Digital health interventions: from LifeGuide to UBhave

Lucy Yardley

University of Southampton
Digital interventions – past, present, future

• The Past:
  – Before digital interventions
  – Digital interventions – state of the art

• The Present: LifeGuide
  – Introducing LifeGuide
  – Illustrating LifeGuide

• The Future: UBhave
  – The potential of sensing smart phones
  – The potential of social networks
Why not stick with traditional methods of delivering behavioural interventions?

a) face-to-face, e.g. teacher, therapist, manager
   - expert, personalised
   - effective but resource intensive

b) print format, e.g. leaflet
   - generic, no support
   - cheap but low impact
Core components of effective behavioural interventions – can they be delivered digitally?

1. Providing advice, ‘tailored’;
   • use ‘diagnostic’ questions to select relevant advice from extensive expert resources

2. Providing longitudinal support, e.g.
   • plans, reminders
   • progress monitoring
   • progress-relevant feedback
   • social support (therapist, peers)
Tailored advice in ‘Internet Dr’

Your Treatment Options
We have put together advice for coping with your symptoms based on doctors’ experience, medical evidence and what has been found useful by people with similar symptoms.

Ask the Internet Doctor
Click here for advice on how you can ease your symptoms without any medication
You do not need to take any medication to treat your symptoms - here are some suggestions for you to ease your symptoms naturally.

Click here for advice on what to ask for from the pharmacy, if you are happy to take medication
You do not need to worry that taking the medication we suggest could harm you. All the medicines we suggest are safe, and our treatment advice gives details of any side effects.

Click here for advice on how to boost your immune system, and help your body to recover naturally
Fighting infection can leave you feeling weak and tired - we have given advice on how to care for yourself and build your strength.
Goal-setting and feedback in ‘POWeR’

You haven’t met your goals this week

That’s OK. You still managed to lose weight

On the next page you can look at the goals you set last time.

You may wish to change the goals that you have not achieved before setting yourself some new goals. You will be able to look over these goals with your nurse at your next appointment, or you can change them now if you want to.

You may find it helps to ask yourself a few questions about each goal.

- **Is it the right kind of goal for you?** For example, maybe you want to change your goal from cutting out snacks to changing to lower calorie snacks.

- **Is the goal too difficult?** For example, instead of cutting down all portion sizes maybe you should start by trying to reduce portion sizes just for your evening meal.

- **What stopped you achieving the goal?** Maybe it is the right goal for you but you need a better if-then plan to help you achieve it.

Click Next to move onto rest of the session.
Sending Supportive Messages

All you need to do is follow three steps to send supportive messages straight to your e-mail account or mobile phone.

You can change these settings anytime by going to the "Supportive messages" tool that will appear on your Tools page after this session.

If you do not want to set-up these messages right now just click the Next button at the bottom of this page.

How would you like to receive your messages? (Please select one)

- I would like to receive e-mail messages.
  My email address is:

- I would like to receive text messages.
  My mobile phone number is:

What type of message would you like?

- I would like to create my own message
  My message is:

- Surprise Me

- Messages to help me keep motivated
Advantages of digital interventions

- **Providers:** cost-effective expert support for self-management - can automate delivery of tailored advice and support to huge population

- **Users:** access to in-depth and specialised support, personalised advice, available 24/7 from home/work/mobile, user-controlled, anonymous

- **Researchers:** unobtrusive detailed assessment - can easily collect longitudinal data on use/effects of each intervention component in large samples
Does delivering interventions digitally work?

- Meta-analysis of 85 web-based behaviour change studies 2000-2008 (N = 43,236)
- Effect size
  - $d = 0.16$ for whole sample (95% CI 0.09 to 0.23)
  - $d = 0.33$ for theory-based interventions
  - $d = 0.35$ for interventions also using telephone
  - $d = 0.81$ for interventions also using text messaging

Digital behaviour change interventions: The present
Challenges facing digital interventions

- The human challenge – creating digital interventions that patients and clinicians find accessible, engaging, trustworthy, useful

- The technological challenge – generating flexible and accessible methods of creating digital interventions
Addressing the technological challenge: Introducing LifeGuide

c-co-designed set of software tools to allow non-programmers to create interactive digital interventions

Health psychologists:  Computer scientists:
Lucy Yardley  Dave de Roure
Susan Michie  Gary Wills
Judith Joseph  Mark Weal
Sarah Williams  Jonathon Hare
Leanne Morrison  Adrian Osmond
Advantages of the LifeGuide

- first comprehensive set of tools enabling researchers with no programming skills to create online interventions
- easy to quickly modify interventions (e.g. during development, after feedback, when circumstances change)
- reduces time and costs caused by duplication of programming for each intervention
Advantages of the LifeGuide

• open source, free – opens up use by new researchers, lower income countries, facilitates collaboration

• embedded in our Virtual Research Environment (LifeGuide Community)

• supports sharing interventions or components, allowing easy modification for different contexts (e.g. translation into different languages, application to different conditions or contexts)
What can you do in LifeGuide?

