



## Assessment

## Measuring the effects of online health information: Scale validation for the e-Health Impact Questionnaire

Laura Kelly<sup>\*</sup>, Sue Ziebland, Crispin Jenkinson*The Nuffield Department of Population Health and the Nuffield Department of Primary Health Care Sciences, University of Oxford, UK*

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## ABSTRACT

**Objective:** Health-related websites have developed to be much more than information sites: they are used to exchange experiences and find support as well as information and advice. This paper documents the development of a tool to compare the potential consequences and experiences a person may encounter when using health-related websites.

**Methods:** Questionnaire items were developed following a review of relevant literature and qualitative secondary analysis of interviews relating to experiences of health. Item reduction steps were performed on pilot survey data ( $n = 167$ ). Tests of validity and reliability were subsequently performed ( $n = 170$ ) to determine the psychometric properties of the questionnaire.

**Results:** Two independent item pools entered psychometric testing: (1) Items relating to general views of using the internet in relation to health and, (2) Items relating to the consequences of using a specific health-related website. Identified sub-scales were found to have high construct validity, internal consistency and test-retest reliability.

**Conclusion:** Analyses confirmed good psychometric properties in the eHIQ-Part 1 (11 items) and the eHIQ-Part 2 (26 items).

**Practice implications:** This tool will facilitate the measurement of the potential consequences of using websites containing different types of material (scientific facts and figures, blogs, experiences, images) across a range of health conditions.

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## 1. Introduction

The internet has huge potential for promoting health and preventing disease [1]. One important way in which the internet has been used in connection with health is through the distribution of information throughout both industrialised and developing nations [2,3]. Many of the characteristics associated with the web make it a promising resource for public health. For example, the accessibility of a wide range of information can promote benefits such as public education and empowerment through informed decision-making. Wide availability of various forms of information however may also lead to negative consequences, such as misinformation or misuse of information [4]. The potential impact of using a particular website on an individual is therefore critical when informing future health information strategies.

Improved knowledge and behavioural outcomes have been demonstrated when using online information compared to traditional forms of information (for example, leaflets or pamphlets) [5]. Whilst these results are encouraging, using the web to source information compared to using printed materials is a very different user experience. In addition to differences in the volume and presentation of conventionally presented medical information, health-related websites can also offer insights into the experience of living with a health condition when printed materials typically do not. Personal experiences can be useful in maintaining the web user's interest, give more in-depth information and provide opportunities to compare and contrast experiences of health [6]. The inclusion of these forms of information, however, can sometimes be omitted by website developers [7]. To ascertain how online information can positively or negatively impact on the user, websites containing different styles of information need to be compared using appropriate methods. To date, attempts to compare the potential consequences of using a website on users and their experiences of using various styles of information have been restricted by the lack of a suitable instrument; it is this gap which we have sought to address.

<sup>\*</sup> Corresponding author. Old Road Campus, Headington, Oxford, UK. OX3 7LF.  
Tel.: +44 0 1865 289425.

E-mail address: [laura.kelly@dph.ox.ac.uk](mailto:laura.kelly@dph.ox.ac.uk) (L. Kelly).

This study set out to develop a valid and reliable instrument which would enable the comparison of two or more health-related websites in a standardised manner. The instrument (the eHealth Impact Questionnaire) aimed to inform health professionals, researchers and web developers about users' experiences of using different types of material (for example scientific facts and figures, blogs, experiences, images) that they might include on their websites.

To inform this instrument, a recent literature review [8] relating to the potential effects of seeing and sharing experiences online and a secondary data analysis of interviews [9] relating to experiences of health were used to generate a range of items. Five themes were identified which outlined the potential experiences and consequences a person may encounter when accessing health websites containing scientific information and/or experiential information. These themes were labelled: (1) Information, (2) Feeling supported, (3) Relationships with others (4) Experiencing Health Services and; (5) Affecting behavior.

Expert and user opinion confirmed the acceptability and relevance of 62 candidate items through expert review and a series of cognitive debrief interviews with internet users. Cognitive interviews also ensured items were interpreted as the researchers intended. Items were divided into two pools: (1) Items relating to general views of using the internet in relation to health (eHIQ-Part 1) and (2) Items directly relating to the use of a specific health-related website (eHIQ-Part 2). See Kelly et al. [9] for further detail. This paper reports the item reduction and psychometric refinement of the candidate items.

