

Meaningful use of activity trackers in healthcare

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Impact paragraph

This chapter describes how the findings of this dissertation are relevant to society. First, the aim and main results are presented, followed by the relevance of this dissertation. Then, the relevance of the findings for stakeholders are reported. Finally, the dissemination activities are described.

Aim and main results

The main aim of this dissertation was to increase knowledge about the meaningful* use of activity trackers in healthcare and (older) adults with chronic diseases and for older adults with or without chronic diseases. This dissertation had three phases in which five studies took place. Phase one assessed the validity and feasibility of commercially available activity trackers. Both appeared to be insufficient for (older) adults with a chronic disease with a chronic disease. In phase two, an existing activity tracker was (re)designed for older adults with or without a chronic disease by adjusting the algorithm and upgrading the user interface. The new activity tracker was called the 'Measure It Super Simple (MISS)' Activity. Older adults evaluated the MISS Activity and found the tracker feasible and easy to use. The optimised algorithm was more valid during activities of daily living in older adults with or without a chronic disease compared to the gold standard and three selected commercially available activity trackers. In phase three, the MISS Activity was integrated into daily clinical practice. Several iterations were needed for healthcare professionals to use the MISS Activity in a way that supported their clinical reasoning and patient engagement. The activity tracker was used both as an assessment tool and an intervention tool.

Relevance of this dissertation

The current Dutch healthcare system faces challenges to keep healthcare sustainable. By 2040, the Netherlands are predicted to have 9.8 million people with a chronic disease there are expected to be 1.6 million people 80 years or older.^{1,2} To keep healthcare sustainable, eHealth, including activity trackers, could be beneficial.^{3,4} Recently, the number of commercially available activity trackers has grown explosively. Activity trackers provide objective insight into physical activity levels and can improve physical activity level if combined with regular exercise or lifestyle guidance.⁵⁻⁸ Healthcare professionals such as physiotherapists⁹, nurses¹⁰, and nutritionists¹¹ are trained to

provide life-style guidance and require insight into a patient's physical activity level for their clinical reasoning. For example the new guideline for physiotherapist for patients with chronic obstructive pulmonary disease (COPD), recommends to us an activity tracker to indicate whether a patient is sufficient active and describes that physiotherapists should educate patients about the importance of sufficient physical activity in relation with a healthy lifestyle¹². Studies show that activity trackers also enhance a patient's self-management and self-efficacy regarding physical activity.^{13,14} Self-monitoring could lead to improved coping, realistic goal setting, and improved quality of life for patients.¹⁵ However, despite their advantages and potential, activity trackers are only sporadically used in healthcare. This dissertation contributes insight and tools to use activity trackers in daily clinical healthcare practice in a meaningful way.

This dissertation was part of the Brightlands Innovation Programme Limburg Meet (LIME)¹⁷, a program that facilitates smarter measurement methods and more efficient data collection for better care and health. Within this programme, this project was part of the theme of 'personalised wearables' along with another doctoral project (the Psmate). Both projects focused on implementing health technology tools in daily clinical practice. Because these projects overlapped, a collaboration was established. The results of both projects will be used for further development of the LIME programme. Further, a network between researchers, entrepreneurs, civilians and educators developed within LIME. This allowed us to collaborate, share and gain knowledge with several different disciplines throughout the course of this dissertation and continues to do so in further research.

Target population and other stakeholders

The results of this dissertation are relevant to several stakeholders: (older) Adults with or without a chronic disease, healthcare professionals, educators and students, researchers, and technology manufacturers.

(Older) Adults with or without a chronic disease

The knowledge obtained from this dissertation can benefit (older) adults with or without a chronic disease. The MISS Activity was designed specifically with and for older adults with or without a chronic disease. Results indicate that the algorithm developed for the MISS Activity can more validly measure step count and physical activity during activities of daily living compared to the three selected commercially available activity trackers. Older adults with or without a chronic disease experienced the user interface of the MISS Activity as feasible and could use it without support from third parties (e.g.,

healthcare professionals). This creates opportunities to measure their physical activity level in a valid and feasible manner for (older) adults with or without a chronic disease. Although the MISS Activity is not available for purchase through websites or stores, it is available from the manufacturer. Healthcare professionals' meaningful use of an activity tracker in their daily clinical practice may improve the quality of care for (older) adults with or without a chronic disease.

