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Internet self-management uniform reporting framework: the need for uniform reporting criteria when reporting internet interventions

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Acknowledgements

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Abstract

A review of the literature was conducted to identify the “active ingredients” needed to produce successful Internet interventions that support older adults to self-manage their chronic disease(s). The term “Internet intervention” was used as an umbrella term to include all online self-management programs. Thirteen articles were found to meet the inclusion criteria from the initial 204 articles identified. Ritterband’s Model of Internet Interventions was used as a framework to classify the intervention components reported. It was found that online self-management interventions can improve outcomes for some older adults. However, the wide diversity of interventions and the measures reported, coupled with the complex nature of the studies, made it difficult to identify the “active ingredients”. To overcome this problem the authors propose a minimum reporting set, the Internet Self-Management Uniform Reporting Framework (iSMURF), which can be used in the reporting of all interventions. iSMURF proposes the collection of specific data from six domains: website design, support, study design, website use, user characteristics and reporting outcomes. The adoption of iSMURF would enable easy comparison of online interventions targeting chronic diseases.
Introduction

Chronic disease and self-management
Older people are more likely to experience deteriorating health and to develop chronic disease(s). Like many Western countries, Australia has an ageing population, with 80% of Australians over 65 years of age found to have three or more chronic conditions\(^1\). Although chronic diseases cannot be cured, many can be effectively self-managed. Self-management has been defined as a partnership between the patient and physician that addresses the medical, behavioural and emotional factors encountered when dealing with a chronic disease\(^2\). This definition encompasses specific behaviours such as adherence to the treatment plan, symptom management, health behaviour changes, and coming to terms with the change in life role from ‘healthy’ to ‘sick’\(^3\). Self-management can be both complicated and dynamic as the aetiology of chronic diseases is often unpredictable, with periods of wellness followed by sudden deterioration in health.

Optimal self-management can often be constrained due to the nature of primary health care services, which may limit the amount of support and education available to patients. Important information about the diagnosis, disease and its self-management is often presented to patients in the physician’s office at the time of diagnosis; however, many people experience increased stress at this time and thus have a reduced ability to absorb the information. Further, short appointment times limit patient-physician contact and mean that information is usually given just once\(^4\). The Internet overcomes these problems by offering immediate access to health care information, at any time of day or night.

Internet Health Interventions
Internet interventions are a cheap and accessible means of offering self-management education, with the main costs being incurred during the development of the intervention\(^5\). Patients using Internet interventions do not incur the time and monetary costs that they would encounter through attending traditional group-based self-management programs. Internet interventions are accessible to everyone with Internet access irrespective of their geographical location, and can be visited at a time and place convenient to the person. The intervention can be revisited as often as necessary, reinforcing concepts and providing further information as required. Benefits for providers of interventions include the ability to easily update information and the capacity to individually tailor information for each person.
Many previous literature reviews have examined various aspects or types of intervention. This is in part due to the variety of Internet interventions that have been developed targeting chronic disease self-management. For example, a 2011 review of the benefits of online patient education for chronic disease identified 49 articles reporting on studies which showed significant improvements in: health outcomes, disease knowledge, and treatment adherence. Another review, also published in 2011, identified 12 randomized control trials that investigated the efficacy of e-health and found that most reported a small to moderately positive effect on primary health outcomes. A 2008 review identified 17 previously conducted systematic reviews addressing Internet-delivered treatments for long-term conditions. This review concluded that Internet interventions increased participants’ knowledge about their condition, impacted positively on self-efficacy and had some impact on health behaviours, including improving physical exercise, adopting a healthy diet and promoting smoking cessation. It is notable that these examples of previous reviews have focused on participant outcomes and not the components of the interventions. As Internet interventions are typically comprised of many parts that may act together or independently, there is considerable uncertainty about which parts are the “active ingredients” that make an intervention successful in creating changes in patient health behaviours and health outcomes.