• Deliver tailored advice based on diagnostic questions, charted progress

• Create questionnaires, change look and feel, add images and videos, graphs of users’ progress over time

• Send automated emails and text messages (e.g. reminders)

• Provide social support (e.g. feedback from health professional)
What can you do in LifeGuide?

• screening and multi-user registration
• stratified randomisation
• automated baseline and follow-up assessment
• monitoring throughput and adherence (all website usage recorded in detail)
• output all data to Excel
Interventions completed or in development (funded by MRC, NIHR, EC, DoH)

Interventions completed and trialled:

• ‘Internet Dr’ to self-manage minor respiratory infections
• hand-washing intervention to reduce spread of infection (pandemic flu)
• intervention to reduce antibiotic prescribing in GPs across Europe
• cognitive-behavioural therapy for irritable bowel syndrome
• e-learning and assessment for health professionals
• smoking cessation intervention
• weight management intervention for primary care (POWeR)

Interventions in development/evaluation:

• POWeRPlus, POWeR in community, Royal Navy, diabetes
• home-based rehabilitation for stroke
• blood pressure control
• fatigue management after cancer
• childhood eczema management
• advice to improve diabetes health literacy across Europe
• many more that do not involve Southampton!
Addressing the human challenge: creating digital interventions that patients and clinicians find accessible, engaging, trustworthy, useful

What have we learned from LifeGuide so far?

Illustrated by:

‘PRIMIT’ intervention to reduce spread of respiratory infection

‘INTRO’ intervention to promote prudent antibiotic prescribing
PRIMIT:
an intervention to reduce respiratory infection transmission

With Paul Little
and Sascha Miller, Emma Teasdale, Leanne Morrison
Development of the PRIMIT intervention

Theoretical modelling:

1. Focus group study to establish feasibility of target behaviours
2. Quantitative study of determinants of intended behaviour
3. Qualitative studies of draft pages and prototype website
4. Test effects of threat and coping web-pages
5. Full pilot of web intervention

A PRImary care trial of a website based Infection control intervention to Modify Influenza-like illness and respiratory infection Transmission
1. Focus group study to select target behaviour(s)

PRECEDE-PROCEED model (Green & Kreuter) suggests should select behaviours likely to be EFFICACIOUS and FEASIBLE / ACCEPTABLE.

Focus groups carried out with 31 participants to elicit views of:

- handwashing
- social distancing
- cough-sneeze hygiene
1. Focus group study to select target behaviour(s)

Findings

Social distancing: least acceptable as prevents caring for loved ones

Cough/Sneeze hygiene: more positive attitudes than social distancing but scepticism about feasibility

Handwashing: more feasible than cough/sneeze hygiene and more acceptable than social distancing

2. Study of determinants of intended behaviour
Mean intentions and determinants for each behaviour
(N= 129; 1 = strongly disagree, 7 = strongly agree)

<table>
<thead>
<tr>
<th></th>
<th>Hand-washing</th>
<th>Cough-sneeze hygiene</th>
<th>Social distancing</th>
</tr>
</thead>
<tbody>
<tr>
<td>I intend to do it</td>
<td>5.24</td>
<td>5.35</td>
<td>4.42***</td>
</tr>
<tr>
<td>Doing it is useful/effective</td>
<td>5.41</td>
<td>5.70*</td>
<td>4.97**</td>
</tr>
<tr>
<td>Doing it makes me feel good</td>
<td>5.12</td>
<td>5.49***</td>
<td>4.76**</td>
</tr>
<tr>
<td>Others think I should do it</td>
<td>4.83</td>
<td>5.41***</td>
<td>4.70</td>
</tr>
<tr>
<td>I am confident I can do it</td>
<td>6.09</td>
<td>4.65***</td>
<td>3.05***</td>
</tr>
</tbody>
</table>
3. Qualitative studies of draft web-pages

28 iterative think aloud interviews, progressively modified website

a) **Format-related findings**, e.g. wanted quizzes and tables with feedback, larger font etc.

b) **Content-related findings**, e.g.

