1   *Abstract (Word Count=199)*

2

3   The objective of this systematic review was to identify types of approaches and methods

4   used to evaluate the effectiveness of healthcare information websites. Simple usage

5   data may not be sufficient to assess if the desired healthcare outcomes were achieved or

6   to determine the relative effectiveness of different web resources on the same health

7   topic. To establish the state of the knowledge base on assessment methods used to

8   determine the effectiveness of healthcare websites, a structured search of the literature

9   was conducted in Ovid Medline resulting in 1,611 articles retrieved, of which 240 met the

10   inclusion criteria for this review. Results of this review found that diverse evaluation

11   methods were used to measure the effectiveness of healthcare websites. These

12   evaluation methods were used during development, prior to release, and after release.

13   Economic assessment was rare and most evaluations looked at content issues such as

14   readability scores. A number of studies did try to assess the usefulness of websites but

15   few studies looked at behaviour change or knowledge transfer following engagement

16   with the designated health website. To assess the effectiveness of the knowledge

17   transfer of healthcare information through the online environment, multiple methods may

18   need to be used to evaluate healthcare websites and may need to be undertaken at all

19   stages of the website development process.

20

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23

24   Summary Statement (n=95)

25

26   What is known about the topic?

27   There is increasing use of online resources such as health websites.

28   More studies on website usage and assessments of their impact are being published.

29   This research can be used to improve the functionality and contribution of these

30   resources.

31

32   What does this paper add?

33   This paper establishes an evidence base of evaluation methods used to assess the

34   effectiveness of healthcare websites.

35   The evaluation methods identified in this review were diverse and applied at different

36   stages of development and production.

37   There is a limited evidence base relating to economic assessment and behaviour

38   change.

Introduction (N=734)

40

41   Given the diversity of information needed by health professionals and health

42   consumers within a diversity of care settings, the online environment offers a

43   powerful means in which to disseminate and maintain information currency as

44   well as encourage engagement with healthcare knowledge. Information seekers

45   now have an unprecedented ability to access vast amounts of information on any

46   health issue via a keyboard or touch screen. Online healthcare information

47   dissemination is powerful because of its reach, its relative cost advantages and

48   its immediate availability. As a result, there is growing interest in the role of e-

49   health and telehealth within the healthcare system, particularly within primary

50   healthcare (Australian Government, 2010).

51

52   Statistics provide evidence of the rapid uptake and use of the Internet by all age

53   groups, geographic regions and countries for accessing information, including

54   healthcare information. Figures from the Internet World Stats website showed

55   that in June 2012, there were 2.45 billion people, or 34.3% of the world's

56   population, with access to the Internet (Internet World Stats, 2013). According to

57   the Australian Bureau of Statistics in Australia, during the same time period there

58   were over 12 million Internet users in Australia, and the number of users is

59   increasing at around 10% annually (Australian Bureau of Statistics, 2012). A

60   significant proportion of this Internet activity relates to health issues. A study by

61   Eysenbach and Kohler examined the prevalence of health related searches on

62   the web by analysing search terms entered into popular search engines. Results

63   of this research showed that an estimated 4.75% of all searches were health

64   related (Eysenbach and Kohler, 2003). The Pew Internet & American Life Project

65   report, Health Online 2013, indicated that 72% of Internet users have looked

66   online for health information of one kind or another within the past year. Three

67   quarters of these searches began at a search engine such as Google or Bing

68   (Fox and Duggan, 2013).