**Internet Interventions and Older Adults**

Older adults have the most to gain from Internet interventions, as they shoulder the greatest burden of ill-health, but little is known about the effectiveness of such interventions for this population. Users of Internet interventions need to have Internet access and be computer literate. While older adults are less likely to be “connected” than other age groups; 34% of 70 – 75 year olds in the United States reported being online in 2012 – these users have been shown to frequently use the Internet to search for health information. However, older adults may experience cognitive and physical decline as they age, impacting their ability to use the computer and Internet.

**Model of Internet Interventions**

Ritterband et al. proposed the Model of Internet Interventions to explain how Internet interventions improve disease symptoms through behaviour change (Figure 1). The model, which was developed from multiple theories and practical experience, facilitates the identification of factors influencing the success of Internet interventions to be identified, observed and measured. The model has nine major components: user characteristics; website use; support; website design; mechanisms of...
change; behaviour change; symptom improvement; treatment; maintenance and the environment (Figure 1). Each component can be divided into areas, and each area can be further sub-divided into elements.

Figure 1: Model of Internet Interventions (Ritterband et al. 2009)

For example:

Component: website

Area: appearance of the website

Element(s): Layout and organisation of the website

Purpose

The purpose of this paper is to report the results of a review aimed to identify the “active ingredients” needed to produce Internet interventions that successfully support older adults to self-manage their chronic disease(s). The Model of Internet Interventions was adapted to provide a framework for the review. For the purpose of this research, the term “older adults” refers to people aged 55 years and over. The term “Internet intervention” is used as an umbrella term to include all online self-management programs, irrespective of their individual tailoring or level of interaction.

Methods

Literature searches were conducted, during May 2012, using the Scopus and Web of Science databases; these two databases currently provide the most comprehensive coverage of the health science literature.
Search Terms
The following search terms were used in both databases: self-management OR patient education AND chronic disease OR chronic illness OR chronic disease management AND computer-based intervention OR Internet OR e-health OR Web-intervention. These terms were derived from the keyword lists of relevant articles that had been obtained previously through a broad exploration of the literature.

Search Restrictions
In Web of Science the search terms were restricted to “topic” and lemmatization was enabled - allowing the automatic finding of words with alternate spellings. In both databases, searches were restricted to articles published since 2002, due to the advances in technology that have occurred in this period. These searches identified 204 articles. The abstracts were reviewed and articles were excluded if they: were not in English; were reviews, discussion articles or proposed protocols; had samples with a mean age of less than 55 years; targeted clinicians or carers; or involved telemedicine. Articles were not excluded on methodological quality.

In order to ensure methodological rigour, a second researcher reviewed each abstract. The researchers disagreed on the inclusion or exclusion of six articles. These articles were subsequently discussed; the decision to retain or exclude each paper was reached by mutual agreement. Articles were excluded for the following reasons: did not report on an intervention targeting a patient (113), age of participants (27), review (20) and use of telemedicine (10). This process resulted in the selection of 33 articles - one of the selected articles was identified by both databases. The articles were obtained and reviewed in full to ensure they met the selection criteria. When no age information was provided the paper was excluded. Review of the complete articles resulted in a further 20 articles being excluded (10 were excluded due to the type of intervention being reported; seven were excluded due to age of participants, and three were classified as telehealth interventions), leaving a final sample of 13 articles. These articles were read and data extracted using a review matrix devised for this project\(^\text{14}\). The matrix included the nine components identified by the Model of Internet Interventions: Environment; User characteristics; Website use; Support; Website; Mechanism of change; Behaviour change; Symptom improvement; and Treatment maintenance. A copy of the matrix can be obtained from the authors.
Results
The 13 selected articles reported on 11 distinct initiatives (Table 1); two articles reported different aspects of two different studies\textsuperscript{15–18}. The 11 studies targeted people with a broad range of chronic diseases: type 2 diabetes (n=6\textsuperscript{15,16,19–22}); heart disease (n=3\textsuperscript{23–25}), multi-morbidities (n=3\textsuperscript{17,18,26}), and overactive bladder (n=1\textsuperscript{27}).

