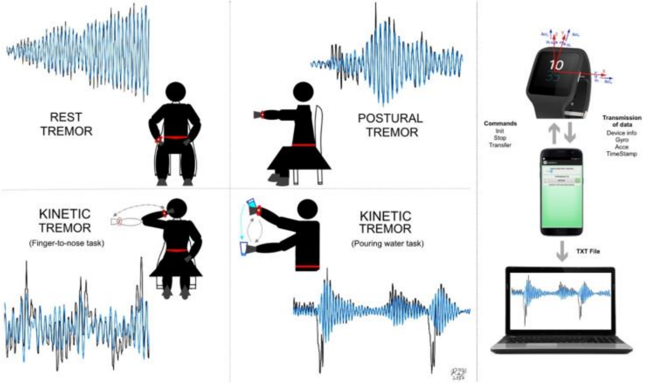
Small physical & cognitive tests & subjective scores



(Credit: Screenshot by Download.com)

www.floodlightopen.com

Essential tremor analysis



López-Blanc et al., 2018

Physical activity & sleep

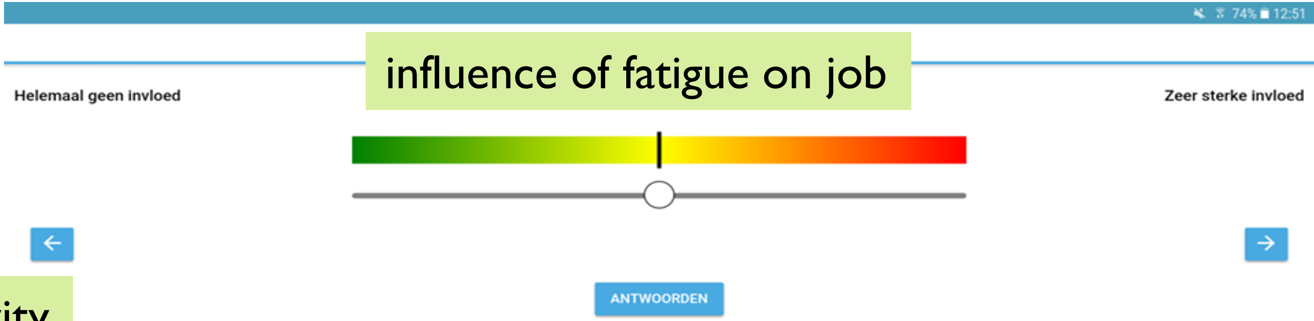
Sanders et al., 2016

Improving physical activity & fatigue

D'hooghe et al., 2018

Monitoring (influence of) symptoms in MS using mobile application

influence of fatigue on job



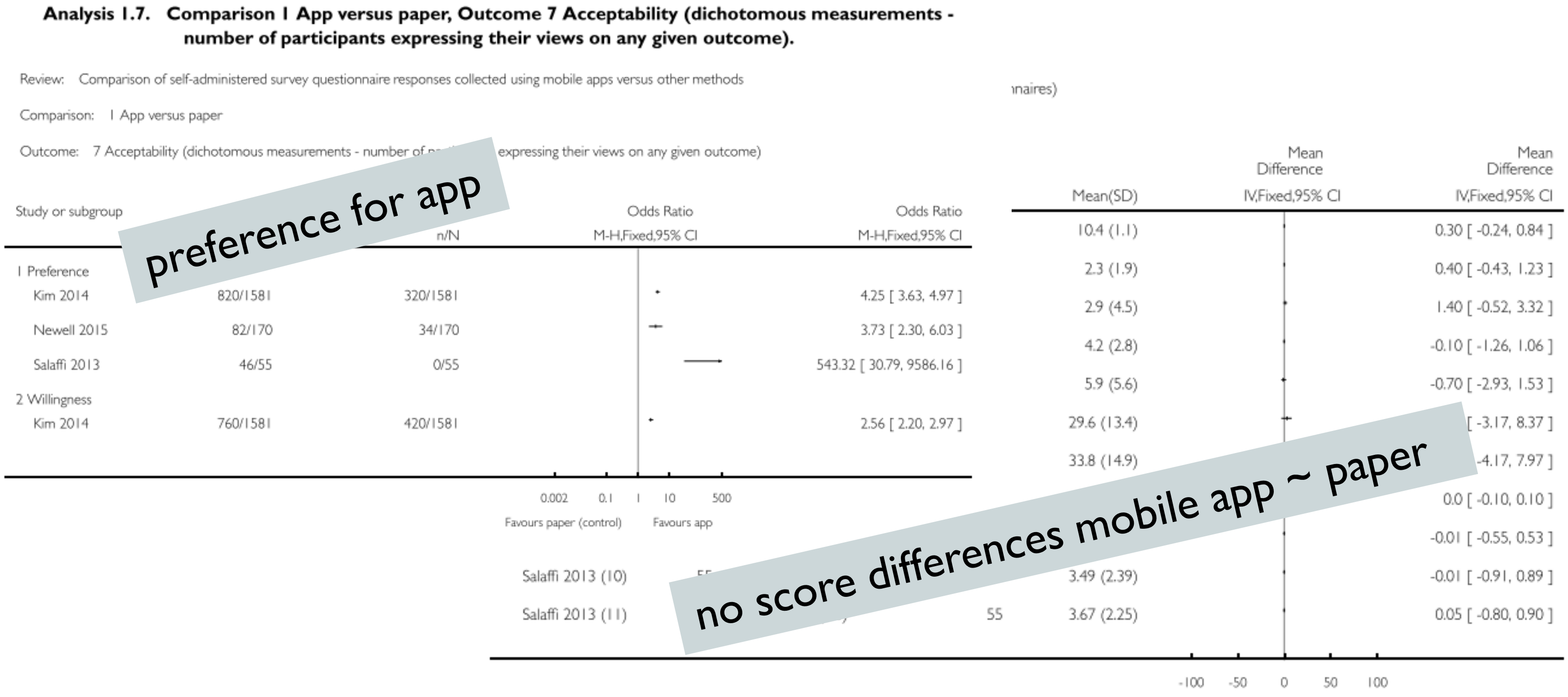
fatigue during activity

Monitoring/Outcome measure

Integrated in diary

Kos et al., 2017: Van Malleghem et al., 2017

Assessment: self-report using mobile application



preference for app

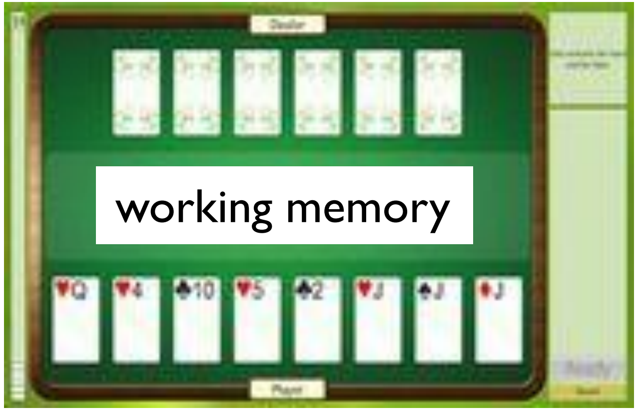
no score differences mobile app ~ paper

Belisario et al., 2015

Assessment & training upper limb using sensors & VR

Behrendt & Schuster-Amft, 2018

Computer-based cognitive training



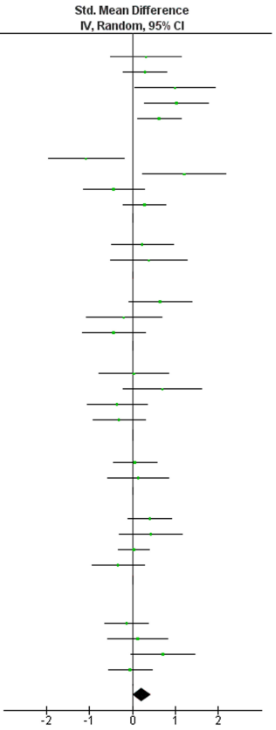
www.rehacom.com/

Computer-based cognitive training: evidence

memory

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
1.1.1 Selective Reminding Test (SRT) delay memory								
Cerasa, et al., 2012	7.11	2.53	12	6.2	3.02	11	3.0%	0.32 [-0.51, 1.14]