69

70   This demand for online health information highlights the importance of

71   information being derived from credible sources. While the technological

72   capabilities to create online resources are becoming increasingly easier,

73   developing high quality content that is readily accessible draws upon a complex

74   range of skills and knowledge. The types of skills and knowledge required can be

75   most readily seen in the US usability guidelines (US Department of Health and

76	Human Services, 2006) or the Australian Government's web publishing
77	guidelines (Australian Government, 2012). An integral part of determining the
78	"value" of a website is to formally investigate the resource in a structured,
79	purposeful manner. This form of investigation, or evaluation, can support design
80	integrity, successful development and delivery, and appropriate modification and
81	recognition of the website (or other form of online information dissemination).
82	Patton has described evaluation as:
83	The systematic collection of information about the activities, characteristics, and
84	outcomes of program services, policy or processes, in order to make judgements
85	about the program or process, improve effectiveness, and /or inform decision
86	about future development (Patton, 2008, p. 27).
87	
88	Evaluation activities in the online environment are particularly important for
89	enhancing the functionality of resources for users and maximising the
90	contribution of online information to outcomes in the health system. By doing so,
91	evaluation can demonstrate the value of the online information and the delivery
92	platform to policy makers, funders and health organisations. Nevertheless, there
93	are challenges in evaluating online health resources. These challenges include
94	different users having different requirements and perspectives on what is a
95	successful outcome (Pawson et al 2011, Greenhalgh & Russell 2010). In
96	addition, there are human, organisational and technical factors relating to system
97	design, development and use that may also impact on appropriate evaluation
98	(Yusof, et al. 2008; Pagliari, 2007, Catwell &Sheikh, 2009).
99	
100	Regardless of these obstacles, however, there is an increasing recognition of the
101	value of such studies both to the individual resource and to the body of
102	knowledge that supports online resource development (Eysenbach, 2011).
103	However, the landscape of approaches used in evaluating health information
104	websites during design, development and production remains unclear. This
105	systematic review maps the different evaluation approaches being used to
106	assess the effectiveness of healthcare websites and, in so doing, provides
107	baseline knowledge not only of the evaluation methods being used but also of
108	aspects of website and information development that appear to be under-
109	evaluated.
110	
111	*Methods (n=416)*
112	

113   The study was conducted between January and April 2012.

114

115   A literature search of the Ovid SP database was conducted on 7 February 2012.

116   The search comprised two constructs: website (Internet/ OR website$.mp.) and

117   evaluation (Evaluation Studies as a Topic/ OR "Outcome and Process

118   Assessment (Health Care)"/ OR assessment.mp. OR "Outcome Assessment

119   (Health Care)"/ OR Quality Indicators, Health Care/ OR Quality Assurance,

120   Health Care/ OR "Quality of Health Care"/ OR quality.mp. OR Quality

121   Improvement/). The following limits were applied: English language, yr=1995-

122   current. Retrievals were restricted to the following Publication Types: evaluation

123   studies OR case reports OR clinical trials OR comparative study OR meta

124   analysis OR randomized controlled trial. The literature search retrieved 1,611

125   references that were downloaded into the electronic reference manager Endnote

126   for screening.

127

128   Included articles needed to meet the following inclusion criteria: discusses a

129   website; describes a study; the study relates to evaluation; and the website

130   provides healthcare information. Exclusion criteria were: not being an online

131   resource; not being a website (social media platforms were excluded); describes

132   online healthcare professional education; not being a study; not relating to health;

133   or the article not being able to be retrieved.

134

135   Abstracts of the retrieved articles were screened by a research assistant (SB)

136   against the inclusion and exclusion criteria. Three sets of randomly selected

137   articles (n=70) were screened by a second rater (JT) to determine inter-rater

138   reliability. Inter-rater reliability ranged from 76% to 92% for the three sets. After

139   each exercise, the two raters met to discuss the sources of variability and refine

140   decision making.

141

142   Two hundred and forty articles met the criteria for inclusion. A flow chart of

143   retrievals, exclusions and included studies is outlined in Figure 1.

144

145 The Data Extraction Form comprised a set of commonly recorded items such as author

146 and citation details, abstract, name of online resource and web address (where

147 provided), healthcare content area, intended audience, year study conducted,

148 description of the evaluation, methods of data collection, and details of any statistical

149 analysis undertaken. In addition, four specific review categories were developed

150   (Website Type, Measurement Focus, Stage of Development, and Evaluation Emphasis).