The number of participants completing each intervention ranged from 15 to 354, with intervention drop-out rates ranging from 0\% to 52\%. The mean age of participants ranged from 55.5 to 69.0 years. Most of the research was carried out in the USA; however, there were two studies from the Netherlands and one study each from the UK, Canada and Korea. Nine of the identified studies utilised a randomised-control trial design, suggesting the results should be valid and reliable. For most articles the date of actual research was difficult to establish, so was estimated based on the date of publication. The components of each intervention were categorised under the headings proposed by the Model of Internet Interventions (Table 2).

User characteristics
All 13 articles provided some information on the demographics of the participants, such as age, sex, education level attained and level of computer skills. While some interventions included strategies to up-skill participants with limited Internet experience (see Support), only one attempted to investigate how Internet experience impacted participants’ use of the intervention\textsuperscript{23}. This study used qualitative methods to determine that while participants knew where to access technical help, many did not seek help as they were embarrassed to reveal their lack of computer skills or to admit that they had forgotten the instructions\textsuperscript{23}.

Website use
Nine articles provided data related to use of the intervention. However, the type of data collected varied among articles and included information such as the number of participants visiting the site, the number of visits each participant made, the visit duration, total time on the site and the time of site visit. Some authors reported participant engagement as the percentage of participants using the intervention for the whole trial\textsuperscript{24}, while one paper classified usage as no, low and high\textsuperscript{23}. Four studies reported usage decreasing with time\textsuperscript{16,20,21,24}. 