## 2. Methods

This study was carried out in two stages. Stage 1 aimed to administer the pilot online questionnaire across a range of health groups with a view to reducing and refining items. Stage 2 aimed to finalise the questionnaire sub-scales using a further sample and to evaluate the validity and reliability of the scales. Recruitment methods for Stages 1 and 2(b) were approved by the University of Oxford's Medical Sciences Division Research Ethics Committee (Reference numbers: MSD/IDREC/C1/2011/77 and MSD-IDREC-C1-2013-063). Stage 2(a) was approved by the NHS Research Ethics Committee (Reference number: 12/SW/0209).

### 2.1. Participants

Participants were men and women who were aged 18 years or over, living in the UK and had access to the internet. To ensure items were appropriate for inclusion in a generic questionnaire, items were administered across a range of health groups (for example, carers, people with chronic conditions, people hoping to modify health behaviour). Estimates suggest that meaningful psychometric tests require at least three times as many respondents as items [10]. The largest item pool (eHIQ-Part 2) contained 39 items in Stage 1 and 34 items in Stage 2. Therefore, at least 117 participants were required for analyses in Stage 1 and at least 102 participants were required in Stage 2.

### 2.2. Recruitment

Stage 1: Open recruitment took place through invitations health blogs, online discussion forums, social networking sites (Facebook and Twitter), news pages on health websites, research volunteer pages, local news advertisements, and a research volunteer email list. Potential participants were asked to click on an electronic link which led them to the study materials.

Stage 2: Mixed modes of recruitment were used. Direct recruitment (Stage 2a) involved distributing postal research

invitations (through the Oxfordshire Primary Care Trust ( $n = 520$ ) and the Birmingham branch of the Multiple Sclerosis Society ( $n = 235$ ). Open recruitment (Stage 2b) included advertisements on health-related websites and social networking sites. Care was taken to advertise the study on websites which had not been used for recruitment in Stage 1. Data were also obtained from a separate website evaluation study which used the candidate eHIQ items. This evaluation study ran in parallel with Stage 2 recruitment.

### 2.3. Materials

A web-based survey was formatted using Bristol Online Survey's (Stage 1) and Qualtrics (Stage 2) software for each population group. Participants were asked to access the online questionnaire and complete a series of questions about their general views of using the internet for health information (eHIQ-Part 1). Participants were then directed to spend 10–15 min browsing a relevant condition-specific health-related website (for example a website hosted by Asthma UK, the MND Association or NHS Choices) and then asked to answer a series of questions (eHIQ-Part 2) relating to the website they had been asked to browse as well as demographic questions. To assess convergent validity, participants in Stage 2 were also asked to complete two reference measures which were hypothesised to have moderate correlations with the eHIQ items.

The first reference measure was a single item from the Health Information National Trends Survey (HINTS) [11]. The single item (In general, how much would you trust information about health or medical topics on the internet?) was predicted to have a moderate correlation to eHIQ-Part 1 scores. The second reference measure comprised of one sub-scale, Access to quality information, from the Web Trust Questionnaire [12]. The sub-scale was predicted to have moderate correlations with all sub-scales within the eHIQ-Part 2. Two of the eight items in the Access to Quality Information sub-scale overlapped with two items already included in the eHIQ-Part 2 questionnaire. The relationship of the eHIQ sub-scales with an adjusted six item sub-scale was therefore undertaken to account for the overlapping items. The length of time estimated to complete the questionnaire was 10–15 min exclusive of the time allocated to browsing the specified website. Stage 2 participants were asked to complete the questionnaire on two occasions with a two week interval to examine test-retest reliability.

### 2.4. Statistical analysis

Analyses for the eHIQ-Part 1 and eHIQ-Part 2 were carried out independently in SPSS, Version 20 [13]. Descriptive statistics were used to present demographic data. Items were subjected to preliminary data checks to confirm their suitability for inclusion in further analysis. Decision rules for item removal included items with high floor and ceiling effects ( $>40\%$  of respondents selecting one of the extreme response options) and items which had large amounts of missing data ( $>10\%$  non-response). A correlation matrix identified items demonstrating poor correlations ( $<0.2$ ) with a large number of items and reliability analysis was carried out to identify items with low item-to-total correlations ( $<0.3$ ) or items which decreased the internal consistency (Cronbach's alpha value). Items were iteratively removed when displaying a high number of poor correlations with other items or if they reduced the Cronbach's alpha value.