Healthcare professionals

Although only physiotherapists and psychosomatic therapists participated in the studies within this dissertation, the findings are potentially relevant to several healthcare professionals such as occupational therapists, nurses, and nutritionists. For instance, the developed feasibility framework (found in the appendix to chapter three) can be used directly in daily clinical practice. Healthcare professionals also can benefit from the availability of the MISS Activity. By using a more valid activity tracker for the measurement of physical activity in (older) adults with or without a chronic disease, healthcare professionals obtain better insight into their physical activity level.

Furthermore, healthcare professionals can benefit from the easy user interface, since it takes little time to get familiar and explain the activity tracker their patients. Healthcare professionals can benefit from the lessons learned from our action research study, through the manual and course for healthcare professionals in which these lessons were integrated.

Educators and students

The findings of this dissertation can be used in courses for healthcare students and professionals that discuss the development and use of activity trackers and other digital health technology. Although measurement tools are incorporated into healthcare course curricula, the use of eHealth is typically addressed in a limited way or not at all.¹⁶ As the use of eHealth is a method to ensure a sustainable healthcare system, one might advocate that the application of eHealth in daily clinical practice should be more addressed. Competencies in eHealth are a prerequisite for healthcare professionals to work with all sorts of health technology. In order to incorporate more eHealth into the curricula, lecturers should receive training focused on the opportunities and use of eHealth in healthcare. For example, Zuyd University of Applied Sciences pilots a program to help educators make decisions on implementing eHealth, with specific attention to eHealth measurement technologies into the curricula of seven health educations (physiotherapy, occupational therapy, speech therapy, nursing, midwifery, social work

and arts therapies) and to gain insight into the support needs of educators during the implementation.

The developed manual can be used as an example of how to integrate activity trackers and other health technologies and to teach students how to use these tools in a meaningful way. Students can benefit from the feasibility framework and the important variables listed when choosing and/or developing an activity tracker for (older) adults with or without a chronic disease.

Researchers

This dissertation is a first step toward integrating the use of activity trackers in healthcare. Researchers can use the findings of this dissertation regarding the validity, feasibility, and implementation of activity trackers in (older) adults with or without a chronic disease. . The developed feasibility framework also can be used when choosing an activity tracker to incorporate in their research or to test the feasibility and use of other activity trackers and other possible eHealth tools. The MISS Activity can be used in future research; in two upcoming studies the MISS Activity will be used as a measurement tool for physical activity in older adults and patients with COPD. Additionally, researchers could learn from the phases of the studies performed in this dissertation and the designs and methods (e.g., action research and co-creation methods). For future research focusing on the use of activity trackers in other healthcare settings, the design and results of our action research study (chapter 6) might be a suitable starting point. Researchers also could study the effect of activity trackers on physical activity in healthcare in (older) adults with or without a chronic disease.

Technology manufacturers

The MISS Activity is available for purchase via the manufacturer for both individual users and researchers or institutes (e.g., hospitals, research centres). Technology manufacturers also might benefit from the developed feasibility framework and the derived list of (older) adults with or without a chronic disease when choosing an activity tracker. Furthermore, this dissertation might encourage technology manufacturers and healthcare professionals to collaborate more frequently when developing new eHealth tools.

Table 1 describes the dissemination activities performed during this dissertation.

Table 1. Knowledge transfer to healthcare, research, and education.