Stuifbergen et al., 2012	43.63	11.32	34	40.43	9.34	27	4.3%	0.30 [-0.21, 0.81]
Brissart et al., 2013	7.7	1.17	10	4.8	3.77	10	2.7%	1.00 [0.05, 1.94]
Bonavita et al., 2015	8.17	1.77	18	6.42	1.5	14	3.3%	1.03 [0.28, 1.78]
Perez-Martin et al., 2017	8.03	2.79	30	6.22	2.86	32	4.3%	0.63 [0.12, 1.14]
1.1.2 Spatial Recall Test								
Cerasa, et al., 2012	18.42	6.22	12	24.3	3.99	11	2.8%	-1.07 [-1.96, -0.19]
Brissart et al., 2013	13.4	1.65	10	10.07	3.33	10	2.6%	1.21 [0.24, 2.19]
Bonavita et al., 2015	16.81	5.14	18	19.23	5.74	14	3.5%	-0.44 [-1.14, 0.27]
Perez-Martin et al., 2017	22.77	5.56	30	21.38	4.14	32	4.3%	[illegible]
1.1.3 Digit Span Forward								
Vogt et al., 2009	9.21	1.93	15	8.8	[illegible]	[illegible]	[illegible]	[illegible]
Brissart et al., 2013	5.9	0.74	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.1.4 Digit Span Backward								
Vogt et al., 2009	7.87	2.38	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Brissart et al., 2013	4.3	1.16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-0.20 [-1.08, 0.68]
Hancock et al., 2015	4.8	1.74	[illegible]	[illegible]	[illegible]	[illegible]	3.4%	-0.43 [-1.16, 0.29]
1.1.5 Verbal Fluency word list								
Cerasa, et al., 2012	20.8	5.69	[illegible]	20.6	5.59	11	3.1%	0.03 [-0.78, 0.85]