Exploratory factor analysis (EFA) was carried out to identify sub-scales within the item pools and to exclude items which did not group in conceptually sound sub-scales. The suitability of using factor analysis on each dataset was assessed using Bartlett's Test of Sphericity ( $p < 0.05$ ) [14] and the Kaiser–Meyer–Olkin (KMO)

statistic (recommended value of 0.6) [15]. Factors with Eigenvalues above one were extracted and an oblique, Direct Oblimin, rotation was sought so that axes were not restricted to right angles allowing correlation between the factors [16,17]. The Structure and Pattern matrices were used to interpret output with the former offering primary guidance for interpretation [18]. Items which had been removed were examined further to ensure no further scales were present.

A range of population characteristics were examined to identify potential covariate factors affecting the identified scales. Convergent validity was explored using Pearson's correlation coefficients ( $r$ ) to compare the identified sub-scales with their respective reference measure [16,19]. Internal consistency was tested for each unidimensional sub-scale using the Cronbach's alpha statistic ( $>0.7$ ). The test-retest procedure was used to establish reliability over time. The level of agreement between scores from the two occasions was assessed using the intra-class correlation coefficient (ICC), where coefficients above 0.70 were considered satisfactory [20].

### 3. Results

#### 3.1. Stage 1: Item reduction

The two part questionnaire, containing 23 items in Part 1 and 39 items in Part 2, was completed by 167 participants. The mean age of the sample was 38.8 years (SD 14.04); 125 were female and 41 male (one unknown) (see Table 1). Checks for floor and ceiling effects confirmed no item had more than 40% of respondents selecting one of the extreme response options and that no item had a large amount of missing data ( $>10\%$  non-response). Therefore, no items were removed due to floor or ceiling effects or missing responses.

Seven items (eHIQ-Part 1) and five items (eHIQ-Part 2) were identified and iteratively removed due to displaying poor correlations ( $<0.2$ ) with a large number of items within the same item pool and decreasing the overall Cronbach's alpha value. The Kaiser–Meyer–Olkin values exceeded the recommended value of 0.6 and the Bartlett's Test of Sphericity reached statistical significance ( $p < 0.01$ ) in both questionnaire parts, supporting the use of EFA.

##### 3.1.1. Exploratory factor analyses (EFA)

eHIQ-Part 1: Five factors with Eigenvalues above one were initially extracted. These factors explained 63.85% of the variance. Catell's Scree test suggested that only two factors should be extracted. Upon examination, factors 3–5 were not believed to constitute meaningful factors and each factor had a Cronbach's alpha of below 0.7. This supported the removal of the seven items loading on factors 3–5. One further item was removed due to poor loadings on all factors. The remaining items were entered into a final factor analysis resulting in two factors explaining 61.06% of the total variance.

Removed items were examined to investigate the further scales present. Six of the eight items achieved a Cronbach's alpha value of 0.64, slightly below the recommended value of 0.7. The six items were retained for the next stage of analysis after considering their conceptual value. Therefore, 14 items in total for the eHIQ-Part 1 entered Stage 2.

eHIQ-Part 2: The 34 remaining items were subjected to EFA and six factors explaining 66.26% of the variance were extracted. Using a Direct Oblimin rotation items were found to group appropriately on the six factors. All factors had a Cronbach's alpha value of 0.76 or above. The 34 items asking about using a specific health-related website were therefore identified as suitable to enter the next stage of development.

**Table 1**  
Participant characteristics.

| Stage 1                    | N = 167       |
|----------------------------|---------------|
| Sex, N (%)                 |               |
| Male                       | 41 (24.7)     |
| Female                     | 125 (75.3)    |
| Missing                    | 1 (–)         |
| Age, Mean years (SD)       | 38.80 (14.04) |
| Employment status, N (%)   |               |
| Employed                   | 73 (44.2)     |
| Not in paid employment     | 39 (23.6)     |
| Student                    | 24 (14.5)     |
| Retired                    | 19 (11.5)     |
| Other                      | 10 (6.1)      |
| Missing                    | 2 (–)         |
| Condition, N (%)           |               |
| Alcohol reduction          | 25 (15)       |
| Asthma                     | 92 (55.1)     |
| MND (carer)                | 11 (6.6)      |
| MS (carer)                 | 22 (13.3)     |
| Smoking cessation          | 17 (10.2)     |
| Stage 2                    | N = 170       |
| Sex, N (%)                 |               |
| Male                       | 59 (35.5)     |
| Female                     | 107 (64.5)    |
| Missing                    | 4 (–)         |
| Age, Mean years (SD)       | 50.4 (13.0)*  |
| Education completed, N (%) |               |
| Secondary school           | 39 (23.4)     |
| Third level                | 128 (76.6)    |
| Missing                    | 3 (–)         |
| Employment status, N (%)   |               |
| Employed                   | 75 (44.6)     |
| Not in paid employment     | 35 (20.8)     |
| Student                    | 7 (4.2)       |
| Retired                    | 48 (28.6)     |
| Other                      | 3 (1.8)       |
| Missing                    | 2 (–)         |
| Condition, N (%)           |               |
| Asthma                     | 17 (10)       |
| Cancer                     | 27 (15.9)     |
| Generic (carer)            | 2 (1.2)       |
| Healthy eating             | 49 (28.8)     |
| Menopause                  | 7 (4.1)       |
| MND                        | 32 (18.8)     |
| MS                         | 26 (15.2)     |
| MS (carer)                 | 4 (2.4)       |
| Smoking cessation          | 6 (3.5)       |