<table>
<thead>
<tr>
<th>Author</th>
<th>Study year</th>
<th>Participants completing intervention</th>
<th>Dropout from intervention group</th>
<th>Participant characteristics</th>
<th>Mean age (years)</th>
<th>Country</th>
<th>Paper aim</th>
<th>Study design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic disease focus: diabetes</td>
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<tr>
<td>Heinrich et al., 2012</td>
<td>≤2012</td>
<td>43</td>
<td>7 (14%)</td>
<td>Patients with DM2</td>
<td>56.0</td>
<td>The Netherlands</td>
<td>To evaluate the web-based self-management programme. Participants were allocated to either: the experimental group who were given access to Diabetes Interactive Education Programme (DIEP); a control group; or a post test control group.</td>
<td>RCT</td>
</tr>
<tr>
<td>Nijland, van Gemert-Pijnen, Kelders, Brandenburg, &amp; Seydel, 2011</td>
<td>≤2011</td>
<td>34</td>
<td>16 (32%)</td>
<td>Patients with DM2</td>
<td>61.0</td>
<td>The Netherlands</td>
<td>To explore the factors affecting initial and long term use of Diabetes Coach.</td>
<td>Longitudinal study</td>
</tr>
<tr>
<td>Glasgow et al., 2011l</td>
<td>≤2011</td>
<td>Website alone = 137; Website &amp; support = 133</td>
<td>Unknown</td>
<td>Patients with DM2</td>
<td>60.0</td>
<td>USA</td>
<td>To report long-term implementation, outcomes and generalisability of results. A website, My Path, (available in English and Spanish) was offered alone or in combination with support via phone and group meetings.</td>
<td>RCT</td>
</tr>
<tr>
<td>Song et al., 2009</td>
<td>2006</td>
<td>15</td>
<td>16 (52%)</td>
<td>Patients with newly diagnosed DM2.</td>
<td>56.3</td>
<td>Korea</td>
<td>To develop and apply a web-based education program. Participants assigned either to web-based self-management group or lecture group.</td>
<td>Quasi-experimental (control group not matched)</td>
</tr>
<tr>
<td>Glasgow, Boles, McKay, Feil, &amp; Barrera, 2003</td>
<td>≤2003</td>
<td>Info only = 33; Peer support = 30 Tailored self-management = 37 **</td>
<td>Info only = 7; (21%); Peer support = 10; (25%); Tailored self-management = 3; (9%)*</td>
<td>Patients with DM2</td>
<td>59.0</td>
<td>USA</td>
<td>To calculate indices of website engagement of Diabetes Network (D-Net). Participants randomised to: information only, tailored self-management or information and peer support.</td>
<td>Randomised design – no control group</td>
</tr>
<tr>
<td>Author</td>
<td>Study year</td>
<td>Participants completing intervention</td>
<td>Dropout from intervention group</td>
<td>Participant characteristics</td>
<td>Mean age (years)</td>
<td>Country</td>
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<td>Study design</td>
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</tbody>
</table>
| Barrera, Glasgow, McKay, Boles, & Feil, 2002 | ≤2002      | Info only = 31  
Coach =31  
Social support = 30  
Social support & coach = 31 | Info only = 9  
(23%)  
Coach =9  
(23%)  
Social support = 10  
(25%)  
Social support & coach = 9  
(23%) | Patients with DM2 | 59.3 | USA | To determine whether the intervention changed participants’ perceptions of social support. Participants were randomly assigned to one of four groups: information only; personal coach & information; social support & information; or personal coach, social support & information. Trial ran for three months. | RCT          |
| **Chronic disease focus: heart disease** |            |                                        |                                 |                              |                  |         |                                                                                                                                                                                                          |              |
| Kerr et al., 2010            | ≤2010      | 129  
(99%) | 31 (19%) | Patients with CHD | 66.8 | UK | To explore the potential of a web-based intervention (Comprehensive Health Enhancement and Social Support - CHESS) for reaching a large number of patients | Prospective cohort study |
| Flatley Brennan, Casper, Kossman, Burke, & Brennan, 2007 | 2005-2006  | 24 | Unknown | Patients with complex cardiac disease | 69.0 | USA | To describes the use of HeartCarell to support patient self-management, symptom interpretation and self-monitoring. HeartCarell formed the core of a Technology Enhanced Practice nursing model. | RCT          |
| Verheijden et al., 2004      | 2002-2003  | 24 | 16%  
(however, 48, 66% - did not access the intervention) | Patients with a diagnosis of: hypertension, type 2 diabetes and/or dyslipidemia | 63.0 | Canada | To assess the effectiveness of web-based nutrition counselling (Heartweb) in addition to usual care. The control group received usual care. | RCT          |
<p>| <strong>Chronic disease focus: other chronic disease</strong> |            |                                        |                                 |                              |                  |         |                                                                                                                                                                                                          |              |
| Ruiz et al., 2011            | ≤2011      | 25 | 0 (0%) | Presence of overactive bladder for at least three months | 62.9 | USA | To determine the usability and outcomes, including knowledge, self-efficacy and quality of life, for older adults using OAB-SMIP (Over Active Bladder – Self-Management Internet-Based Program). | Cohort       |
| <strong>Chronic disease focus: multiple conditions</strong> |            |                                        |                                 |                              |                  |         |                                                                                                                                                                                                          |              |
| Cudney &amp; Weinert, 2012       | 2007-2009  | 123 | 22 (14%) | Rural women | 56.2 | USA | To describe the development and evaluation of the online health teaching units (Women-to-Women). | RCT          |</p>
<table>
<thead>
<tr>
<th>Author</th>
<th>Study year</th>
<th>Participants completing intervention</th>
<th>Dropout from intervention group</th>
<th>Participant characteristics</th>
<th>Mean age (years)</th>
<th>Country</th>
<th>Paper aim</th>
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</thead>
<tbody>
<tr>
<td>Weinert, Cudney, Comstock, &amp; Bansal, 2011</td>
<td>2007-2009</td>
<td>118</td>
<td>37 (24%)</td>
<td>Rural women</td>
<td>55.5</td>
<td>USA</td>
<td>To report the effect of a computer intervention (Women-to-Women) on psychosocial adaptation</td>
</tr>
<tr>
<td>Lorig et al., 2006</td>
<td>≤2006</td>
<td>354</td>
<td>103 (23%)</td>
<td>&gt; 18 years with heart disease, chronic lung disease or type 2 diabetes</td>
<td>57.4 (online intervention)</td>
<td>USA</td>
<td>To determine the efficacy of the internet chronic disease self-management program. Subjects randomised to experimental or usual care groups.</td>
</tr>
</tbody>
</table>

