

Institution: University of Southampton		
Unit of Assessment: 11 Computer Science and Informatics		
Title of case study: 11-04 LifeGuide: Online Behavioural Interventions		
Period when the underpinning research was undertaken: 2008 – 2018		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Dr Mark Weal	Associate Professor	1992 – present
Dr Gary Wills	Associate Professor	1998 – present
Dr Jonathon Hare	Lecturer	2011 – present
Professor David De Roure	Professor	1986 – 2010
Dr Don Cruickshank	Senior Research Fellow	2000 – present
Dr Danius Michaelides	Senior Research Fellow	2000 – 2017
Period when the claimed impact occurred: August 2013 – July 2020		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact

The LifeGuide platform, developed at the University of Southampton, is a unique set of open-source internet-based software tools that allow researchers to flexibly create, modify and evaluate internet-based behavioural change interventions. The interventions have been deployed in ground-breaking, large scale, randomised controlled trials as well as being rolled out through social enterprise projects and scaling-up research funding.

Since August 2013, the impact of the research has been to:

- **Support a large international community of collaborators** to run large-scale online behaviour change interventions which previously wouldn't have been possible. For example, LifeGuide is being used to disseminate an effective intervention to reduce the occurrence of hand dermatitis to all 435,000 members of the Royal College of Nursing.
- **Create a social enterprise project to roll out validated health interventions** through the NHS and other organisations. For example, the POWeR weight loss intervention has been delivered for Hampshire County Council and is currently prescribable by GPs to 1.8 million registered patients in Hampshire.
- **Change care pathways in the NHS and Europe** to improve patient activation and lead to more efficient care. For example, cochlear implant recipients in over a third of the 22 cochlear implant centres in the UK are using the LifeGuide developed CHOICE care pathway.

2. Underpinning research

Using LifeGuide software avoids costly duplication of effort and resources when developing new digital interventions [3.1], enabling researchers and practitioners in the public, private and third sectors to develop web-based interventions more cost-effectively and retain control over them, allowing them to be modified and reused for other contexts without the need to buy in expensive web programming support. This is a world-leading innovation; there is no other such existing software or research programme that allows non-programmers to develop such complex interventions.

The LifeGuide platform builds on the myExperiment project [2007-2009, **Grant A**] led by Professor David De Roure, which focussed on designing and implementing software to empower scientists to share workflows, promoting open science and methodological reuse. The platform was intuitive to use by interdisciplinary researchers from non-technical backgrounds, and provided security and auditability to satisfy the ethical requirements of high-quality scientific research. [3.2]

The LifeGuide platform was developed from an ESRC grant [2008-2011, **Grant B**] led by Professor Lucy Yardley (Psychology, UOA 4) with De Roure, Dr Mark Weal and Dr Gary Wills. Further funding from JISC [2009-2011, **Grant C**], led by Wills, developed an accompanying Virtual Research Environment.

The LifeGuide platform supports a range of adaptable generic intervention components that can be used to construct digital interventions. Research has also been carried out to enable bespoke

intervention components where required to extend the possibilities of digital interventions beyond those of more traditional methods. Research as part of the WIME project [2010-2012, **Grant D**] improved the authoring interface to increase accessibility. Funding from NIHR led to the integration of adaptive games for use within stroke rehabilitation interventions [2010-2012, **Grant E**]. The EPSRC funded the UBHave project [2011-2015, **Grant F**] to extend the approach off the desktop, developing the LifeGuide Toolbox, a LifeGuide authoring platform for mobile platforms [3.3]. As part of the DIPSS project (2014-2019, **Grant G**), additional support was developed to facilitate more complex clinician patient communication within the LifeGuide platform. The research programme extended the functionality of the platform, facilitate new types of intervention development, and improved the effectiveness of the delivery, trialling, deployment and analysis of interventions.

