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The Effect of Telehealth Interventions on Quality of Life of Cancer Patients: A Systematic Review and Meta-Analysis

Running Title: The Effect of Telehealth Interventions

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30 ABSTRACT

31 Introduction: In 2016, approximately 1.7 million new cases of cancer were diagnosed. Cancer  
32 patients can have physical, functional, and psychosocial issues when dealing with cancer  
33 treatment. Telehealth has been effectively introduced to help deliver treatment to patients  
34 suffering from chronic disease, however, there is little consensus on its effectiveness in  
35 administering socio-behavioral cancer treatments. Thus, this study determines the benefits of  
36 telehealth-based interventions providing emotional and symptom support in improving quality of  
37 life (QOL) among cancer patients.

38 Methods: Two researchers conducted comprehensive searches on PubMed, SCOPUS, Medline,  
39 PsycINFO, ERIC, Psychology and Behavioral Collection, and Medline Complete. Key search  
40 terms included telehealth or telemedicine and quality of life and cancer. Manuscripts were  
41 included if they assessed a telehealth delivered intervention for adult cancer patients and  
42 provided a QOL assessment. Data were extracted to calculate mean effect sizes for QOL  
43 measures on the effectiveness of telehealth relative to usual care for cancer treatments.

44 Results: Out of 414 articles identified in our initial search, nine articles fit our inclusion criteria.  
45 Both telehealth (Hedges  $g = 0.211$ ,  $p=0.016$ ) and standard of care (Hedges  $g = 0.217$ ,  $p<0.001$ )  
46 cancer treatment delivery methods demonstrated small but statistically significant improvements  
47 in QOL measures. However, there were no statistically significant differences in effectiveness  
48 between the telehealth interventions and usual care ( $p=0.76$ ).

49 Conclusions: The results indicate that telehealth interventions are as effective at improving QOL  
50 scores in patients undergoing cancer treatment as in-person usual care. Further studies should be  
51 undertaken on different modalities of telehealth to determine its appropriate and effective use in  
52 interventions to improve the quality of life for cancer patients undergoing treatment.

53

54

55 INTRODUCTION

56 Nearly two million new cases of cancer are diagnosed every year in the United States.<sup>1</sup> Cancer  
57 patients can experience multiple issues during treatment, including physical, functional, and  
58 psychosocial symptoms and complications.<sup>2-7</sup> Cancer diagnoses can lead to severe psychological  
59 distress and disrupt patients' lives, increasing strains on work, family, and social  
60 relationships.<sup>2,8,9</sup> Improved management of emotional distress and symptoms, especially after  
61 new diagnoses and treatments, could significantly improve quality of life for cancer patients.<sup>10</sup>  
62 Furthermore, the need for effective and cost-efficient interventions to address psychosocial  
63 symptoms resulting from treatment will increase in the future with the aging demographic  
64 distribution in the US and consequent increase in cancer diagnoses.<sup>11</sup>

65  
66 Telehealth has been effectively used to help manage many chronic conditions and to improve  
67 compliance with treatment and patients' overall well-being.<sup>4</sup> The terms 'telehealth' or  
68 'telemedicine' are often used interchangeably and can have multiple definitions. Telemedicine is  
69 often used to refer to diagnosis and monitoring technology, whereas telehealth may be used to  
70 include management, education, and other allied health care services.<sup>12</sup> The Health Resources  
71 and Services Administration defines telehealth as the use of technology to deliver health care,  
72 health information, or health education at a distance.<sup>13</sup> Telehealth technologies, including  
73 telephone, videoconferencing, and internet-based interventions, have the capability of bringing  
74 services into the patient's home and helping them manage their symptoms without needing to be  
75 physically present at a hospital or clinic.<sup>3,10</sup> Telemedicine patients have reported good acceptance  
76 of and satisfaction with the use of technology in comparison with in-person visits.<sup>14,15</sup> Providing  
77 patients greater access to symptom management and emotional support services may lead to

78 patients taking a more active role in their health care and could improve patient outcomes  
79 including overall quality of life (QOL).<sup>3</sup>

80

81 The purpose of this systematic review and meta-analysis is to examine the effect that telehealth  
82 interventions providing emotional and symptom management have on cancer patients' QOL. To  
83 our knowledge, there has been no study done to date that has examined the overall effect of  
84 supporting patients in the management of their symptoms via telehealth technology in  
85 comparison to in-person usual care (UC). We determine whether interventions utilizing  
86 telehealth-delivered support are more effective in improving QOL versus UC from baseline until  
87 the end of the intervention period.