Brissart et al., 2013	18.5	2.83	10	15.7	4.56	10	2.8%	0.71 [-0.20, 1.62]
Bonavita et al., 2015	16.84	2.82	18	17.98	3.54	14	3.5%	-0.35 [-1.06, 0.35]
Rilo et al.,2016	27.62	5.59	21	30.57	11.91	21	3.9%	-0.31 [-0.92, 0.30]
1.1.6 Brief Visuospatial Memory Test-delay (BVMT)								
Stuifbergen et al., 2012	9.3	3	34	9.1	3.1	27	4.3%	0.06 [-0.44, 0.57]
Hancock et al., 2015	21.13	4.95	15	20.29	6.85	15	3.4%	0.14 [-0.58, 0.85]
1.1.7 Verbal Learning Test-delay (VLT)								
Stuifbergen et al., 2012	12.3	3.6	34	10.7	4.1	27	4.3%	0.41 [-0.10, 0.92]
Hancock et al., 2015	51.33	10.12	15	46.33	12.36	15	3.4%	0.43 [-0.29, 1.16]
Hanssen et al., 2016	58.2	11.8	60	57.8	10.7	60	4.9%	0.04 [-0.32, 0.39]
Rilo et al.,2016	8.71	2.67	21	9.48	1.81	21	3.9%	-0.33 [-0.94, 0.28]
1.1.8 Paced Auditory Serial Addition Test-3 s (PASAT)								
Cerasa, et al., 2012	36.2	9.75	12	-41	8.79	11	0.6%	8.00 [5.33, 10.66]
Stuifbergen et al., 2012	45.2	11.2	34	46.7	11.2	27	4.3%	-0.13 [-0.64, 0.37]
Bonavita et al., 2015	40	7.76	18	38.95	7.98	14	3.5%	0.13 [-0.57, 0.83]
Hancock et al., 2015	93.64	15.49	15	78.57	24.65	15	3.3%	0.71 [-0.03, 1.45]
Perez-Martin et al., 2017	29.7	15.48	30	30.44	16.08	32	4.3%	-0.05 [-0.54, 0.45]
Total (95% CI)			**588**			**546**	**100.0%**	**0.22 [0.01, 0.43]**