Research collaborations with the wider LifeGuide team to develop and extend the platform and trial web-based interventions have attracted funding of well over GBP50 million (from MRC, EPSRC, ESRC, NIHR, EC and medical charities). A range of interventions have been developed and the development process and funding has been used to further improve the software and innovate novel approaches to the delivery of online interventions. These include mobile based and hybrid approaches to intervention delivery [3.4] and the use of machine learning techniques to provide mechanisms for smart notification systems [3.5]. The work has built up a body of knowledge and expertise about how best to design and develop software to create effective digital interventions, which have been shared with the research community to enable other research teams to also create effective LifeGuide interventions.

In 2016, the Health Foundation funded a cochlear implant remote care programme (**Grant H**). A successful pilot named CIRCA [3.6] has led to a GBP500,000 scaling up roll out (CHOICE), with the platform being used to deliver novel care pathways and remote support through over half of the auditory implant centres in the UK (**Grant I**).

3. References to the research

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- 3.1 **Hare, Jonathan**; Osmond, Adrian; Yang, Yang; **Wills, Gary**; **Weal, Mark**; **De Roure, David**; Joseph, Judith and Yardley, Lucy (2009) LifeGuide: a platform for performing web-based behavioural interventions. ACM WebSci'09: Society On-Line, Athens, Greece. ACM Press. <https://eprints.soton.ac.uk/267201>
 - 3.2 **De Roure, David** and Goble, Carole. (2009) Software Design for Empowering Scientists. IEEE Software. 26: 88–95. <https://doi.org/10.1109/MS.2009.22>
 - 3.3 Morrison, Leanne; Hargood, Charlie; Lin, Sharon Xiaowen; Dennison, Laura; Joseph, Judith; Hughes, Stephanie; Michaelides, Danius; Johnston, Derek; Johnston, Marie; Michie, Susan; Little, Paul; Smith, Peter; **Weal, Mark** and **Yardley, Lucy** (2014) Understanding usage of a hybrid website and smartphone app for weight management: a mixed methods study. Journal of medical Internet Research, 16.(10), e201. <https://doi.org/10.2196/jmir.3579>
 - 3.4 **Weal, Mark**; Hargood, Charlie; Michaelides, Danius; Morrison, Leanne and Yardley, Lucy (2012) Making online behavioural interventions mobile. Digital Research 2012, Oxford, United Kingdom. Sep 2012. <https://eprints.soton.ac.uk/343040/>
 - 3.5 Morrison, Leanne; Hargood, Charlie; Pejovic, Veljko; Geraghty, Adam; Lloyd, Scott; Goodman, Natalie; Michaelides, Danius; Weston, Anna; Musolesi, Mirco; **Weal, Mark**, Yardley, Lucy (2016) The Effect of Timing and Frequency of Push Notifications on Usage of a Smartphone-Based Stress Management Intervention: An Exploratory Trial. PLoS ONE, pp. 1-32. <https://doi.org/10.1371/journal.pone.0169162>
 - 3.6 Cullington, Helen; Kitterick, Pdraig; **Weal, Mark** and Margol-Gromada, Magdalena (2018) Feasibility of personalised remote long-term follow-up of people with cochlear implants: a randomised controlled trial. BMJ Open, 8 (4), 1-11. <https://doi.org/10.1136/bmjopen-2017-019640>

Grants

A myExperiment, **D. De Roure**, C. Goble, JISC VRE2 Programme, GBP350k, 2007-2011

Impact case study (REF3)

B Development and evaluation of a Behavioural Intervention Grid (BI-Grid). L. Yardley, **D. De Roure**, **G. Wills**, S. Michie, **M. Weal**, ESRC (RES-149-25-1069), National Digital Social Research programme, GBP669,515, 2008-2011

C A VRE to support cross-disciplinary and cross-institutional collaboration in internet-based behavioural research (IBBRE), **G. Wills**, L. Gilbert, L. Yardley, **D. De Roure**, JISC, GBP200k, 2009-2011