151   They are described below. A trial extraction of data from a random selection of 10% of

152   included studies was jointly undertaken (JT, SB) to finalise the Data Extraction Form and

153   to determine its workability. Weekly meetings were held across the project allowing

154   review of coding issues in data extraction.

155

156   Four additional extraction categories were created to provide a further basis for

157   organising the included studies:

158   Website Type: This categorisation indicated whether the included study looked at one or

159   more websites and whether it was evaluating the same or different content areas at a

160   single or multiple time points.

161

162   Measurement Focus: This item categorised the included study by using the focus of

163   measurement reported in the article. The categories represented specific components of

164   evaluation activity and focus across the design, development, implementation, and

165   maturity phases of a website's life cycle. The initial categories were developed from

166   reports in the literature that covered developmental and technical perspectives and user

167   needs (Cunliffe, 2000; Calero et al, 2005; Elling et al, 2007; Tankeleviviene &

168   Damasevicius, 2009). In a joint data extraction exercise, the categories and descriptors

169   for the Measurement Focus items were expanded, refined and documented. The

170   categories reflect the outcome measures being examined in the evaluation method (eg

171   usability testing, web metrics, behaviour change, and economic assessment).

172

173   Stage of Development: This categorisation relates to phase of website development with

174   3 pre-release categories and 3 post-release categories. The Australian Government

175   Information Office's range of Better Practice Checklists & Guidance materials highlights

176   the need for consideration of the lifecycle of a website from concept to decommissioning

177   (Australian Government Information Office, 2013).

178

179   Evaluation Emphasis: This categorisation utilises an evaluation framework developed to

180   guide evaluation activities for the CareSearch website (www.caresearch.com.au). The

181   framework was developed following a program logic activity to outline the role of

182   evaluation within the development of the CareSearch website (Tieman & Martin, 2009).

183   The three levels of emphasis relate to enhancing access, measuring use, and assessing

184   usefulness or impact.

185

186   Descriptive statistical analysis was conducted using SPSS, Version 19.0.01 (2010).

190   Re*sults (n=262)*

191   Results of the review found that over half of the studies evaluated a particular

192   group of websites on a single topic (e.g. breast cancer information) at single time

193   point (59.2%, 142/240). Forty-four studies compared the performance of a group

194   of websites across different healthcare topics (18.3%) and ten studies looked at a

195   particular group of websites (e.g. mental health advice) at different time points

196   (4.2%). Fifteen studies looked at one website at a single time point (6.3%) and a

197   further 31 looked at a single website at multiple time points (12.9%).

198

199   Cancer, mental health, reproductive health and paediatrics were the most

200   common health content areas of the websites included in evaluation studies.

201

202   When appraising the measurement focus of the evaluation studies, assessment

203   of content quality areas such as accuracy and currency of the information

204   (68.8%, 165/240) and structural elements such as menu systems, navigation or

205   hyperlinks (43.3%, 104/240) were the two most commonly assessed areas as

206   can be seen in Table 1. Project evaluation and economic assessment were the

207   least common types of measurement focus.

208

209   Most of the studies in this review were conducted after the release of the

210   designated website (80.8%, 194/240). Approximately 30% looked at studies prior

211   to release during the concept analysis/needs analysis phase (14.2%, 34/240) or

212   the development phase (17.5%, 42/240) as illustrated in Table 2.

213

214   Though more than 80% of the studies (199/240) addressed issues relating to

215   enhancing access to the website, less than a third attempted to assess the

216   usefulness of the resource in terms of whether it had actually changed practice or

217   outcomes (Table 2).

218

219   *Discussion*

220   Throughout the screening and analysis, it became clear that the evaluation methods

221   being described were extensive and variable. Understanding the range and nature of

222   approaches being used, and possible issues associated with implementing particular

223   approaches, is important to ensure that the most appropriate types of studies are

224   undertaken to meet different evaluation purposes, and that they reflect the different

225   stages of website development. Eysenbach (2011) has highlighted the need to improve

226   and standardise the quality of reporting in this field to facilitate the use and dissemination

227   of this published research.