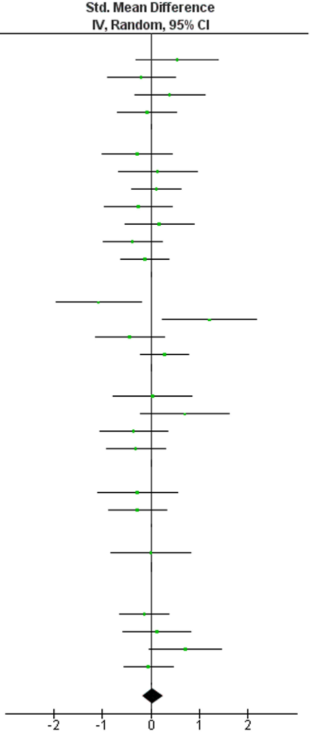
Heterogeneity: $Tau^2 = 0.20$; $Chi^2 = 79.64$, df = 28 ($P < 0.00001$); $I^2 = 65\%$
Test for overall effect: Z = 2.04 (P = 0.04)
Test for subgroup differences: $Chi^2 = 10.62$, df = 7 (P = 0.16), $I^2 = 34.1\%$



processing speed

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
1.1.1 Stroop Color–Word Interference Test (SCWIT)								
Cerasa, et al., 2012	19.41	5.14	12	16.5	5.22	11	3.2%	0.54 [-0.29, 1.38]
Bonavita et al., 2015	89.66	28.42	18	96.96	44.89	14	3.8%	-0.20 [-0.90, 0.51]
Hancock et al., 2015	35.93	6.68	15	33.2	6.94	15	3.7%	0.39 [-0.33, 1.11]
Rilo et al.,2016	42.77	11.6	21	43.62	11.36	21	4.2%	-0.07 [-0.68, 0.53]
1.1.2 Symbol Digit Modalities Test								
Vogt et al., 2009	53.87	14.7	15	58.67	19.19	15	3.7%	-0.27 [-0.99, 0.45]
Cerasa, et al., 2012	38.69	9.9	12	37.3	8.45	11	3.3%	0.15 [-0.67, 0.96]
Stuifbergen et al., 2012	49.6	11.1	34	48.1	14	27	4.7%	[illegible]
Bonavita et al., 2015	28.22	7.99	18	30.87	12.72	14	[illegible]	[illegible]
Hancock et al., 2015	53.13	10.79	15	50.67	15.86	[illegible]	[illegible]	[illegible]
Rilo et al.,2016	42.62	12.46	21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Perez-Martin et al., 2017	46.47	13.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.1.3 Spatial Recall Test								
Cerasa, et al., [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-1.07 [-1.96, -0.19]
Brissart et al., [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.7%	1.21 [0.24, 2.19]
Bonavita et al., [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.74	14	3.8%	-0.44 [-1.14, 0.27]
Perez-Martin et al.	[illegible]	[illegible]	[illegible]	21.38	4.14	32	4.8%	0.28 [-0.22, 0.78]
1.1.4 Verbal Fluen[illegible]								
Cerasa, et al., 2012	20.8	5.69	12	20.6	5.59	11	3.3%	0.03 [-0.78, 0.85]
Brissart et al., 2013	18.5	2.83	10	15.7	4.56	10	2.9%	0.71 [-0.20, 1.62]
Bonavita et al., 2015	16.84	2.82	18	17.98	3.54	14	3.8%	-0.35 [-1.06, 0.35]
Rilo et al.,2016	27.62	5.59	21	30.57	11.91	21	4.2%	-0.31 [-0.92, 0.30]
1.1.5 Trail Making Test A								
Cerasa, et al., 2012	-44.83	13.1	12	-40.9	13.94	11	3.3%	-0.28 [-1.10, 0.54]
Rilo et al.,2016	-45.24	16.53	21	-40.43	18.23	21	4.2%	-0.27 [-0.88, 0.34]
1.1.6 Trail Making Test B								
Cerasa, et al., 2012	-120.9	37.9	12	-121.1	37.4	11	3.3%	0.01 [-0.81, 0.82]
1.1.7 Paced Auditory Serial Addition Test-3 s (PASAT)								
Cerasa, et al., 2012	36.2	9.75	12	-41	8.79	11	0.6%	8.00 [5.33, 10.66]
Stuifbergen et al., 2012	45.2	11.2	34	46.7	11.2	27	4.7%	-0.13 [-0.64, 0.37]
Bonavita et al., 2015	40	7.76	18	38.95	7.98	14	3.8%	0.13 [-0.57, 0.83]
Hancock et al., 2015	93.64	15.49	15	78.57	24.65	15	3.6%	0.71 [-0.03, 1.45]
Perez-Martin et al., 2017	29.7	15.48	30	30.44	16.08	32	4.8%	-0.05 [-0.54, 0.45]
Total (95% CI)			**496**			**461**	**100.0%**	**0.04 [-0.17, 0.25]**