   False transmission beliefs – viruses as airborne, so don’t need to wash hands after using a tissue

   Social barriers/facilitators – didn’t want to be seen as obsessive, or as having dirty hands!

   Control barriers/facilitators – forgetting, not having time, dry skin, using hand gels
Simple Steps to Reduce Colds and Flu

This website is in 4 weekly sessions. You will receive an email to let you know when the next session is ready.

In each session you will find all the information you need to protect yourself and the people you live with from colds and flu.

This includes:

- **personalised information** for you and the people you live with
- **medical facts** about viruses to help explain how you catch them
- **simple advice** on how to protect yourself from cold and flu viruses
- **support and tips** on how to make these ideas easier
- **ongoing feedback** and help with...
Would You Shake This Hand?

Probably not!

The funny thing is that if your hands were this dirty you would feel too embarrassed to touch other people - or too disgusted to touch your own face.

But it is hard to know if hands are dirty just by looking at them - they can have lots of viruses on them but still look clean.

It’s a bit like cleaning your teeth - other people can't always tell if they are clean just by looking, but you know they feel smooth and shiny after they have been brushed.

When you wash your hands you can tell they are clean because they smell nice, and feel soft and smooth. That is when you can be confident that they are cleaner and safer.
How to Make Handwashing a Habit

Many good hygiene ideas are already part of our way of life, so we do them without thinking about how important they are for preventing illnesses.

For example, to stop stomach bugs we do things everyday that we know work - store food in fridges, cook it well, and throw away anything bad. And, although cleaning dishes can take time and is boring (even with a dishwasher!), we do it rather than eat off a dirty plate or with dirty knives and forks.

*Washing your hands is the same.*

You can get cold and flu viruses on your hands at any time during the day. That is why it is a good idea to wash them regularly throughout the day:

- **before eating** is particularly important because you might be putting the viruses on your hands directly into your mouth.

- **after going to the toilet** is a good idea because of other germs from using the loo, but also because you do this regularly throughout the day, and there is a basin in the room.
Dry Hands

Some people think that washing their hands in winter dries the skin out.

But this isn’t actually the case - if you wash your hands a lot in the summer they don’t dry out. The reason they do in the winter is because cold weather effects the skin.

There are lots of things you can do to keep your hands protected in the winter - and you can actually use washing them to help!

- **wearing gloves outside** - the cold weather and winds take away the natural oils that keep your hands soft.

- **drinking water** - people tend to drink less water in the winter than in the summer. If you drink 2 litres of water a day your skin is less likely to dry out.

- **avoid harsh soaps and detergents** - if you’re using cleaning products, or washing dishes, wearing rubber gloves will protect your hands.

When you wash your hands it is a good opportunity to put some of the oils which protect them back onto the skin:

- **use a moisturising soap** - replace your usual soap with one that will soften your skin.

- **use hand creams** - if you use a cream or lotion a couple of times a day it will help keep your hands soft. You could keep one next to the sink or towel in the bathroom and use it after you have washed your hands.
# Interactive hand-washing plan

## How Often Do You Wash Your Hands?

If you think about **how much you have washed your hands over the last week**, which circle best describes each activity? Please click on one circle for each activity.

**WASHING YOUR HANDS INCLUDES USING A HAND GEL OR USING SOAP AND WATER**

<table>
<thead>
<tr>
<th>Over the last week, I washed my hands:</th>
<th>almost never</th>
<th>sometimes</th>
<th>quite often</th>
<th>very often</th>
<th>almost always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before I ate a meal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before I ate snacks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e.g. crisps, sweets, fruit)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>when I went to the toilet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>when I came into the house</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e.g. after work, shopping, travelling)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>after I had been close to someone who</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>had a cold or flu</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>after blowing my nose or</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sneezing/coughing on my hands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Feedback on hand-washing plan

When Could You Wash Your Hands More?

The more you wash your hands, the better protected you and the people you live with are from colds and flu.

To help do this you can choose your own hand washing plan.

This plan can help you wash your hands MORE than you do already:

- by committing to washing your hands at certain times
- and then helping to remind you when to wash them

Below is the table showing how much you have washed your hands UP TO NOW.

To choose your plan you can click on a new button to show how much you want to wash them IN THE FUTURE.