228

229   The significant number of articles reporting on the findings of evaluations of health

230   information websites suggest that evaluation of online resources is feasible and of

231   interest. Even though there was considerable diversity in terms of the focus of the

232   measurement of the studies, very few studies addressed the economics of online health

233   information provision, or the costs and benefits of information transfer within this

234   environment independently or compared to other forms of information transfer. Most

235   studies also described work that was conducted at a single time point limiting the ability

236   to assess the impact of changes to individuals or to websites over time. Studies around

237   the assessment of the quality of the information content provided in the website and

238   readability levels, reports on changes to structural aspects of the website and issues in

239   search and search engine retrieval were much more commonly published than studies

240   addressing behaviour change or knowledge transfer. While ensuring functionally

241   accessible websites is extremely important, more emphasis is needed on assessing the

242   impact that engagement with these online resources has on individuals and on the health

243   system.

244

245   Relatively few studies focused on program evaluations. Hence, there is only a limited

246   amount of published material available to web developers and project managers in

247   assessing the performance of the online resource against specified criteria from funding

248   agencies or policy makers. The apparent paucity of evaluation research in this field may

249   also reflect the reality of decision making processes involved in committing to creating an

250   online resource which may restrict the time and capacity to articulate and define the

251   purposes and intended contributions of the resource to health outcomes. For groups

252   commissioning or creating websites or webpages, the review would indicate that more

253   needs to be done in articulating desired outcomes of the project not just outlining the

254   product specification. Partners in web planning and development need to consider who

255   the intended users are, the capacities and experience of these users, and the

256   circumstances in which they will seek, find and use the provided health information. The

257   information needs of the intended audience should guide planning and inform decision

258   making about formats, presentation, design and navigation to enhance knowledge

259   transfer and knowledge use.

260	
261	There were some indications that different methods have been used at different stages
262	of the website development process. User testing activities and usability studies were
263	reported in a number of studies suggesting that formative evaluation prior to launch has
264	been seen as a valuable aspect of the web development process. However, it is worth
265	noting that although there were many studies looking at issues around the quality and
266	accessibility of the online content, very few explicitly explored issues around access for
267	marginalised groups such as online options for non-English speaking groups or
268	enhancements for use of information by intellectually disabled groups. Previous research
269	on a "digital divide" highlights the importance of not only providing resources in
270	appropriate forms but of facilitating and supporting access by the whole community (Choi
271	et al, 2013; Kruse et al, 2012; Reinfeld-Kirkmann et al, 2010). Given that many see
272	online information provision as a remedy that enables equitable distribution of health
273	information, this remains an area for further study.
274	Most post-release studies reported on visitor numbers and usage statistics, or provided
275	the results of visitor surveys and user satisfaction scales. However, there was often little
276	interpretation of the possible meaning of these metrics other than as trend indicators of
277	use. The possibility of web metrics acting as surrogates of individual and health system
278	actions needs to be explored. Further research around the meaning of usage patterns
279	could add great value to these readily available metrics. For example, commercial
280	enterprises will assess the relationship between product views and orders, and then use
281	these web metrics to assess the impact of marketing strategies or product releases.
282	Identifying and evaluating possible relevant metrics for health information would be a
283	valuable piece of research. For example, does time of use correlate with different
284	environmental circumstances for users such as no colleagues available for advice during
285	night duty? Or what number of page views correlate to actual visitor action such as
286	booking a GP appointment? Glyn et al (2012) have already used a web metric system,
287	Google Insights, to show a relationship between an annual breast cancer awareness
288	campaign and online breast cancer activities. Similarly, comparative data on usage
289	rates and penetration are needed for health websites to provide background information
290	against which to assess the effectiveness of strategies and approaches used in website
291	development and delivery.
292	
293	It is interesting to note that many of the evaluation studies were not undertaken by the
294	agencies responsible for the online resource. This suggests that the study of online
295	health information has become an area of research interest in its own right. For many
296	health agencies, assessing the quality of online resources is important as patients,

297 carers and families are using this information for self-diagnosis, decision making about
298 treatment options or as part of their engagement with health professionals (Boucher,
299 2010; Sillence et al 2007; McMullan 2006; Rubenstein, 2012).