D Developing and Evaluating Interventions to Reduce Inappropriate Prescribing of Antibiotics in Primary Care, CSO CZH/4/610. with S. Treweek, **M. Weal** and others, GBP220k, 2010-2012

E Development and pilot evaluation of a web-supported programme of Constraint Induced Therapy following stroke (LifeCIT). J. Burridge, **M. Weal** and others. NIHR RfPB, GBP250k, 2010-2012

F UBhave: ubiquitous and social computing for positive behaviour change. L. Yardley, **M. Weal**, P. Smith, **D. De Roure** and others, EPSRC C-DIP EP/I032673/1, GBP1.52m, 2011-2015

G DIPSS: Integrating Digital Interventions into Patient Self-Management Support. L. Yardley, **M. Weal** and others. NIHR RP-PG-1211-20001, GBP2m, 2014-2019

H Personalised long-term follow-up of cochlear implant users. H. Cullington, **M. Weal** and others. Health Foundation. GBP75k, 2015-2016

I Telemedicine for adults with cochlear implants in the UK: empowering patients to manage their own hearing healthcare. H. Cullington, **M. Weal**, and others, Health Foundation – scaling up award, GBP500k, 2018-2020

4. Details of the impact

A major rationale for LifeGuide was the potential it offered to avoid costly duplication of effort and resources when developing new digital interventions, enabling researchers to develop web-based interventions more cost-effectively, and allowing them to be modified and reused for other contexts (including dissemination via the public and third sectors) without the need to buy in expensive web programming support. The software platform developed in this research has facilitated a large international community of behavioural scientists and clinicians who have been able to design and trial digital behaviour change interventions at scale. Once demonstrated to be effective, the LifeGuide platform enabled the dissemination of successful interventions through rollouts such as the LifeGuide Social Enterprise scheme and the impact of these successful interventions has been to help established new care pathways which can have benefits both to patients directly, and also the health care service providers in terms of resourcing.

Support a large international community of collaborators

The LifeGuide software has been free to download since 2009 and academics all over the world are currently running trials using the LifeGuide platform, and the 'LifeGuide Community' website [5.1] which provides support for disseminating LifeGuide software use now has nearly 3000 members who are also using the software to develop interventions, based across the UK and internationally (over 20 countries). Endorsed by Public Health England in 2018 [5.2], it has attracted substantial funding in the period 2013-2020. International collaborations include Cigna Insurance, who developed an e-health employee wellbeing intervention that has been rolled out by multinational companies to 20 countries [5.3]. A second example is the work carried out with the University of Ulster to develop an intervention to help maximise sexual wellbeing for people living with prostate cancer, in partnership with the charity Prostate Cancer UK [5.4]. Our web-based 'LifeGuide Community' resources support intervention designers by providing the software for free download, together with wikis, demos and facilities for all members of research teams to comment on every page of the intervention during development. Hundreds of researchers (including postgraduate students) both in the UK and internationally have independently created interventions that we are hosting on our server, and other teams are creating interventions that they are hosting themselves, their research has reached large numbers of lay users and practitioners and increased the efficiency and productivity of their work.

LifeGuide is being used to disseminate an effective intervention to reduce the occurrence of hand dermatitis to all 435,000 members of the Royal College of Nursing [5.5]. LifeGuide interventions include preventive interventions for the general public, tackling common, high priority public health problems. For example, the LifeGuide team developed the first online intervention worldwide to promote hygienic behaviour to reduce transmission of infection (such as seasonal or pandemic flu)

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and reduce the prescribing of antibiotics [5.6]. There are also LifeGuide interventions to help patients and health professionals manage numerous common and serious health problems better, including interventions for asthma, dizziness [5.7], helping patients carry out rehabilitation at home following a stroke (LifeCIT), interventions to help patients self-manage hypertension, cancer-related fatigue, depression and stress, irritable bowel syndrome and eczema.