Heterogeneity: $Tau^2 = 0.18$; $Chi^2 = 64.69$, df = 26 ($P < 0.0001$); $I^2 = 60\%$
Test for overall effect: Z = 0.35 (P = 0.73)
Test for subgroup differences: $Chi^2 = 4.90$, df = 6 (P = 0.56), $I^2 = 0\%$



Dardiotis et al., 2018

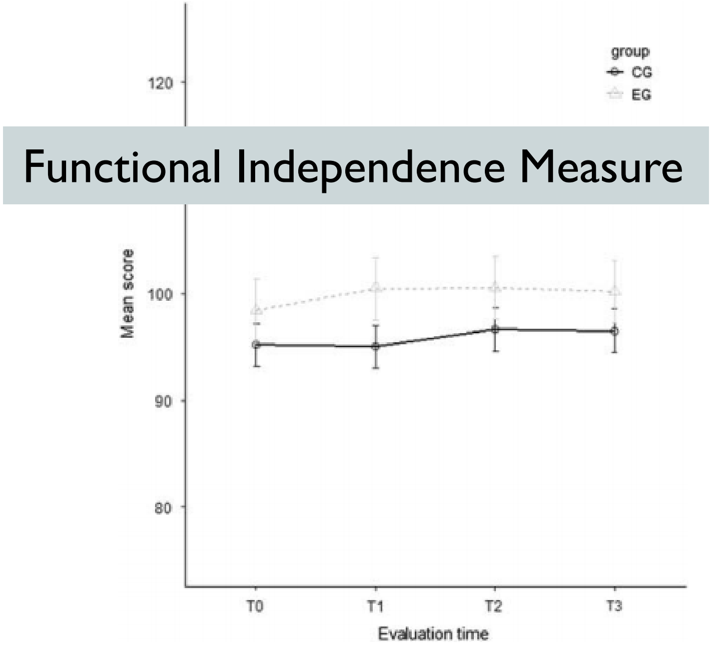
Training using robotics

www.anagennisimedicalresort.com

Heidelberg University Hospital

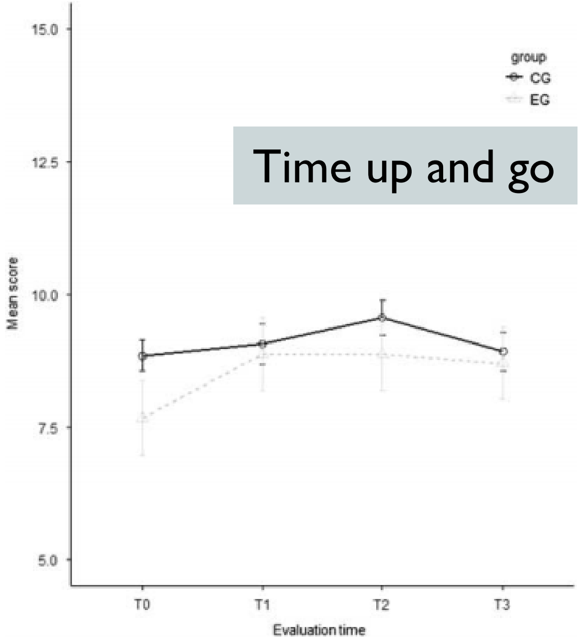
Training motor performance using robotics & VR in addition to traditional rehab

Fig. 1



Interaction between treatment and evaluation time confirmed that differences in FIM scores between the two groups changed over time. CG, control group; EG, experimental group; FIM, Functional Independence Measure.

Fig. 2



Interaction between treatment and evaluation time confirmed that differences in the time up and go scores between the two groups changed over time. CG, control group; EG, experimental group.