Remember: washing your hands includes using an antibacterial hand gel, or soap and water

<table>
<thead>
<tr>
<th>I will try to wash my hands:</th>
<th>almost never</th>
<th>some times</th>
<th>quite often</th>
<th>very often</th>
<th>almost always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before I eat a meal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before I eat snacks (e.g. crisps, sweets, fruit)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>when I go to the toilet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>when I come into the house</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Printable plan

Our Flu Prevention Plan

I commit to washing my hands with gel, or soap and water:

• ALMOST NEVER before I eat a meal
• ALMOST NEVER before I eat snacks
• ALMOST NEVER when I go to the toilet
• ALMOST NEVER when I come into the house
• ALMOST NEVER when I have been close to someone who has a cold or flu
• ALMOST NEVER after blowing my nose or sneezing/coughing on my hands

Signed
Our suggestions for hand-washing plan

4. Preliminary test of effects of threat and coping web-pages

Web-based survey (N = 84)

2X2 factorial design testing effect of

a) threat messages
b) coping message

on intentions (etc.)

<table>
<thead>
<tr>
<th>Measure and threat level</th>
<th>No coping messages</th>
<th>Coping messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low threat</td>
<td>4.02 (1.88)</td>
<td>3.78 (2.05)</td>
</tr>
<tr>
<td>High threat</td>
<td>3.33 (1.68)</td>
<td>2.61 (1.48)</td>
</tr>
</tbody>
</table>

(scored from 1 = strongly agree to 7 = strongly disagree)

Miller, S., Yardley, L. & Little, P. (2012) Psychology, Health & Medicine, 17, 59-81
5. Interim data from full pilot of web intervention

- In pragmatic design, 487 people randomised to prevention website or control (no advice)

- Significant effect of intervention on reported hand washing post-intervention (4 weeks; \( d = .42, p < .001 \)), maintained at follow-up (12 weeks; \( d = .34, p < .001 \))

- Changes in attitudes and intentions fully mediated intervention effects

- Full trial nearly completed, testing effects on infection rates in 16,000 people

INTRO:

web-based intervention for GPs in four EC countries

With Paul Little, Theo Verheij, Chris Butler et al.
Elaine Douglas, Sarah Tonkin-Crine, Sibyl Anthierens et al
Reducing antibiotic prescription for cough

Use web-based interventions to:

a) Educate GPs to use CRP test to improve detection of when antibiotics not needed/helpful

b) Educate GPs to use booklet to convince patients when antibiotics not needed/helpful (theory-based education and booklet)

Developed, translated and piloted qualitatively in 11 months
Intervention created in UK, modified for Spain, Poland, Belgium, NL (translation plus country-specific changes)
Using the LifeGuide website to develop the intervention
Addressing different determinants of prescribing

<table>
<thead>
<tr>
<th>Perceptions of ARTI management</th>
<th>GPs’ previous experience of ARTI management</th>
<th>Uncertainty in ARTI management</th>
<th>Perceptions of external pressure to reduce prescribing</th>
<th>Perceptions of potential conflict with patients</th>
<th>Perceptions of how to provide patient-centred care</th>
<th>Perceptions of occupational pressure</th>
</tr>
</thead>
</table>


• CRP test
  – reduce management uncertainty

• Communications skills training + booklet
  – enhance patient-centred care
  – reduce perceived pressure to prescribe, conflict with patients
Problem posed by antibiotic overuse for resistance at international and practice level, harms to individual patients

Evidence that reducing prescribing reduces resistance

Acknowledgement of barriers to reducing prescribing from diagnostic uncertainty, patient expectations – INTRO training as potential solution
INTRO trial results – prescribing rates (relative to pre-intervention baseline)

- 253 practices recruited 6771 patients
- 3742 (55%) were prescribed antibiotics

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>CRP</th>
<th>Communication</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>58%</td>
<td>35%</td>
<td>41%</td>
<td>32%</td>
</tr>
<tr>
<td>Risk ratio</td>
<td>1.00</td>
<td>0.54</td>
<td>0.69</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(p&lt;0.001)</td>
<td>(p&lt;0.001)</td>
<td>(p&lt;0.001)</td>
</tr>
<tr>
<td>Adjusted risk ratio</td>
<td>1.00</td>
<td>0.53</td>
<td>0.68</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(p&lt;0.001)</td>
<td>(p=0.003)</td>
<td>(p&lt;0.001)</td>
</tr>
</tbody>
</table>
GP agreement that taking part in the study helped reduce prescribing
Patient questionnaires scores by allocation to and receipt of CRP or booklet (mean and s.d.)