* Two different mean ages are reported in this paper
** Details extracted from McKay et al 2002.
Table 2: Components from the Model of Internet Interventions identified in each paper

<table>
<thead>
<tr>
<th>Author</th>
<th>Environment</th>
<th>User characteristics</th>
<th>Website use</th>
<th>Support</th>
<th>Website design</th>
<th>Mechanisms of change</th>
<th>Behaviour change</th>
<th>Symptom improvement</th>
<th>Treatment maintenance</th>
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<tr>
<td>Heinrich, de Nooijer et al</td>
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<td>Nijland, van Gemert-Pijnen et al</td>
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<td>Glasow, Christiansen et al</td>
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<td>Song, Choe et al</td>
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<td>Glasgow, Boles et al</td>
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<td>Barrera, Glasgow et al</td>
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<tr>
<td>Kerr, Murray et al</td>
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<td>Brennan, Casper et al</td>
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<tr>
<td>Verheijden, Bakx et al</td>
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<td>Ruiz et al</td>
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<td>Cudney &amp; Weinert</td>
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<tr>
<td>Weinert, Cudney et al</td>
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<tr>
<td>Lorig, Ritter et al</td>
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*Measures reported
↑ At least one measure was seen to improve
- Measure taken, but no changes observed
Support
For this review, both technical and clinical support were coded as ‘support’. Two studies provided computers for participants to use\textsuperscript{16,24}, whilst others provided technical training to participants either as individual sessions\textsuperscript{20,23} or when attending clinic appointments\textsuperscript{27}. One study utilised online moderators to remind participants to log-in, offer encouragement and model behaviours such as action planning; and a companion book to act as a reference manual to the material presented\textsuperscript{26}. One study provided users with a technical manual to accompany the intervention\textsuperscript{20}.

Many interventions offered participants peer-support, often in the form of online forums \textsuperscript{15–18,23–27}. The impact of such support is unclear and was often not investigated as a separate component of the intervention. However, in one study, participants given access to an information based intervention with peer support did not experience statistically significant changes in behaviour and symptoms when compared to a group provided with information only\textsuperscript{16}. By contrast, another study found perceived support increased most when the intervention included a forum\textsuperscript{15}, although the effect was moderated when offered in combination with a personal coach. The authors did not offer an explanation for this finding.

Website design
Four articles provided information about the design of their website,\textsuperscript{18–20,22} but the breadth of the information provided varied widely between studies. Two articles provided descriptive information, with one including screen shots \textsuperscript{18,22}; the other two included insights gained from the participants\textsuperscript{19,20}.

Mechanisms of change
A number of studies measured parameters that can be mediators for change (n=6). These parameters included knowledge, self-efficacy, self-esteem and acceptance of illness. In five studies, at least one of the reported measures showed significant improvement after the intervention \textsuperscript{15,17,19,22,27}. Due to the differences between interventions the current review did not attempted to compare or contrast these measures.

Behaviour Change
Only four studies reported measuring behaviour change\textsuperscript{16,21,22,26}. A range of measures were assessed which were specific to the intervention types. These included: changes in aerobic exercise, stretching and strengthening exercise, practice of stress management\textsuperscript{26}, diabetes care behaviour\textsuperscript{16,22}, eating patterns\textsuperscript{16,21}, physical activity\textsuperscript{16,21} and medication adherence\textsuperscript{21}. While positive behaviour changes are needed in order for symptom improvement to occur\textsuperscript{12}, not all studies attempted to measure these
changes.