Russo et al., 2017

Training: depression

Review

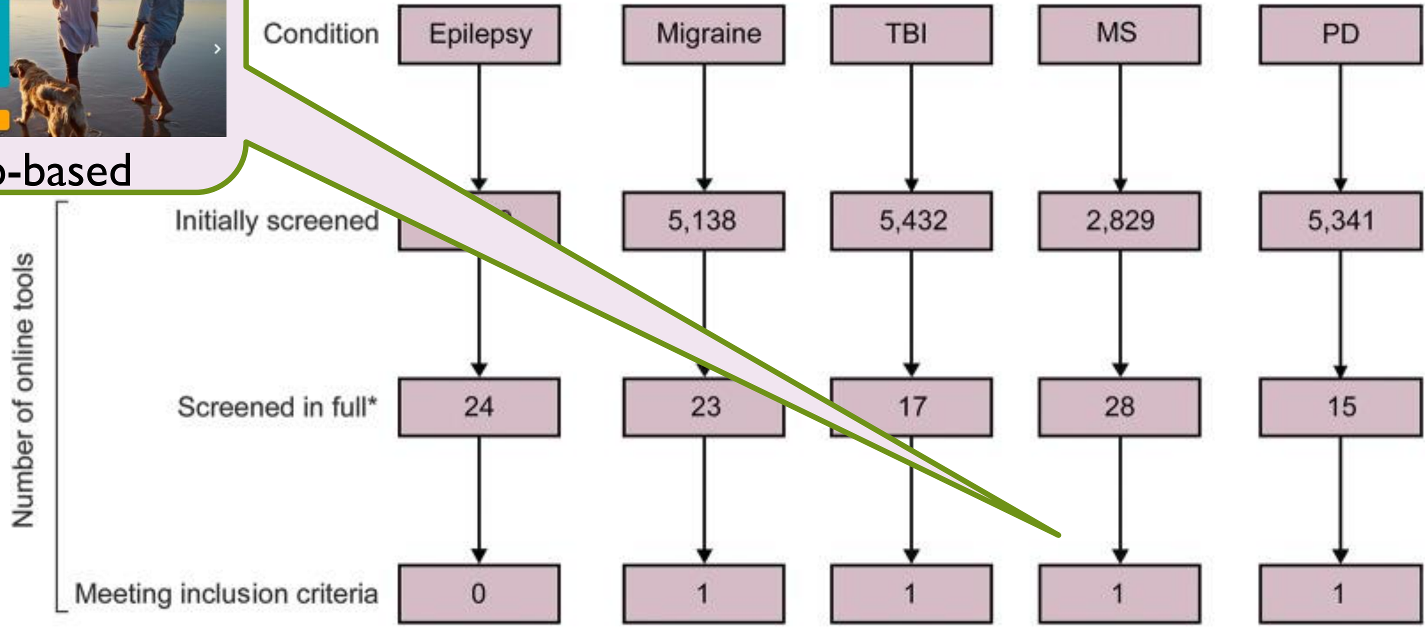
Neurology® Clinical Practice

Online tools for individuals with depression and neurologic conditions

A scoping review

Sara Lukmanji, MPP; Tram Pham, BHSc; Laura Blaikie, BA; Callie Clark, MSc; Nathalie Jetté, MD, MSc; Samuel Wiebe, MD, MSc; Andrew Bulloch, PhD; Jayna Holroyd-Leduc, MD; Sophia Macrodimitris, PhD; Aaron Mackie, MD; Scott B. Patten, MD, PhD

Web-based



https://overcomingms.org/recovery-program

Lukmanji et al., 2017

Training: VR for pain reduction

PAIN. Publish Ahead of Print():, FEB 2019
DOI: 10.1097/j.pain.0000000000001539, PMID: 30817437
Issn Print: Model.IssnPrint
Publication Date: 2019/02/01

Print

Virtual Reality, Music and Pain: developing the premise for an interdisciplinary approach to pain management

Emily Honzel;Sarah Murthi;Barbara Brawn-Cinani;Giancarlo Colloca;Craig Kier;Amitabh Varshney;Luana Colloca;

+ Author Information

Investigation of the effect of the virtual reality application on experimental pain severity in healthy

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3. Department of Nursing, Bursa Uludag University Faculty of Health Sciences, Bursa, Turkey