88

## 89 METHODS

90 The recommendations outlined in the preferred reporting items for systematic reviews and meta-  
91 analyses (PRISMA) statement were used to guide this systematic review and meta-analysis.<sup>16</sup>

92

### 93 2.1 Data Acquisition

94 An electronic database search was initially conducted from inception to December, 31 2016 by  
95 two of the coauthors using the following databases: National Library of Medicine Catalog  
96 (Medline/PubMed), SCOPUS, the Cumulative Index for Nursing and Allied Health Literature  
97 (CINAHL), Ebsco Health (Medline complete). The initial key-term search consisted of:  
98 “telehealth OR telemedicine” AND “Cancer” AND “quality of life OR assessment”. After the  
99 initial search, article titles and abstracts were inspected for relevance to the inclusion and  
100 exclusion criteria, followed by obtaining full-texts for identified manuscripts. Manuscripts were

101 then further scrutinized for inclusion and exclusion criteria post-retrieval. Reference lists of full-  
102 text manuscripts were then hand-searched and cross-referenced for potentially relevant papers.  
103 Another separate search on the Cochrane Library was conducted for systematic reviews  
104 containing similar content. Relevant systematic reviews were then obtained and cross-referenced  
105 for additional manuscripts missed during the original search. Consensus among all the authors  
106 was then sought for an article's final inclusion in the meta-analysis.

107

## 108 2.2 Inclusion and Exclusion Criteria

109 All manuscripts included in the systematic review and meta-analysis must have been  
110 published in a peer-reviewed journal and met the following inclusion criteria: 1) Patients  
111 included must have had any form of cancer and been undergoing active treatment; 2) Patients  
112 must have been adults, 18 years of age or older; 3) Interventions must have used some form of  
113 telehealth/telemedicine, including but not limited to telephone calls and/or web based  
114 interventions; 4) The focus of each intervention must have been on emotional support or self-  
115 management of symptoms through counseling, educational intervention or telepsychiatry; and 5)  
116 Studies must have used a measurable QOL scale or questionnaire. Studies were excluded if they:  
117 1) Were written in a language other than English; 2) Included pediatric patients; 3) If they  
118 assessed the efficacy of palliative care; or 4) Combined in-person and telehealth in the same  
119 intervention.

120

## 121 2.3 Data extraction and analysis

122 For the systematic review portion of this study, descriptive data were extracted from each of the  
123 included articles pertaining to their methodology and results. Numerical data extracted for the

124 meta-analysis included sample sizes, QOL measures means and standard deviations from  
125 baseline and post-intervention as well as effect sizes for each study whenever data were  
126 available. If effect size results were not reported, they were conservatively estimated based on  
127 the obtainable data from each included study. Following the retrieval of study data, standardized  
128 mean differences between baseline and post-test while adjusting for small sample bias (Hedges  
129  $g$ ) were calculated for telehealth interventions and usual care (UC) separately.<sup>17</sup> A mean effect  
130 size ( $\Delta$ ) for both telemedicine and UC was determined using a random effects model due to the  
131 uncertainty of evaluating a homogenous population.<sup>18</sup> Heterogeneity was assessed via  $I^2$  and  $Q$ -  
132 statistics. To gauge the impact of bias from unpublished studies on the mean effect size, the fail-  
133 safe  $N$  was also evaluated.<sup>18</sup> All effect-size data and heterogeneity statistics were calculated with  
134 the Comprehensive Meta-Analysis (V3.3.070, Biostat, Inc., Englewood, NJ) software package.  
135 Effect size data were interpreted as 0.1-0.3=small, 0.3-0.5=moderate and  $>0.5$ = large effects.<sup>19</sup>  
136 After effect size calculations were acquired, independent  $t$ -tests were then used to determine if  
137 differences existed between the effect sizes of the telemedicine and UC cancer delivery  
138 interventions utilizing the IBM Statistical Package for the Social Sciences (SPSS) software  
139 (Version 24.0, IBM, Inc., Armonk, NY). The significance level was set to  $p < .05$  for all statistical  
140 analyses a-priori.