300

301 Finally, this review developed several evaluation variables to differentiate between the
302 focus measures being used, the website types under review, the stage of website
303 development and the actual emphasis of the evaluation. This highlights the need for a
304 common language to describe not only the design characteristics of evaluation studies
305 but the contribution of the evaluation research in terms of stage of development and the
306 focus of the evaluation with respect to the information users, funders and the health
307 system.

308

309 *Limitations to this review*
310 This review only included articles published after 1995 from a single biomedical
311 bibliographic database. It is likely that there are substantial numbers of unpublished
312 reports and conference presentations looking at evaluations of health websites. It should
313 be noted that no quality assessment of the individual studies was undertaken. The focus
314 of the analysis was on the purpose of the study not on the conduct of the study.

315

316 This study employed several evaluation schemas developed for the review. These
317 categories have not been independently validated and assessed as website evaluation
318 scales; so, additional examination of the value of these schemas is warranted.

319

320 This study only looked at health information provided through a website. The reality is
321 that the web is no longer a vast library of web pages accessed through discrete
322 websites; it is a complex mix of information sources and formats, online interfaces,
323 searching tools and brokers, and participation and management gateways. It is unknown
324 whether similar approaches to evaluation can be used for other types and forms of online
325 information dissemination and exchange.

326

327 *Conclusion*
328 Healthcare information is no longer the providence of the local doctor or nurse. Just as
329 the nature of medical technology has changed, so too has provision of healthcare
330 information. The online environment has changed the ways in which health consumers
331 and health professionals seek and engage with health information,but our understanding
332 of how effectively information is being provided and used through this medium is still
333 limited. There is a need for further research that looks beyond the creation and access of

334 health websites to the impact that health websites have on outcomes for health
335 consumers and their effects on health professionals and health services.
336
337 Evaluation activities and studies of evaluation processes are an essential part of the
338 process of understanding the contribution these resources can make.   Evaluation
339 activities undertaken during planning and development can assist in developing
340 accessible and usable websites. Evaluation undertaken following release of a website
341 can help not only to demonstrate use of these online resources but also help to assess
342 the effect of these online resources on individuals and, potentially, on services and
343 organisations and the health system. Commissioning agencies need to ensure that web
344 developers and content providers are aware of best practice requirements and
345 encourage research to direct the effective preparation and use of web-based healthcare
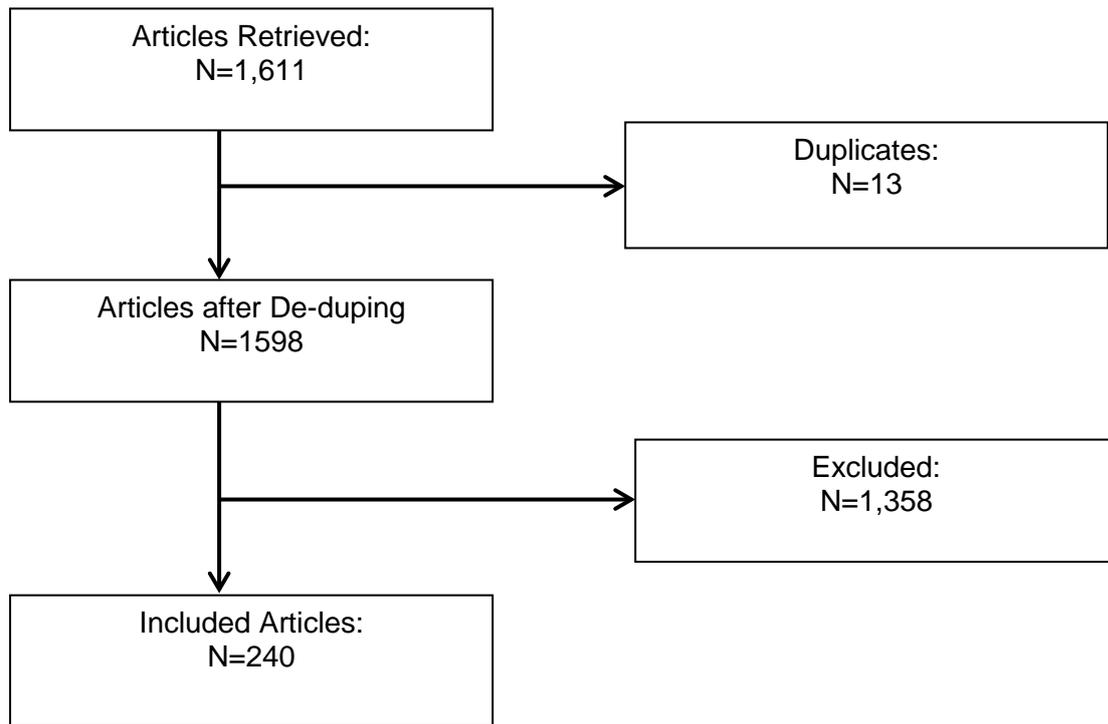346 information.
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466   Figure 1: Schematic representation of articles screening
467
468
469   Articles Retrieved:
470   N=1,611
471