http://dx.doi.org/10.1590/1806-9282.65.3.446

Karaman et al., 2019

Advice: sensors at home - GPS

MSJ Experimental Translational Clinical

Original Research Paper

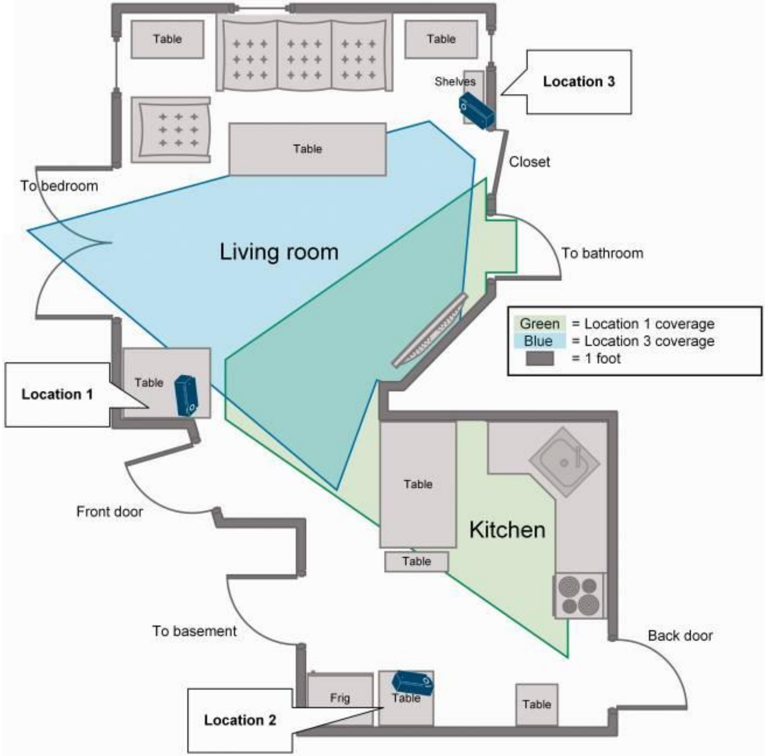
Movement measurements at home for multiple sclerosis: walking speed measured by a novel ambient measurement system

Victoria MJ Smith, Jonathan S Varsanik, Rachel A Walker, Andrew W Russo, Kevin R Patel, Wendy Gabel, Glenn A Phillips, Zebadiah M Kimmel and Eric C Klawiter

Multiple Sclerosis Journal— Experimental, Translational and Clinical

January-March 2018, 1–9

DOI: 10.1177/ 2055217317753465



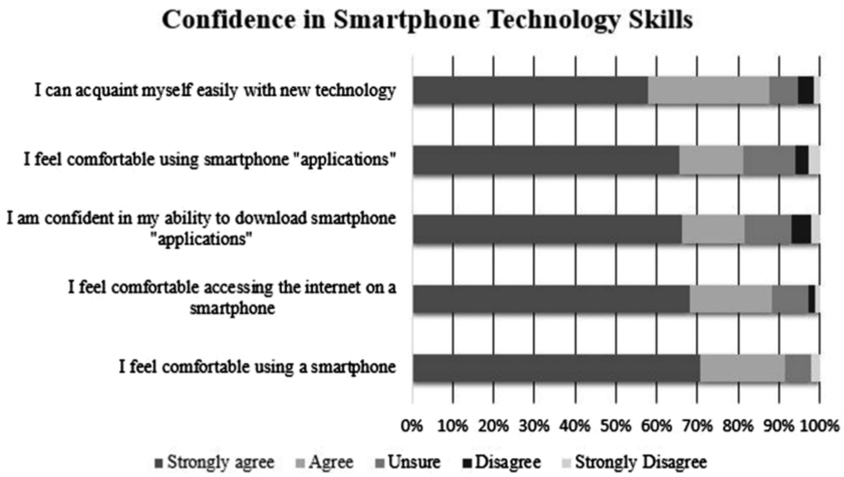
Documenting outdoor activity and travel behaviour in persons with neurological conditions using travel diaries and GPS tracking technology: a pilot study in multiple sclerosis

An Neven, Davy Janssens, Geert Alders, Geert Wets, Bart Van Wijmeersch & Peter Feys

Pages 1718-1725 | Received 25 Jul 2012, Accepted 15 Nov 2012, Published online: 24 Jan 2013

Download citation https://doi-org.kuleuven.ezproxy.kuleuven.be/10.3109/09638288.2012.751137