Knowledge transfer to healthcare, research, and education	
Presentations	<p>Ummels D. <i>'De ActiV LiFe studie. Commercieel verkrijgbare activiteitenmeter in de fysiotherapie'</i> (Oral presentation at Dag van de Fysiotherapeut, Utrecht, 11 november 2016)</p> <p>Ummels D. <i>'De ActiV LiFe studie. Commercieel verkrijgbare activiteitenmeters in de fysiotherapie en ergotherapie'</i> (Oral presentation at Symposium activiteitenmeters in de zorg, Heerlen, 9 mei 2017)</p> <p>Ummels D, Beekman E, Theunissen K, Braun S, Beurskens S. <i>Validiteit van negen commercieel verkrijgbare activiteitenmeters in chronisch zieken tijdens een activiteitenprotocol met algemeen dagelijkse levensverrichtingen.</i> (Poster presentation at Dag van de Fysiotherapeut, Barneveld, 24 november 2017)</p> <p>Ummels D, Beekman E, Theunissen K, Braun S, Beurskens S. <i>Validiteit van negen commercieel verkrijgbare activiteitenmeters in chronisch zieken tijdens een activiteitenprotocol met algemeen dagelijkse levensverrichtingen.</i> (Poster presentation at Onderzoek in beweging, Maastricht, 27 februari 2018)</p> <p>Crijns F, Hochstenbach L, Ummels D. <i>Hoe breng je de meetwetenschap naar de praktijk.</i> (Oral presentation at Lime Meeting. Geleen, 11 oktober 2018)</p> <p>Ummels D, Beekman E. <i>The validity of activity trackers during activities of daily living.</i> (Oral presentation at Dag van de Fysiotherapeut, Den Bosch, 8 december 2018)</p> <p>Ummels D, Koppert M. <i>Activiteitenmeters en andere wearables in de fysiotherapie: wat en hoe?</i> (Oral presentation at Fysio-Xperience, Eindhoven, 14 juni 2019.)</p> <p>Ummels D, Beekman E, Moser A, Braun, S, Beurskens S. <i>Ervaringen met het gebruik van commercieel verkrijgbare activiteitenmeters in de fysiotherapie van patiënten met een chronische aandoening: een kwalitatieve studie.</i> (Poster presentation at Dag van de Fysiotherapeut, Den Bosch, 16 november 2019)</p> <p>Ummels D, <i>Ervaringen met het gebruik van commercieel verkrijgbare activiteitenmeters in de fysiotherapie van patiënten met een chronische aandoening: een kwalitatieve studie.</i> (Oral presentation at Dag van de Fysiotherapeut, Den Bosch, 16 november 2019.)</p> <p>Ummels D, <i>Patients experiences with commercially available activity trackers embedded in physiotherapy treatment: A qualitative study,</i> (Oral presentation at Association for the Advancement of Assistive Technology in Europe congress, Bologna, 28 Augustus 2019)</p> <p>Ummels D, Daniëls N. <i>Hoe een wearable werkbaar wordt. Ervaringsverslag na doorontwikkeling van wearables en apps.</i> (Oral presentation at Lime meeting, Heerlen, 10 december 2019)</p>
Publications in national professional journals	<p>Ummels D., Beekman E., Braun S., Theunissen K., Moser A., Beurskens S. <i>Validiteit en ervaringen in de dagelijkse praktijk. Commercieel verkrijgbare activiteitenmeters.</i> <i>Fysiopraxis.</i> 2019. Jaargang 28 december 2019/januari 2020.</p> <p>Ummels D. Beekman E., Moser A., Braun S., Beurskens A. <i>Ervaring van patiënten met een chronische aandoening met het gebruik van commercieel verkrijgbare activiteitenmeters in de fysiotherapie.</i> <i>Physios.</i> 2020 Jaargang 12. Nummer 1.</p>

Multimedia	<p>Several online publications in layman's terms about the studies of this dissertation.</p> <p>Zuyd University of Applied Sciences: https://www.zuyd.nl/onderzoek/lectoraten/projecten-autonomie-en-participatie/promotie/activiteitenmeters-in-de-gezondheidszorg https://www.zuyd.nl/over-zuyd/nieuws/2020/11/lime</p> <p>Limburg Meet: https://www.limeconnect.nl/nieuws/meten-bij-ouderen/ https://www.limeconnect.nl/nieuws/commercieel-verkrijgbare-activiteitenmeters/ https://www.limeconnect.nl/nieuws/commercieel-verkrijgbare-activiteitenmeters-vaak-ingewikkeld/ https://www.limeconnect.nl/nieuws/commerciele-fitness-trackers-schieten-te-kort/</p> <p>Smart Health: https://www.smarthealth.nl/2018/04/19/onderzoek-commerciele-fitness-trackers-schieten-te-kort-voor-patienten-met-chronische-aandoening/ https://www.smarthealth.nl/2019/04/30/fysiotherapeuten-en-hun-patienten-nog-niet-gewend-aan-inzet-stappenteller-of-app/</p> <p>FMT Gezondheidszorg: https://fmtgezondheidszorg.nl/commercieel-verkrijgbare-activiteitenmeters-vaak-te-ingewikkeld-voor-mensen-met-een-chronische-ziekte/</p> <p>Nieuws voor leefstijlcoaches: https://www.nieuwsvoordietisten.nl/activiteitenmeters-zijn-vaak-te-ingewikkeld/</p> <p>ICT& Health: https://www.icthealth.nl/nieuws/wearable-vaak-nog-te-ingewikkeld-voor-gebruiker/</p> <p>Accelerometry: https://www.accelerometry.eu/consumer-activity-monitors-often-too-complicated-for-people-with-chronic-diseases/ https://www.accelerometry.eu/miss-activity-valid-and-user-friendly-measuring/ https://www.accelerometry.eu/commercial-activity-trackers-fall-short-for-patients-with-chronic-illness/</p>
Video clip	<p>One video about the use of activity trackers in physiotherapy has been developed belonging to the publication in Physios. https://www.physios.nl/tijdschrift/editie/artikel/t/ervaringen-van-patienten-met-een-chronische-aandoening-met-het-gebruik-van-commercieel-verkrijgbare-activiteitenmeters-in-de-fysiotherapie</p>
Healthcare course	<p>Course for healthcare professionals on how to use activity trackers in daily clinical practice taught at Zuyd University of Applied Sciences.</p>
Manual	<p>Manual 'how to use activity trackers in daily clinical practice' which can be used in healthcare, education, and research</p>
Framework	<p>Development of the feasibility framework which can be used in healthcare, education, and research (appendix of chapter three).</p>
Symposium	<p>Organised <i>Symposium activiteitenmeters in de zorg</i> (Zuyd Hogeschool, Heerlen, 9 mei 2017)</p>
Lectures	<p>Commercieel verkrijgbare activiteitenmeter in de fysiotherapie en ergotherapie. Zuyd University of applied science, bachelor track physiotherapy. 2016.</p>