**Symptom improvement**
Six articles reported measures of participants’ symptoms at baseline and at the end of the intervention. These measures included: glycosylated haemoglobin (HbA1c)\textsuperscript{12}, total cholesterol\textsuperscript{16}, low density cholesterol\textsuperscript{16}, triglycerides\textsuperscript{16}, pain\textsuperscript{26}, shortness of breath\textsuperscript{26}, fatigue\textsuperscript{26} and a patient-reported measure of bladder condition symptoms\textsuperscript{27}. In five of these studies at least one of the measures had improved significantly\textsuperscript{16,17,22,26,27}. In one study, which examined nutritional counselling and social support, participants receiving the Internet intervention showed no improvement in any of the symptom measures\textsuperscript{25}.

**Treatment maintenance**
Two of the articles reported medium or long-term follow-up measures. One study reported significant improvements in health status at one-year after baseline\textsuperscript{26}. Another study reported continued improvements in five of the six psychosocial outcomes measured at 24 weeks (the intervention ceased at 11 weeks): self-esteem, acceptance, depression, stress and loneliness\textsuperscript{17}.

**Environment**
Environment was defined as support provided external to the intervention; using this definition only one paper investigated social support\textsuperscript{17}. This study found that participants with higher scores for social support were most likely to drop-out of the intervention. Conversely, married women were more likely to remain in the study, suggesting that spousal support and social support are not directly correlated.

**Discussion**
This review showed that online self-management interventions can improve outcomes for some patients completing some interventions, the wide diversity and complexity of interventions along with the lack of detail provided in the articles makes it difficult to identify the “active ingredients” needed to create effective interventions for older adults. These results support the need for a standardised set of reporting criteria that can be used by researchers in the future\textsuperscript{29}. Based on the findings of this review, we offer suggestions for a minimum reporting set, addressing four of the nine components from the Model of Internet Interventions: user characteristics, website use, support and website design (Figure 2, the Internet Self-Management Uniform Reporting Framework - iSMURF).
While the variability of Internet interventions makes it difficult to suggest a relevant reporting set for all of the components of the Model of Internet Interventions, these four components are more standardised and are applicable to all interventions irrespective of the theoretical underpinnings and target age group. Two other areas of data collection “study design” and “reporting outcomes” have been included in the proposed iSMURF. These components were identified by comparing the different reporting styles used by the articles identified through this literature review.

**The Internet Self-Management Uniform Reporting Framework**

The following section discusses the rationale for including each of the six iSMURF reporting domains: Website design, Support, Study Design, Website use, User Characteristics and Reporting Outcomes.

*Figure 2: The internet Self-Management Uniform Reporting Framework (iSMURF)*

<table>
<thead>
<tr>
<th><strong>Website design</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological platform</td>
<td></td>
</tr>
<tr>
<td>Use of evidence based guidelines in site design</td>
<td>Yes/no</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Support</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision of computer/ technical equipment to participants</td>
<td>Yes/no</td>
</tr>
<tr>
<td>Provision of technical support</td>
<td>Yes/no</td>
</tr>
<tr>
<td>Use of clinicians/moderators</td>
<td>Yes/no</td>
</tr>
<tr>
<td>Frequency of contact</td>
<td></td>
</tr>
<tr>
<td>Mode of contact e.g. phone, email etc</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Study design</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of study</td>
<td></td>
</tr>
<tr>
<td>Length of study</td>
<td></td>
</tr>
<tr>
<td>Recruitment methods</td>
<td>Paid/unpaid</td>
</tr>
<tr>
<td></td>
<td>Online/offline</td>
</tr>
<tr>
<td>Potential reach of intervention</td>
<td>Open to everyone</td>
</tr>
<tr>
<td></td>
<td>After clinical assessment</td>
</tr>
<tr>
<td></td>
<td>Invited user group</td>
</tr>
<tr>
<td>Use of incentives</td>
<td>Times and amounts</td>
</tr>
<tr>
<td>Use of reminders</td>
<td>Times and amounts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Website use</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Engagement</td>
<td>Total number of visits</td>
</tr>
<tr>
<td></td>
<td>Average number of visits by participants</td>
</tr>
<tr>
<td></td>
<td>Most viewed page</td>
</tr>
<tr>
<td>Exposure</td>
<td>Total duration of viewing</td>
</tr>
<tr>
<td></td>
<td>Average viewing time by participants</td>
</tr>
<tr>
<td>Attrition</td>
<td>Over time e.g. baseline and post intervention as minimum</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>User characteristics</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Mean</td>
</tr>
</tbody>
</table>
Website Design