To consider…



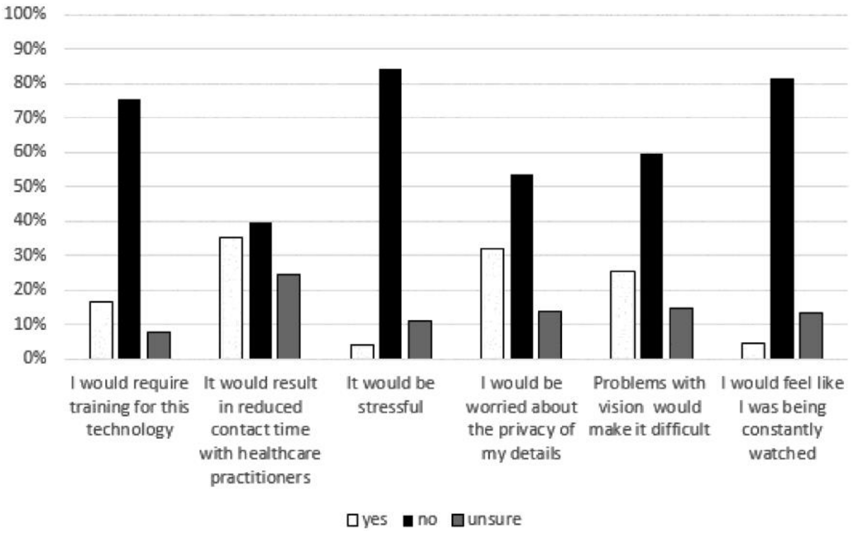
DISABILITY AND REHABILITATION, 2018
VOL. 40, NO. 12, 1434–1442
http://dx.doi.org/10.1080/09638288.2017.1300332

RESEARCH PAPER

A questionnaire study to explore the views of people with multiple sclerosis of using smartphone technology for health care purposes

Nicola Griffin[a] and Maria Kehoe[b]

[a]Department of Physiotherapy, King's College Hospital NHS Foundation Trust, London, United Kingdom; [b]Department of Health Service Executive Community Physiotherapy, Kildare/West Wicklow, Naas, Ireland



Profile of web-based PT programme users

- technology literate (or have a significant other who are)
- value the flexibility
- prefer to exercise independently in an environment of their choice
- have confidence and skills to self-manage without face to face contact

Original Article

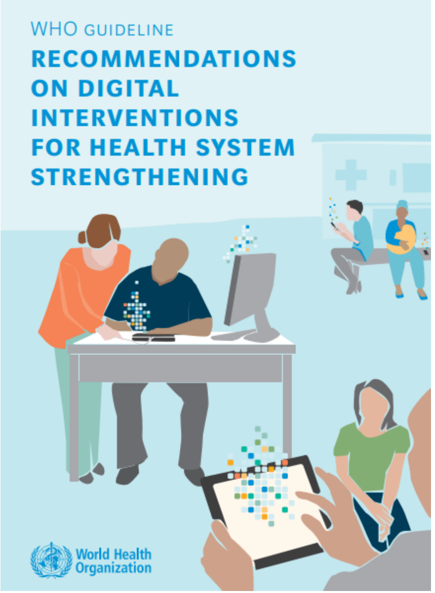
A qualitative exploration of the participants' experience of a web-based physiotherapy program for people with multiple sclerosis: Does it impact on the ability to increase and sustain engagement in physical activity?

Rachel Dennett, Elaine Coulter, Lorna Paul & Jennifer Freeman

Received 26 Jul 2018, Accepted 11 Feb 2019, Published online: 23 Mar 2019

Download citation https://doi-org.kuleuven.ezproxy.kuleuven.be/10.1080/09638288.2019.1582717 Check for updates

Digital health



Recommendation and justification/remarks

Client-to-provider telemedicine — Recommendation 4
(Recommended only in specific contexts or conditions)

WHO recommends client-to-provider telemedicine:

- **under the condition that it complements, rather than replaces, face-to-face delivery of health services; and**
- **in settings where patient safety, privacy, traceability, accountability and security can be monitored.**

In this context, monitoring includes the establishment standard operating procedures that describe protocols for ensuring patient consent, data protection and storage, and verifying health worker licenses and credentials.

Digital tracking combined with decision support and targeted client communication — Recommendation 9
(Recommended only in specific contexts or conditions)

WHO recommends the use of digital tracking combined with both decision support and targeted client communication under these conditions:

- **in settings where the health system can support the implementation of these intervention components in an integrated manner; and**
- **for tasks that are already defined as within the scope of practice for the health worker; and**
- **where potential concerns about data privacy and transmitting sensitive content to clients can be addressed.**

Rehabilitation partners using digital health

Key messages

- Digital health may add-on to rehabilitation
- No replacement of face-to-face rehab
- Assessment, monitoring, training
- Consider context, preferences and abilities of people with MS and relevant others
- Large (multicenter) studies are needed to support evidence

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RIMS REHABILITATION IN MULTIPLE SCLEROSIS

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