Inclusion of students	129 students from different disciplines of Zuyd University of Applied Sciences: physiotherapy, communication and multimedia design, ICT, health technology healthcare biometrics, facility management, pre-university education, and international business. (https://www.zuyd.nl/over-zuyd/nieuws/2020/11/lime)
Publications	<p>All articles in this dissertation are published in international peer-reviewed journals.</p> <p>Counting Steps in Activities of Daily Living in People With a Chronic Disease Using Nine Commercially Available Fitness Trackers: Cross-Sectional Validity Study. Ummels D, Beekman E, Theunissen K, Braun S, Beurskens A. JMIR Mhealth Uhealth, 2018; 2(6);e70</p> <p>Patients' experiences with commercially available activity trackers embedded in physiotherapy treatment: a qualitative study. Ummels D, Beekman E, Moser A, Braun S, Beurskens A. Disability and Rehabilitation, 2020; 42(23), 3284-3292</p> <p>Measure It Super Simple (MISS) activity tracker: (re)design of a user-friendly interface and evaluation of experiences in daily life. Ummels D, Braun S, Stevens A, Beekman E, Beurskens A. Disability and Rehabilitation: Assistive technology, 2020; 24;1-11 online ahead of print.</p> <p>The Validation of a Pocket Worn Activity Tracker for Step Count and Physical Behavior in Older Adults during Simulated Activities of Daily Living. Ummels D*, Bijmens W*, Aarts J, Meijer K, Beurskens A, Beekman E. Gerontology and Geriatric medicine, 2020; 30-6;2333721420951732.</p> <p>Using an Activity Tracker in Healthcare: Experiences of Healthcare Professionals and Patients. Ummels D., Beeman E., Braun S., Beurskens A. International Journal of Environmental Research and Public Health. 2021, 18(10), 5147</p> <p>One article describing the study protocol of phase one is published in a international peer-reviewed journal.</p> <p>Beekman E, Braun S, Ummels D, van Vijven K, Moser A, Beurskens A. Validity, reliability and feasibility of commercially available activity trackers in physical therapy for people with a chronic disease: a study protocol of a mixed methods research. Pilot Feasibility Stud. 2017; Nov 23;3:64.</p>
Follow-up grants	<p>One follow-up grant has been granted: SIA KIEM-HBO. De verkenning van de ontwikkeling en evaluatie van een stappenplan voor geïntegreerd gebruik van activiteitenmeters binnen de zorg voor mensen met chronische pijn.</p> <p>One follow-up grant has been submitted: Meten op maat met eHealth, Methodisch ondersteunen bij het duurzaam gebruik in de eerstelijns zorgpraktijk.</p>
Spin-off projects	<p>One internal Zuyd University project within the transition theme 'Gezonde Samenleving' where educators are supported in make decisions on implementing eHealth, with specific attention to eHealth measurement technologies into the curricula of seven health educations (physiotherapy, occupational therapy, speech therapy, nursing, midwifery, social work and arts therapies) and to gain insight into the support needs of educators during the implementation.</p> <p>The MISS Activity can be used in future research, two studies are already planning on using the MISS Activity as a measurement tool for physical activity in older adults (project: H2020 Pharaon) and patients with COPD (project: COPD subtypes based on Western and Chinese diagnostics).</p>

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