Further impactful interventions have included reducing antibiotic prescribing across Europe (INTRO) (299 GPs, 4,360 patients, published in the Lancet) [5.8]; promoting hygienic behaviour to reduce transmission of respiratory infection including pandemic flu (PRIMIT) (over 20,000 patients to date, and has also been accepted for the Lancet); supporting self-management of respiratory symptoms (around 2,000 patients to date).

LifeGuide has been part of research collaborations with our team to develop and trial web-based interventions using LifeGuide have attracted funding of well over GBP40 million (from MRC, EPSRC, ESRC, NIHR, EC and medical charities); we have already secured funding up to 2023. There are already published well over 50 development papers and reports of feasibility and community trials based on this research programme.

Social Enterprise rollout

A University Enterprise Project has been established with a view to converting into a Social Enterprise company to roll out successfully trialled interventions. This translational research ensures that evidence based health improvements become part of health delivery programmes through NHS, local authority and other partners. So far the POWeR weight loss intervention has been delivered as part of a 3 year contract signed in 2017 by Hampshire County Council and is currently prescribable by GPs to 2 million registered patients in Hampshire [5.9]. Solent NHS Trust have made it available to a further 235,000 people, and in 2018 Redcar and Cleveland Borough Council signed a two-year contract to roll it out to all residents in the region – over 100,000 people [5.10]. POWeR has been invited for inclusion in the NHS England assessment of digital behaviour change interventions. A further three interventions are now available for roll out through this scheme (Germ Defence [5.6], INTRO [5.8] and Balance Retraining [5.11]). We are working with Asthma UK to create an intervention based on My Breathing Matters for dissemination widely.

Preventing infection is an important method of reducing the need for antibiotics. An MRC funded development of a LifeGuide intervention to promote handwashing to reduce the spread of respiratory infection in the home (particularly seasonal and pandemic flu) was trialled in 20,000 UK adults: the frequency, severity and transmission of infections was reduced, as were consultations and antibiotic prescriptions. This was the first digital intervention worldwide to effectively reduce infection transmission in the home. The 'Germ Defence' website was endorsed by NICE as a recommended resource supporting the guidance 'Antimicrobial stewardship: changing risk-related behaviours in the general population' (see section 1.3.5 of guidance [5.6]) and it is available free of charge to the general public from the NICE website.

The LifeGuide programme co-led the development of a self-guided DVD/booklet intervention that used breathing exercises to improve outcomes for patients with asthma. LifeGuide was used to offer access to the intervention on publication (in Lancet Respiratory Medicine, 2018) for health professionals and patients and has 3,008 recorded session usages in the impact period [5.12]. It has the support of a national charity (Asthma UK) and the Southampton team is currently working with Asthma UK to make the intervention available in a variety of formats, including to young people.

Changing care pathways in the NHS and Europe

Digital interventions for healthcare professionals also have the potential to reduce antibiotic usage. The EC funded development of a LifeGuide intervention to reduce unnecessary antibiotic prescribing across Europe. Online training provided GPs with motivation, skills training and resources to engage patients with lower respiratory tract infection in self-management without antibiotics, when appropriate. The intervention reduced prescribing rates by 20% in 246 GP practices (4360 patients) in UK, Spain, Poland Belgium and the Netherlands (see paper in Lancet, 2014). The study informed NICE guidance on reducing antimicrobial resistance and the redesign of the Public Health England TARGET leaflet for primary care patients. The intervention materials are now informing development of interventions to reduce antibiotic usage in UK hospitals (funded by two new NIHR programme grants). Working with the University of Southampton team, the digital

intervention has also been provided as a national education resource to Belgium [5.10] and has been adapted for children with respiratory tract infection in the Netherlands (by Dr Anne Dekker, trial published in Journal of Antimicrobial Chemotherapy, 2018). A LifeGuide intervention to reduce unnecessary antibiotic use in hospitals is now being trialled in 36 hospitals and has already been adopted and rolled out nationally by the British Society for Antimicrobial Chemotherapy [5.13].