\* Excludes HERG Evaluation study population as participants were asked to select the age band they belonged to.

#### 3.2. Stage 2: Scale confirmation and evaluating validity

The reduced questionnaire was completed by 170 participants (see Table 1). Stage 2a recruited 47 participants, Stage 2b recruited 96 participants and the separate website evaluation study recruited 27 participants. Of the 170 respondents, 59 were men and 107 were women (four unknown). The mean age of those recruited in Stages 2a and b was 50.4 years (SD 13.02). The website evaluation study asked participants to select their age group, the modal age range being 51–75 years old. Of those consenting to take part in either Stage 2a or 2b, 71.1% ( $n = 143$ ) completed the full questionnaire.

##### 3.2.1. Scale confirmation

In order to find the optimal factor solutions for the eHIQ-Part 1 and Part 2, items were entered into an EFA to examine the questionnaire structure.

eHIQ-Part 1: EFA confirmed four factors present, however, one item was removed as it did not load with other similar items and had poor distributions across response options (i.e. no participant selected the 'Strongly disagree' response category). A further EFA

**Table 2**  
Structure and Pattern factor loadings (eHIQ-Part 1).

| Item | Structure   |             | Pattern     |             |
|------|-------------|-------------|-------------|-------------|
|      | 1           | 2           | 1           | 2           |
| 6.   | <b>0.84</b> | 0.31        | <b>0.93</b> | −0.18       |
| 7.   | <b>0.84</b> | 0.48        | <b>0.81</b> | 0.06        |
| 10.  | <b>0.84</b> | 0.45        | <b>0.83</b> | 0.02        |
| 11.  | <b>0.77</b> | 0.49        | <b>0.71</b> | 0.11        |
| 8.   | <b>0.67</b> | 0.38        | <b>0.65</b> | 0.04        |
| 9.   | <b>0.62</b> | 0.59        | <b>0.43</b> | 0.36        |
| 4.   | 0.41        | <b>0.80</b> | −0.013      | <b>0.81</b> |
| 3.   | 0.39        | <b>0.79</b> | −0.03       | <b>0.81</b> |
| 5.   | 0.37        | <b>0.71</b> | 0.000       | <b>0.71</b> |
| 2.   | 0.39        | <b>0.65</b> | 0.063       | <b>0.62</b> |
| 1.   | 0.32        | <b>0.61</b> | −0.002      | <b>0.61</b> |

Extraction method: principal component analysis.

suggested three factors were present, however, two items which formed the third factor were removed due to poor internal consistency (Alpha = 0.59). The two remaining sub-scales explained 56.58% of the variance with the Structure and Pattern matrices (see Table 2) demonstrating high loadings on their respective factors. The two sub-scales retained were entitled: (1.1) Attitudes towards online health information and (1.2) Attitudes towards sharing health experiences online. Both sub-scales demonstrated good internal consistency ( $\geq 0.77$ ) and were conceptually relevant to overall attitudes towards online health information (see Table 3).

eHIQ-Part 2: EFA identified six sub-scales explaining 66.34% of the variance. One of the six factors consisted of two items which exhibited poor internal consistency (Cronbach's  $\alpha = 0.50$ ). Inspection of the Structure and Pattern matrices indicated that one of the two items loaded on another, conceptually relevant, factor while the remaining item did not. The item which did not load on any other factor was therefore removed and all remaining items were entered into a further EFA producing five factors. Reflections on the fourth and fifth factors concluded in a consensus between the authors that, grouped together, items did not constitute theoretically sound factors and explained very little variance. The seven items in factors four and five were therefore removed and a final EFA confirmed the three remaining factors explaining 61.68% of the variance. The Structure and Pattern matrices (see Table 4) were used to interpret the final factor structure and confirmed high