141

## 142 RESULTS

143 Figure 1 is a flow diagram of our article selection process. Our initial search for articles using  
144 our search terms within the designated literature databases yielded a total of 414 articles. A  
145 search in the Cochrane database for systematic reviews containing similar content provided 5  
146 systematic reviews, and all the references within the systematic reviews, totaling 370 article

147 titles, were screened. After titles and abstracts were screened, 57 articles were retained to be  
148 assessed by two authors to ensure consensus on inclusion. After duplicates and those that did not  
149 fit the inclusion criteria were excluded, full text assessments were performed on the 21  
150 remaining articles. Nine articles were excluded due to the patient population being cancer  
151 survivors and not in active treatment, and one article was excluded because the intervention was  
152 exercise-based. Nine articles (Table 1) ultimately fit all systematic review and meta-analysis  
153 criteria.

154  
155 Five out of nine articles used telephone-based interventions (56%), another three studies used  
156 web-based designs or connected devices (33%) and one (11%) utilized videoconferencing. The  
157 time period for the studies varied, ranging from 6 weeks to one year. One article did not  
158 specifically report the time period from baseline to final assessment, but stated it was one month  
159 after treatment.<sup>20</sup> The mean age of the patients within the 9 articles ranged from 53 to 67 years of  
160 age. Five of the articles focused on specific cancers, e.g., colorectal, breast, and head and neck  
161 cancers,<sup>7,21–24</sup> whereas three articles included three or more types of cancer within their study  
162 population.<sup>20,25,26</sup> Pfeifer et al. (2015) included both breast and prostate cancer patients.<sup>27</sup>

163  
164 Of the nine articles included, only one had statistically significant results for overall QOL scores  
165 from baseline to end of the study period and did not have a comparable control group.<sup>20</sup> Two  
166 articles did find clinically significant improvements in the intervention effect on QOL, but were  
167 not statistically significant. Berry et al. (2014) did not find statistically significant between-group  
168 changes in QOL overall, but did report statistical significance for a sub-analysis by age. There  
169 was a statistically significant intervention effect for those  $\geq 50$  years of age, though not for those



170 younger.<sup>26</sup> Hegel et al (2011) found statistically significant improvements for the intervention  
171 group compared to the usual care control for overall QOL as well as emotional and social well-  
172 being subscales at 6 weeks. However, after the intervention was completed, the 12-week end of  
173 study QOL scores were not statistically significant between groups.<sup>22</sup> A similar effect was found  
174 in Pfeifer's (2015) study, as there was no statistically significant difference between groups in  
175 the overall QOL score, although there were statistically significant differences in physical well-  
176 being after the intervention.<sup>27</sup> The Ruland (2013) and Rhyanen (2013) studies reported no  
177 statistically significant between-group results for the telehealth intervention on QOL. Both  
178 studies did find other statistically significant results related to lower anxiety and depression scale  
179 scores for those in the intervention groups compared to the usual care controls over the study  
180 period.<sup>23,24</sup> Ruland et al. (2013) found that the intervention group had significant decreases in  
181 depression scale scores and did not have the significant decreases that were found over time in  
182 the control group for QOL and self-efficacy scores.<sup>23</sup> Rhyanen et al. (2013) collected data more  
183 frequently and were able to associate QOL changes with events such as increases in QOL after  
184 surgery and decreases in QOL at the end of radiotherapy.<sup>24</sup> The intervention group had a  
185 continual decrease in anxiety over time, whereas the control group had greater anxiety before  
186 surgery and chemotherapy, as well as during chemotherapy treatments.<sup>24</sup> In the study, anxiety  
187 was statistically significantly associated with overall QOL scores and physical, psychological,  
188 and spiritual well-being subscales.<sup>24</sup>

189

190 In total, 16 individual effect sizes—nine for telehealth interventions and seven for UC—were  
191 calculated. Across the nine studies included in the meta-analysis, 680 patients received  
192 telehealth cancer interventions, while 602 patients received UC. The distribution for all

193 unweighted effect sizes calculated are displayed on a forest plot in Figure 2. The summary  
194 statistics for the mean effect sizes for telehealth and UC with their 95% confidence intervals,  
195 heterogeneity statistics and fail safe N calculations are reported in Table 2. Both telehealth ( $\Delta =$   
196  $0.211, p=0.016$ ) and UC ( $\Delta = 0.217, p<0.001$ ) demonstrated small but statistically significant  
197 mean effects compared to baseline QOL across the included studies. They each had relatively  
198 low Q and  $I^2$  values indicating homogeneity across the included studies (refer to supplemental  
199 materials for funnel plot files). No statistically significant differences were present between the  
200 mean effect sizes of telehealth and UC interventions ( $t= -0.31, p=0.76$ ).