The articles which provided information around website design often provided little information regarding the technology supporting the intervention. This may occur due to the complexities of interventions, meaning that only limited information can be reported in each journal article. However, the reporting of such information is useful and could increase collaboration between professionals working within e-health. iSMURF proposes that at a minimum the following points are reported: 1) type of technological platform used, and 2) use of evidence based guidelines in site design. Reporting of information on how website content is presented e.g. text only or use of videos, would also be pertinent. However, this has not been included as iSMURF serves as a minimum reporting set.

Support

The support category has been included to capture information covering three distinct areas: technical support, peer support and clinician support. Collection of this information increases the transparency of interventions.

Study design

Some of the study methodologies reported potentially played a role in the success or failure of the intervention, but were not captured by the Model of Internet Interventions. One example is the recruitment of participants; techniques ranged from the use of targeted invites sent to participants identified via physician computer systems to general advertisements using low-tech paper flyers. Recruitment strategies influence the reach of each intervention and potential participation\(^\text{30}\). They also play a large role in determining the representativeness of the sample recruited and potentially the success of the intervention\(^\text{31}\). As such, iSMURF suggests reporting whether participants were recruited using online or offline methodologies and who could register (Figure 2 - iSMURF). Further,
information on incentives to encourage participants should be reported. Some studies utilised financial incentives to reduce drop-out rates\textsuperscript{17,21,26}, while others reported sending reminder emails to encourage participants to log-in\textsuperscript{21,25,26}. The potential importance of incentives in the effectiveness of Internet interventions is reflected by their inclusion in the suggested reporting criteria (Figure 2).

The interventions identified showed considerable variation in duration, ranging in length from two weeks\textsuperscript{19} to two years\textsuperscript{20}. It is unclear from this review what the optimal length of use of an Internet intervention is or the amount of exposure participants need (or how this could be determined reliably with so many uncontrolled variables). However, reporting of duration adds to the knowledge base about Internet interventions, thereby justifying its inclusion in the iSMURF reporting criteria (Figure 2).

Finally, there are a number of evidence based guidelines are available for the development of websites targeting older adults\textsuperscript{32,33}, however, their use in the studies reviewed were not mentioned. It is suggested that use of these guidelines and identification of which guidelines be reported (Figure 2).

**Website Use**

The reporting of website use is fundamental to advancing our understanding of Internet interventions. While most studies reported high dropout rates (the law of attrition)\textsuperscript{34}, the use of attrition as a measure of usage remains controversial when it does not show fluctuations in use over time, or the impact of push factors (methods to encourage use of interventions, such as reminder emails). Further, participants can experience a ‘ceiling effect’ when they feel that their condition is under control and that they are ‘doing well’ and no longer need the intervention\textsuperscript{20}. Total duration of use, average time of all visits and most viewed pages are all frequently utilised as measures of website use. These measures have been included in iSMURF as a minimum measure (Figure 2 - iSMURF). However, the best methods of measuring website engagement are currently the topic of debate and are likely to include composite measures of engagement and exposure\textsuperscript{31}.