**Table 4**  
Structure and pattern factor matrices (eHIQ-Part 2).

| Item | Structure   |             |       | Pattern     |             |       |
|------|-------------|-------------|-------|-------------|-------------|-------|
|      | 1           | 2           | 3     | 1           | 2           | 3     |
| 14.  | <b>0.87</b> | 0.30        | −0.42 | <b>0.89</b> | 0.03        | 0.06  |
| 15.  | <b>0.84</b> | 0.31        | −0.36 | <b>0.88</b> | 0.08        | 0.14  |
| 19.  | <b>0.81</b> | 0.24        | −0.37 | <b>0.85</b> | −0.01       | 0.08  |
| 20.  | <b>0.77</b> | 0.26        | −0.60 | <b>0.64</b> | −0.10       | −0.31 |
| 18.  | <b>0.73</b> | 0.57        | −0.65 | <b>0.50</b> | 0.27        | −0.26 |
| 23.  | <b>0.73</b> | 0.35        | −0.67 | <b>0.52</b> | −0.02       | −0.41 |
| 17.  | <b>0.72</b> | 0.64        | −0.66 | <b>0.47</b> | 0.37        | −0.24 |
| 11.  | <b>0.70</b> | 0.37        | −0.49 | <b>0.59</b> | 0.11        | −0.13 |
| 10.  | <b>0.62</b> | 0.34        | −0.57 | <b>0.44</b> | 0.04        | −0.33 |
| 26.  | 0.40        | <b>0.81</b> | −0.43 | 0.15        | <b>0.77</b> | 0.02  |
| 6.   | 0.36        | <b>0.81</b> | −0.53 | 0.02        | <b>0.72</b> | −0.18 |
| 9.   | 0.23        | <b>0.78</b> | −0.35 | −0.03       | <b>0.79</b> | 0.01  |
| 12.  | 0.45        | <b>0.74</b> | −0.60 | 0.11        | <b>0.57</b> | −0.27 |
| 3.   | 0.26        | <b>0.74</b> | −0.36 | 0.02        | <b>0.74</b> | 0.01  |
| 5.   | 0.48        | <b>0.72</b> | −0.52 | 0.21        | <b>0.59</b> | −0.13 |
| 24.  | 0.56        | <b>0.70</b> | −0.51 | 0.34        | <b>0.56</b> | −0.07 |
| 25.  | 0.04        | <b>0.67</b> | −0.18 | −0.17       | <b>0.77</b> | 0.09  |
| 1.   | 0.36        | 0.36        | −0.80 | −0.08       | −0.01       | −0.84 |
| 4.   | 0.40        | 0.52        | −0.79 | −0.03       | 0.19        | −0.71 |
| 22.  | 0.56        | 0.41        | −0.76 | 0.22        | 0.04        | −0.63 |
| 21.  | 0.69        | 0.44        | −0.74 | 0.41        | 0.06        | −0.49 |
| 7.   | 0.53        | 0.23        | −0.73 | 0.23        | −0.18       | −0.69 |
| 8.   | 0.52        | 0.44        | −0.69 | 0.21        | 0.12        | −0.52 |
| 16.  | 0.63        | 0.58        | −0.68 | 0.35        | 0.30        | −0.36 |
| 2.   | 0.20        | 0.42        | −0.68 | −0.23       | 0.15        | −0.72 |
| 13.  | 0.52        | 0.53        | −0.66 | 0.22        | 0.25        | −0.43 |

loadings of each item on their respective factor. Some cross-loading of items on secondary factors were evident on 12 items. This was expected as the a priori hypothesis was that factors would be correlated and an oblique rotation was adopted, which assumes correlations between factors. The three sub-scales were entitled: (2.1) Confidence and identification, (2.2) Information and presentation, and (2.3) Understanding and motivation. All scales had good internal reliability ( $\geq 0.80$ ) and are listed in Table 5.