201

202 Multiple sensitivity secondary analyses were performed by revising the meta-analysis to include  
203 only those articles that used the Functional Assessment for Cancer Therapy (FACT) scale for  
204 quality of life. Including only these six studies increased the effect size of the intervention group  
205 ( $\Delta = 0.338, p=0.006$ ), and the effect size was considered moderate. The control group in this  
206 analysis had a smaller increase in effect size ( $\Delta = 0.256, p=0.013$ ). This suggests that using  
207 different scales for measuring QOL may affect the measurable impact of the telehealth  
208 interventions. We also stratified the meta-analysis to compare telephone interventions ( $n=5$ )  
209 versus internet/device interventions ( $n=4$ ). This resulted in telephone interventions having a  
210 larger, moderate effect size ( $\Delta=0.325, p=0.028$ ) than the internet/device interventions ( $\Delta=0.092,$   
211  $p=0.341$ ). However, these were not statistically different ( $t= -0.584, p = 0.577$ ), likely due to the  
212 low sample of studies.

213

214 DISCUSSION

215 Our study performed a systematic review of peer-reviewed studies that utilized telehealth  
216 interventions to improve emotional support and symptom self-management for patients receiving  
217 treatment for cancer. Our findings demonstrated a statistically significant, albeit small increase in  
218 QOL for the telehealth intervention group relative to baseline across the nine studies in the meta-  
219 analysis. The UC group had a similar, statistically significant improvement across seven studies,  
220 but we found telehealth to be non-inferior to UC in improving quality of life for cancer patients.  
221 Sensitivity analysis suggested that telephone-based interventions may be superior to  
222 internet/device interventions for cancer patients.

223

224 The studies in our meta-analysis and systematic review were relatively homogenous as  
225 demonstrated by funnel plots (refer to supplemental materials). Harrison et al. (2011) was the  
226 only potential outlier showing significantly improved effectiveness of telehealth versus UC;  
227 however, this was the only study analyzing patients with colorectal cancer.<sup>21</sup> It is possible that  
228 telehealth-based psychosocial treatments would vary in effectiveness across cancer diagnoses.  
229 Unfortunately, there has been insufficient research to demonstrate this.<sup>21</sup>

230

231 Our findings are consistent with prior research demonstrating non-inferiority of tele-psychiatry  
232 interventions versus face-to-face treatment.<sup>28-30</sup> Thus, by maintaining a comparable QOL while  
233 averting the need to travel for in-person therapy or treatment, the use of telehealth for  
234 psychosocial support of cancer patients is likely to be cost-effective. Furthermore, telehealth may  
235 be effective in improving outcomes other than QOL, however, such as patient satisfaction and  
236 acceptability of the new modality.<sup>31</sup> For example, a systematic review conducted by Calvin et al  
237 suggested that most patients accept and are satisfied with many forms of telehealth interventions

238 they received.<sup>32</sup> Another study showed that telehealth did not lead to lower patient satisfaction in  
239 communicating with their providers.<sup>33</sup>