**User Characteristics**

The collection of information on users’ characteristics is generally self-explanatory and includes basic demographics such as age, sex and ethnicity; although it is suggested that both mean age and the age range of participants are reported, as this would provide useful information to future researchers, specifically those working with defined populations, such as older adults. iSMURF suggests collecting information on the number of chronic disease diagnoses each participant reports.
While it is recognised that self-report methods are not ideal this measure would provide some indication of the self-management burden faced by each individual. Finally, in this category, iSMURF suggests the collection of a measure of health literacy. While, this measure would ideally come from a standardised instrument, it is recognised that different instruments suit different protocols. Health literacy has been included as it may play a role in intervention effectiveness and can also be used to show which population segments are accessing Internet interventions.

**Reporting Outcomes**

Two measures have been included in this category; participant satisfaction and cost effectiveness. Participant satisfaction with the interventions was reported in only one study and this study utilised qualitative research methods to establish participant satisfaction\(^\text{23}\). Various tools can be utilised to measure participant satisfaction. Danaher (2009) champions the use of global measures of satisfaction, e.g., participant satisfaction, program relevance or whether participants would recommend the program to others\(^\text{31}\). Such generic measures overcome potential problems encountered when users and researchers use different words to describe the same part of an intervention. iSMURF suggests the inclusion of a measure of participant satisfaction; at a minimum this should be a quantitative measure of global satisfaction. The need for information on costs and cost effectiveness of Internet interventions has been identified elsewhere\(^\text{35}\). Both measures have been included in the iSMURF criteria as a cue to researchers working in the area.

**The Relationship between iSMURF and the Model of Internet Interventions**

The Model of Internet Interventions was developed as a theoretical model to help explain behaviour change and symptom improvement. The Model has been previously praised for its comprehensive nature\(^\text{10}\), and provided a useful framework on which to structure the results of this and similar reviews. iSMURF furthers the work carried out by Ritterband and colleagues in developing the Model of Internet Interventions, by proposing reporting guidelines at a micro level. iSMURF has purposefully excluded some of the components suggested by the Model of Internet Interventions such as Mechanisms of Change e.g. changes in participants’ knowledge; Behaviour Change e.g. changes in participants’ levels of physical activity; and Symptom Improvement as these measure are often disease specific and not easily comparable across interventions.

Consideration of how to collect the information suggested by iSMURF should be integral in the design phase of studies to ensure that the data collected provides a comprehensive report of intervention implementation. Collection of these measures would facilitate easy comparison of
interventions and could, in the future, be used to help identify the “active components” of Internet interventions. It should be acknowledged that iSMURF outlines a minimum data reporting set and researchers are encouraged to provide information about their interventions over and above that suggested. Further, it is recognised that iSMURF will undergo various changes and iterations as its adoption spreads. However, it represents the first step in unified reporting of Internet self-management interventions.

**Importance of this Work**
Although many literature reviews have examined the effectiveness of online health education, we believe that this is the first review to specifically analyse the components of the Internet interventions and not simply the outcomes. Further, we believe this is the first review to investigate self-management interventions targeting older adults – those who can benefit most from such interventions. While the study was a systematic literature review, no attempt was made to identify studies not listed through the databases (gray literature). Secondly, many of the studies identified had small numbers and targeted specific chronic diseases limiting the generalizability of the results.

**Conclusions**
This research began as a review of the Internet intervention literature to identify the components that create successful interventions for older adults, using the Model of Internet Interventions as a way of structuring the findings. It was discovered that the information reported across interventions varied widely and inhibited easy comparison, resulting in the proposal of iSMURF, a minimum reporting framework to be used by researchers working on Internet interventions. The availability of standardised data will, over time, allow an increased understanding of the effectiveness of Internet interventions and the identification of the “active components” that make interventions successful.
References