### 3.2.2. Scale distributions and validation

Each scale was transformed to a 0–100 metric, where 0 = low perceived value of the internet (or website) for health, and 100 = high perceived benefit of using the internet (or website) in relation to health (see Fig. 1 for algorithm). Descriptive statistics for the final eHIQ sub-scales are shown in Table 6. The eHIQ sub-scale

**Table 3**  
Items grouped by sub-scale (eHIQ-Part 1).

| Scale and items   | Item to total correlation | Cronbach's alpha |
|---|---------------------------|------------------|
| 1.1 Attitudes towards online health information   |                           | 0.77             |
| 4. I would use the internet if I needed help to make a decision about my health (for example, whether I should see a doctor, take medication or seek other types of treatment). | 0.64                      |                  |
| 3. The internet can be useful to help people decide if their symptoms are important enough to go to see a doctor.   | 0.60                      |                  |
| 5. I would use the internet to check that the doctor is giving me appropriate advice.   | 0.58                      |                  |
| 2. The internet can help the public to know what it is like to live with a health problem.  | 0.52                      |                  |
| 1. The internet is a reliable resource to help me understand what a doctor tells me.  | 0.39                      |                  |
| 1.2 Attitudes towards sharing health experiences online   |                           | 0.89             |
| 6. The internet is a good way of finding other people who are experiencing similar health problems.   | 0.68                      |                  |
| 7. It can be helpful to see other people's health-related experiences on the internet.  | 0.72                      |                  |
| 10. The internet is a good way of finding other people who are facing health-related decisions I may also face.   | 0.72                      |                  |
| 11. Looking at health websites reassures me that I am not alone with my health concerns.  | 0.67                      |                  |
| 8. The internet is useful if you don't want to tell people around you (for example, your family or people at work) how you feel.  | 0.56                      |                  |
| 9. It can be reassuring to know that I can access health-related websites at any time of the day or night.  | 0.56                      |                  |

**Table 5**  
Items grouped by sub-scale (eHIQ-Part 2).

| Items  | Item to total correlation | Cronbach's alpha |
|--|---------------------------|------------------|
| 2.1 Confidence and identification  |                           | 0.92             |
| 14. I feel I have a sense of solidarity with other people using the website.   | 0.79                      |                  |
| 15. I can identify with other people using the website.  | 0.72                      |                  |
| 19. I feel I have a lot in common with other people using the website.   | 0.70                      |                  |
| 20. The website gives me the confidence to explain my health concerns to others.   | 0.72                      |                  |
| 18. The website gives me confidence that I am able to manage my health.  | 0.75                      |                  |
| 23. The website makes me more confident to discuss my health with the people around me (for example, my family or people at work). | 0.73                      |                  |
| 17. I value the advice given on the website.   | 0.74                      |                  |
| 11. The people who have contributed to the website understand what is important to me.   | 0.65                      |                  |
| 10. The website prepares me for what might happen to my health.  | 0.61                      |                  |
| 2.2 Information and presentation   |                           | 0.89             |
| 26. The website is easy to use.  | 0.74                      |                  |
| 6. The language on the website made it easy to understand.   | 0.75                      |                  |
| 9. I can easily understand the information on the website.   | 0.66                      |                  |
| 12. I trust the information on the website.  | 0.69                      |                  |
| 3. The information on the website left me feeling confused.  | 0.65                      |                  |
| 5. The website provides a wide range of information.   | 0.68                      |                  |
| 24. Photographs and other images were used appropriately on the website.   | 0.67                      |                  |
| 25. I found the images on the website distressing.   | 0.51                      |                  |
| 2.3 Understanding and motivation   |                           | 0.90             |
| 1. The website encourages me to take actions that could be beneficial to my health.  | 0.67                      |                  |
| 4. The website includes useful tips on how to make life better.  | 0.71                      |                  |
| 22. The website encourages me to play a more active role in my healthcare.   | 0.70                      |                  |
| 21. The website helps me to have a better understanding of my personal health.   | 0.74                      |                  |
| 7. I feel more inclined to look after myself after visiting the website.   | 0.65                      |                  |
| 8. I have learnt something new from the website.   | 0.64                      |                  |
| 16. On the whole, I find the website reassuring.   | 0.69                      |                  |
| 2. The website has a positive outlook.   | 0.55                      |                  |
| 13. I would consult the website if I had to make a decision about my health.   | 0.64                      |                  |

Formula for scoring each sub-scale =

$$\frac{\text{Sum of scores of each item in scale} - \text{minimum raw score}}{\text{Maximum raw score} - \text{minimum raw score}} \times 100$$

**Fig. 1.** eHIQ sub-scale scoring algorithm.

scores followed a relatively normal distribution across the study sample. Scores were examined for floor and ceiling effects. High frequencies at the limits of the scales can suggest a lack of sensitivity at the extreme points. No scales exhibited floor or ceiling effects, with the sub-scale (1.2) Attitudes towards sharing health experiences online marginally exceeding a ceiling 5% cut off point with 5.9% of respondents achieving a score of 100.