240

241 Our inclusion criteria stated that all articles must have an overall quality of life measurement. Of  
242 the nine studies in our systematic review, the majority (67%) used the FACT instrument—either  
243 the general or cancer-specific FACT instrument—as shown in Table 1. The general FACT scale  
244 was developed and validated between 1987 and 1992, in a five-phase process, including item  
245 generation, item review and reduction, scale construction and piloting, initial evaluation, and  
246 additional evaluation.<sup>34</sup> FACT-G is a 27-item instrument that has subscale scores for physical,  
247 functional, social, emotional well-being and satisfaction with treatment.<sup>34</sup> Cancer-specific FACT  
248 scales include those questions that are in the FACT-G but have additional questions that are  
249 cancer specific, such as for colorectal cancer (FACT-C), breast cancer (FACT-B), and head and  
250 neck cancer (FACT-HN).<sup>35–38</sup> Berry et al.(2014) used the Symptom Distress Scale (SDS), which  
251 has 15 items—the 13 included in the usual SDS instrument and an additional 2 questions related  
252 to sexual activity and interest, and fever and chills.<sup>26</sup> The SDS used a 5-point Likert scale  
253 ranging from no distress or normal (0) to severe distress (5), creating a total SDS score from an  
254 unweighted summation of the scores.<sup>39</sup> Ruland et al. (2013) also used a 15-dimensional self-  
255 administered instrument for measuring QOL based on similar symptoms to the SDS, but using a  
256 5-point Likert score where higher scores denoted improved health status.<sup>23,40</sup> The breast cancer  
257 version of the Quality of Life Instrument was used by Ryhanen and colleagues.<sup>24</sup> Their  
258 instrument had 46 items grouped into four subscales related to physical, psychological, social  
259 and spiritual well-being. A 10-point Likert scale was used with 0 indicating the worst outcome

260 and 10 the best outcome. An overall QOL score was created by summing the subscale variables  
261 and calculating the mean values.<sup>41</sup>

262

263 Although our focus was on the improvement in quality of life of cancer patients who received a  
264 telehealth intervention for emotional or symptom management support, it is important to note  
265 that telehealth increases access to care for cancer patients, as well as for those suffering from  
266 other chronic conditions. Rural patients are at higher risk for decreased access to specialized  
267 care, and telehealth has been found to increase access to quality care. Telehealth can ease the  
268 burden of travel time, cost, and the discomfort that may be associated with long travel times.<sup>42,43</sup>  
269 Telehealth can also overcome issues related to ethnicity, culture, and language that affect health,  
270 by facilitating access to culturally competent providers and interpreters.<sup>43</sup>

271

272 Our study should be interpreted in the context of certain limitations. Our meta-analysis had a  
273 small sample size of manuscripts and patient pools, and thus we were unable to perform a  
274 moderator analysis to determine if alternative factors influenced the effectiveness of treatment  
275 delivery. On a similar note, different cancers, stage of cancer and treatment protocols may have  
276 varying impacts on QOL, which we were unable to explore due to the limited number of studies.

277 <sup>44-46</sup> A study on the factors affecting the quality of life of cancer patients undergoing  
278 chemotherapy found worse quality of life in breast cancer, head and neck, sarcoma, lung and  
279 gynecological cancers. Colorectal cancer patients were found to have the better quality of life.<sup>46</sup>

280 Lower quality of life in breast cancer patients may be due to changes in self-image due to  
281 surgery and hair loss, as well as decreased sexual function and early menopause. Similarly, head  
282 and neck cancers and sarcomas surgical treatment can lead to disfigurement and cause lower

283 quality of life for patients.<sup>46</sup> In addition, we were unable to effectively assess manuscript quality  
284 as part of our analysis as there was a range of study designs included. Due to the low sample, we  
285 chose to include all studies relevant to our inclusion criteria and agreed upon by author  
286 consensus, regardless of design. Because of inconsistent and limited published data, we erred on  
287 the conservative side when necessary during effect size calculations; however, this only occurred  
288 for two studies, Pfeifer et al. (2015) and Hegel et al. (2011).<sup>22,27</sup>

289

## 290 CONCLUSIONS

291 Our systematic-review with meta-analysis demonstrated that supplementary interventions  
292 through telehealth have a comparable impact on quality of life scores relative to in-person usual  
293 care. Utilizing telehealth, may allow clinicians and healthcare systems to increase access for  
294 those cancer patients who lack the means to travel for additional treatment or are rurally located  
295 creating increase travel costs and time. Some of the studies in this meta-analysis did see  
296 improvements in other areas such as depression, anxiety, and emotional, social, and physical  
297 well-being, even when overall quality of life was not statistically significantly improved. Our  
298 findings suggest more studies need to be conducted on the impact of telehealth interventions  
299 across different cancer diagnoses to gain better insight into the differential effect these  
300 interventions may have on quality of life for cancer patients undergoing treatment.

301

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303

304 None

305

306

307 AUTHOR DISCLOSURE STATEMENT

308

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