<table>
<thead>
<tr>
<th>Group allocation</th>
<th>Receipt of CRP</th>
<th>Group allocation</th>
<th>Receipt of booklet</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRP</td>
<td>CRP</td>
<td>Booklet</td>
<td>Booklet</td>
</tr>
<tr>
<td>Not</td>
<td>CRP</td>
<td>Not</td>
<td>Booklet</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>CRP</td>
<td>Antibiotics</td>
<td>Antibiotics</td>
</tr>
<tr>
<td>necessary</td>
<td>3.79 *** (1.17)</td>
<td>4.07 (1.78)</td>
<td>3.90 (1.72)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.94 (1.77)</td>
<td>3.93 (1.76)</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>3.90 (1.72)</td>
<td>3.94 (1.77)</td>
<td>3.93 (1.76)</td>
</tr>
<tr>
<td>harmful</td>
<td>4.07 (1.78)</td>
<td>4.03 (1.48)</td>
<td>4.04 (1.45)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.11 (1.47)</td>
<td>4.12 (1.48)</td>
</tr>
<tr>
<td>Patient</td>
<td>4.07 (1.78)</td>
<td>4.04 (1.45)</td>
<td>4.04 (1.45)</td>
</tr>
<tr>
<td>Enablement</td>
<td>4.03 (1.48)</td>
<td>4.11 (1.47)</td>
<td>4.12 (1.48)</td>
</tr>
<tr>
<td>Consultation</td>
<td>4.12 (1.46)</td>
<td>4.11 (1.47)</td>
<td>4.12 (1.48)</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>4.12 (1.46)</td>
<td>4.11 (1.47)</td>
<td>4.12 (1.48)</td>
</tr>
</tbody>
</table>

* p < 0.05, ** p < 0.01, *** p < 0.001
Conclusions

• Brief online training in using CRP and communication skills with patient booklet both effective in reducing prescribing

• The communication skills and booklet resulted in the most positive attitudes for GPs and patients

• Although CRP was the most effective intervention, attitudes of GPs and patients using it were more mixed, and may need addressing
Digital behaviour change interventions: The future
Introducing Ubhave: ubiquitous and social computing for positive behaviour change - core funding from EPSRC, as part of call for promoting cross-disciplinary research

Social Scientists:
Lucy Yardley
Peter Smith
Susan Michie

Computer scientists:
Cecilia Mascolo
Mark Weal
Mirco Musolesi
Dave de Roure
How will we use mobile phones for digital interventions in UBhave?

- Phones will detect movement, location, co-location, mood (building on Cambridge’s ‘Emotionsense’)

- Will develop software that uses detection of what person is doing and feeling to trigger timely behaviour support

- Opens up possibilities for entirely new way to approach behaviour change support – supplement conscious forward planning with ‘nudges’ when most needed

- Tools will be designed to be reusable by all for developing any behaviour change intervention (building on LifeGuide)
How will we use social networking for digital interventions in UBhave?

• Increasingly, social networks used to
  – communicate 24/7 with family and friends
  – communicate with dispersed networks of people with shared interests

• We will design tools to deliver just-in-time support from both types of virtual community

• Social networking will also be used for recruitment, dissemination, building virtual support communities
Illustration: weight management intervention

- User makes plans for needing weight management support when a) lonely, bored and b) out for evening with friends

- *Phone detects at home in day, no movement or co-location, low mood* - triggers link to virtual social support community, prompts preferred physical activities

- *Phone detects in town in evening, movement and co-location, mood good* – triggers planned reminders of acceptable ways to refuse or substitute fattening foods/drinks, links to calorie guides for foods
Current studies: POWeR Mobile

• Series of n-of-1 studies (ABAB design)

• New statistical analyses of intervention usage

• Mass roll-out together with POWeR
  – through MyPersonality on Facebook
  – via workplaces in the NorthEast (with Scott Lloyd)
Other plans for LifeGuide/UBhave

- added functionality as desired (open source) e.g. visual interface
- added connectivity (remote monitoring, links to medical records)
Issues for UBhave and LifeGuide

• What works best, for whom?

• What ethical issues are raised by intensive monitoring/intervention and how can these be addressed?

• How should digital interventions be integrated with existing behaviour change support?

• How can effective digital interventions be disseminated effectively?
You are very welcome to join us!

To receive LifeGuide Community newsletters email
V.J.Hayter@soton.ac.uk

For more information about how you can download and use LifeGuide go to
www.lifeguideonline.org