The relationships between the sub-scales and a range of potential covariate factors were examined. No significant differences were found for either sex (t-tests) or age (Pearson's correlations) among all sub-scale scores. A significant difference (ANOVA) was observed between the sub-scale (1.2) Attitudes towards sharing health experiences online [ $F(2,166) = 4.60, p = 0.011$ ] scales and mode of recruitment. Post-hoc comparisons using Tukey's indicated that there were significant differences between those in Stage 2a (Mean = 65.51, SD = 14.89) and the website evaluation study (Mean = 76.85, SD = 15.17). This difference may have been due to the sample size, however, it is conceivable that those in the website

evaluation study were more open to sharing experiential information as they had volunteered to take part in research relating to the experiences of cancer.

Relationships (Pearson's correlation coefficients) between eHIQ scores and the selected reference measures were examined to assess convergent validity. Correlations between the eHIQ-Part 1 sub-scales and the HINTS single item were weak to moderate ( $r = -0.35$  to  $-0.52, p < 0.01$ ). Correlations between the eHIQ-Part 2 sub-scales and the adjusted Web Trust Questionnaire sub-scale were moderate to good ( $r = 0.75$  to  $0.76, p < 0.01$ ). Results confirmed expectations that the scales are significantly related but are sufficiently divergent.

Participants were invited to complete the eHIQ on two separate occasions with a two week interval. Of the 170 sample, 143 were asked to complete a second questionnaire (those in the website evaluation study were not asked to complete a second questionnaire). Of the 143 people asked, 90 (62.94%) people responded. A computer error meant 22 MND responses were not

**Table 6**  
Descriptive statistics for the eHIQ sub-scale validation survey.

| Sub-scale   | N   | Mean  | SD    | Range (raw score) | Skewness | Kurtosis | ICC* (N)  |
|---|-----|-------|-------|-------------------|----------|----------|-----------|
| 1.1 Attitudes towards online health information         | 169 | 63.31 | 16.90 | 5–25              | −0.775   | 0.850    | 0.85 (68) |
| 1.2 Attitudes towards sharing health experiences online | 169 | 70.69 | 16.30 | 6–30              | −0.68    | 1.69     | 0.76 (68) |
| 2.1 Confidence and identification                       | 165 | 58.17 | 17.54 | 9–45              | −0.739   | 0.964    | 0.89 (61) |
| 2.2 Information and presentation                        | 167 | 73.18 | 13.93 | 8–40              | −1.69    | 6.75     | 0.79 (61) |
| 2.3 Understanding and motivation                        | 167 | 61.23 | 16.07 | 9–45              | −0.89    | 1.75     | 0.91 (61) |

\* Absolute agreement.



valid and seven respondents did not fully complete the eHIQ-Part 2. The levels of agreement (ICC = 0.76 to 0.91) indicated good test-retest reliability for all sub-scales.

#### 4. Discussion and conclusion

##### 4.1. Discussion

This paper documents the steps taken to psychometrically refine and validate the eHealth Impact Questionnaire (eHIQ). The methods used reflect best practice guidelines in health-related questionnaire development [21,22] and, where possible, adhere to design recommendations for web surveys [23–25].

Analyses confirmed the presence of two sub-scales in the eHIQ-Part 1: (1.1) Attitudes towards online Health Information and (1.2) Attitudes towards Sharing Health Experiences Online. These sub-scales are useful in assessing an individual's feeling towards using the web for health information. It has previously been shown that attitudes towards using the internet are significantly associated with intention to use the internet for health information [26]. A person's orientation to online information may therefore influence the extent to which a person engages with a website and this may be investigated further using a more recent instrument such as the eHIQ-Part 1.

The first of three sub-scales identified in eHIQ-Part 2 was (2.1) Confidence and Identification. This scale measures the extent to which an individual identifies with others using a specific website and whether they feel that visiting the website has affected their confidence in discussing and managing their health. These issues were found to be important within the preliminary qualitative work to support this research [9] and are further supported through research relating to patient empowerment when using health-related websites, particularly in research relating to online support groups [27,28]. Identifying with others using a website (or their experiences) and gaining confidence to succeed in managing their health can be linked to Social Learning Theory [29–31]. In this context, encouragement is gained to adopt or mirror behaviours displayed by a person who they can relate to.

The second sub-scale, (2.2) Information and Presentation, measures ease of use from the user's perspective. Items also assess ease of understanding, perceived trustworthiness of information and the appropriateness of images used. Perceptions of trustworthiness have been linked to engagement with websites in previous research [6,32]. The elements measured by the Information and presentation scale are therefore known to be important issues which contribute to the user experience.