The Health Foundation has provided GBP500,000 to scale-up the roll out of the cochlear implant home support intervention (CHOICE) to support 800 cochlear implant recipients through over a third of the 22 cochlear implant centres in the UK. This work changes the traditional care pathways for recipients of cochlear implants as well as improving empowerment and patient activation. Roll out of the new care pathway began in July 2019 [5.14].

5. Sources to corroborate the impact

- 5.1 LifeGuide Community website: <https://www.lifeguideonline.org>
- 5.2 This Public Health England guidance for developing behaviour change interventions recommends LifeGuide as a useful tool for public health practitioners (p. 32): https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/744672/Improving_Peoples_Health_Behavioural_Strategy.pdf
- 5.3 A paper (published 2019) authored by global healthcare company Cigna describes how they successfully developed an e-health employee wellbeing intervention that has been rolled out by multinational companies to 20 countries. <https://doi.org/10.1177%2F2055207619852856>
- 5.4 Testimonial letter from Professor Eilis McCaughan and Dr Carrie Flanagan, Ulster University. They used LifeGuide to develop and disseminate an intervention to maximise sexual wellbeing for people living with prostate cancer, in partnership with Prostate Cancer UK: <https://web.archive.org/web/20201208151631/https://prostatecanceruk.org/about-us/projects-and-policies/truenth>
- 5.5 Royal College of Nursing website: <https://www.rcn.org.uk/clinical-topics/infection-prevention-and-control/skin-health>
- 5.6 Germ Defence link on NICE website: <https://www.nice.org.uk/guidance/ng63/resources/endorsed-resource-germ-defence-4359029869>
Link to the version of Germ Defence adapted for COVID-19: www.germdefence.org
- 5.7 Menieres Society and VEDA (American Vestibular Disorders Association) both feature links to Balance Retraining from their websites:
Menieres Society - <http://www.menieres.org.uk/information-and-support/treatment-and-management/vestibular-rehabilitation>; VEDA - <http://vestibular.org/diagnosis-treatment>
- 5.8 Testimonial letter from Professor Sibyl Anthierens at the University of Antwerp. LifeGuide was used in trials to reduce antibiotic prescribing for adults and children, and for making interventions available on the Belgian national website for continuing education of GPs.
- 5.9 Letter from Hampshire County Council confirming the value of our close partnership and that a three-year contract was signed to roll-out POWeR to residents of Hampshire. Primary care pathway: <http://documents.hants.gov.uk/public-health/prevention-pathways/Weightmanagementprimarycarepathway.pdf>
- 5.10 Testimonial letter from Scott Lloyd, Health Improvement Specialist, NHS Redcar and Cleveland confirms the usefulness of LifeGuide for modifying our POWeR weight loss programme and the 2-year contract to roll it out to all residents in the region.
- 5.11 Testimonial letter from Dr Otto Maarsingh, Vrije Universiteit Amsterdam, The Netherlands. Translated LifeGuide Balance Retraining intervention into Dutch for a research study now shown to be effective and published in BMJ. The LifeGuide team are working with them to disseminate the intervention to patients in Dutch and the original English version.
- 5.12 Intervention for breathing exercises for asthma patients: <http://www.breathestudy.co.uk>
- 5.13 This is the British Society of Antimicrobial Therapy website nationally disseminating the Antibiotic Review Kit for hospitals developed by the University of Southampton LifeGuide team. <http://bsac-vle.com/ark-the-antibiotic-review-kit/>
- 5.14 CHOICE - The Current Health Foundation scaling-up project is in the process of rolling out the intervention to half of the Auditory Implant Centres across the UK, recruiting over 800 recipients of cochlear implants for new clinical pathways supported by the LifeGuide developed intervention. <https://ais.southampton.ac.uk/choice/>