472   Duplicates: N=13

473

474   Articles after De-duping N=1598

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476

477   Excluded: N=1,358

478
479
480   Included Articles: N=240
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Table 1: Number and percentage of studies by Measurement Focus		
Measurement Focus	No.	%
Feasibility Formative evaluation identifying need, consideration of audience, items for inclusion etc	29	12.1%
Heuristic Systematic inspection of a user interface design for usability by an expert	22	9.2%
User testing Feedback of the prototype website by intended users	32	13.3%
Text content assessment Includes readability assessment, literacy testing, text analysis	56	23.3%
Content Quality Studies of the accuracy, currency and quality of the website content. Can include automated assessment	165	68.8%
Structural Elements Measures structural elements of the website such as navigability, menu systems, hyperlinks	104	43.3%
Visuals/Graphic Identity Studies looking at presentation of the website (e.g. inclusion of high quality pictures)	47	19.6%
Metric Analysis Retrieval and analysis of site metrics such as visitor numbers, referrals	37	15.4%
Search engine optimisation Studies that assess the effectiveness of page tagging, search term analysis etc that lead a user to the website	61	25.4%
Visitor Satisfaction Surveys Online/offline surveys of satisfaction with the resource	25	10.4%
Knowledge Transfer Studies that assess that whether access and engagement with the website has led to an increase in knowledge or understanding by the web visitor	29	12.1%
Behaviour change Studies that assess whether visitor 's health behaviours have changed due to engagement with a website (eg stopped smoking, anxiety reduced etc)	32	13.3%
Project Evaluation Assessment by funders, policy makers of the value of their website project	7	2.9%
Economic Assessment Cost benefit analysis, economic analysis, cost pricing of an individual website	7	2.9%

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16

Table 2: Number and percentage of studies by stage of website development and by evaluation emphasis		
Stage of Website Development	*No*	*%*
Concept Analysis, Needs Assessment	34	14.2
Development Phase	42	17.5
Release/Launch	8	3.3
Post Release Effectiveness	194	80.8
Iterative Enhancements	6	2.5
Redesign	5	2.1
Other	1	0.4
Evaluation Emphasis	*No.*	*%*
Access (Facilitating the ability of users to be able to access the resource)	199	82.9
Use (Tracking if, and how, the resource is being used)	68	28.3
Usefulness (Addressing whether the resource has made a difference to use or practice)	72	30.0

490