The final eHIQ-2 sub-scale, (2.3) Understanding and Motivation, measures the extent to which the respondent felt reassured, understood their condition better and felt motivated to manage their health after viewing a specific website. These items reflect aspects of the participant learning and belief or confidence in their capabilities to carry out intentions. This has been referred to using terms such as 'self-efficacy' [33,34] and 'perceived behavioural control' [35] in health behaviour theory and is an important aspect of motivation or intention to change [36].

Overall, the eHIQ scales can be used across conditions and the development process has incorporated the 'user' in all stages of development. This contrasts with other instruments which include users' views by incorporating existing literature, but do not directly include them in the item development process [7,37]. Past studies have used instruments which have been modified for the purposes of the study in question and therefore were not originally designed for use in the eHealth setting [38] or have used internet specific instruments that only measure very precise aspects of using a website such as trust [12]. The availability of the eHIQ may benefit future controlled comparison trials where an 'active' group

(for example, participants using a website containing experiential information plus conventional medical information) is compared to the 'control' group (for example, website containing conventional information only).

There are a number of limitations to this study. Twelve items in the eHIQ-Part 2 sub-scales loaded on more than one sub-scale. This was somewhat expected given our previous hypothesis that these scales would be correlated and therefore influenced the choice to interpret factors using an oblique rotation. Items were assigned to the factor on which they loaded most highly. The allocation of items to their respective sub-scales on this basis also made conceptual sense as they were similar in meaning to other items in each sub-scale. Whilst it could be argued greater distance between the cross-loadings on each scale would have been more desirable to demonstrate more distinct sub-scales, this also suggests that creating an overall summary index score may be appropriate. This will be investigated further using higher order factor analyses. Confirming convergent validity for the eHIQ subscales proved to be difficult due to the limited availability of a 'gold-standard' pre-existing measure which would be expected to demonstrate moderate correlations with the sub-scales. This however also demonstrates the lack of suitable instruments available to make comparisons of health-related websites. Statistical analyses using the best available reference measures confirmed the eHIQ sub-scales were sufficiently related to each respective measure to demonstrate convergent validity, yet sufficiently dissimilar to validate the independent construct [39].

All sub-scales had some evidence of being negatively skewed indicating that the distribution was concentrated on the positive end of the scale (i.e. positive view of the websites). This was expected as participants were asked to view established websites run by government organisations (for example, NHS Choices) or major charities (for example, the MS Society) and likely to encourage favourable results. Despite the concentration of scores at the positive end of the construct, the distributions were relatively normal.

A further limitation is the need for further investigations to see if the eHIQ sub-scales provide meaningful data. One way in which this may be investigated would be ascertain what a meaningful change in eHIQ scores is likely to be. Participants may be asked to view what the literature would suggest is a 'poor' website (for example, the presence of negative trust cues such as pop-up advertisements) and then complete the eHIQ. This could be followed by asking participants to view what the literature would consider a 'good' website (for example, positive trust cues such as quality indicator markers) and then complete the eHIQ. The difference in the scores may be considered a meaningful difference and be used to carry out a sample size calculation.

##### 4.2. Conclusion

To advance our understanding of the impact of various forms of online information, ehealth research needs to contrast and compare information available to the everyday user. Developing a tool which is suitable for use in controlled trials is an essential development if health information is to be systematically and meaningfully evaluated. While some traditional outcome measures may be incorporated into a trial, a focused internet specific instrument may pick up important, yet subtle aspects associated with using information from the web. Using a tool which facilitates the comparison of one website to another (i.e. a control website) also has the advantage of being able to blind participants to the research question, which has been a cause for concern in past research [40].

##### 4.3. Practice implications

This paper contributes to the growing literature concerning the effects of online information. Further research incorporating the

eHIQ may inform future directions in the provision of online information. This standardised tool will enable comparisons between websites which use different approaches in information dissemination and may help inform website developers and healthcare professionals on the benefits or hazards of including patients' experiences or social media within more conventional, facts and figures based, health information websites.

Further information on licensing and use of the questionnaire is available from Isis Outcomes (<http://www.isis-innovation.com/outcomes/>), those interested in using the eHIQ should contact Isis Outcomes.

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## Declaration

I confirm all patient/personal identifiers have been removed or disguised so the patient/person(s) described are not identifiable and cannot be identified through the details of the story.

## Conflict of interest statement

None declared.

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