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# BMJ Open

## Spatially Exploring the Intersection of Socio-Economic Status and Canadian Cancer-Related Medical Crowdfunding Campaigns

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-026365
Article Type:	Research
Date Submitted by the Author:	11-Sep-2018
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Keywords:	Crowdfunding, Equity, Spatial Analysis

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Manuscripts

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3 1 **Spatially Exploring the Intersection of Socio-Economic Status and Canadian Cancer-Related**  
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5 2 **Medical Crowdfunding Campaigns**  
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18 12  
19 13 Keywords: Crowdfunding; Equity; Cancer; Spatial Analysis

20 14 Word Count: 2947  
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## 29 Abstract

30 **Objectives:** Medical crowdfunding is a rapidly growing practice where individuals leverage social  
31 networks to raise money for health-related needs. This practice has allowed many to access health care  
32 and avoid medical debt but has also raised a number of ethical concerns. A dominant criticism of this  
33 practice is that it is likely to increase inequities in access to healthcare if persons from relatively wealthy  
34 backgrounds, media connections, tech savvy, and educational attainments are best positioned to use and  
35 succeed with crowdfunding. To date this concern has been largely speculative and not supported by data.  
36 Our objective in this paper is to assess this concern using socio-economic data and information from  
37 crowdfunding campaigns.

38 **Setting:** To assess this concern, we present an exploratory spatial analysis of a new dataset of  
39 crowdfunding campaigns for cancer-related care by Canadian residents.

40 **Participants:** Four datasets were used: 1) a medical crowdfunding dataset that included cancer-related  
41 campaigns posted by Canadians; 2) 2016 Census Profile for aggregate dissemination areas; 3) aggregate  
42 dissemination area boundaries; and 4) forward sortation area boundaries.

43 **Results:** Our exploratory spatial analysis demonstrates that use of crowdfunding for cancer-related needs  
44 in Canada corresponds with high income, home ownership, and high educational attainment. Campaigns  
45 were also commonly located near city centres.

46 **Conclusions:** These findings support speculative concerns that those in positions of relative socio-  
47 economic privilege disproportionately utilize crowdfunding to address health-related needs. This study  
48 was not able to determine whether other socio-economic dimensions such as race, gender, ethnicity,  
49 nationality, and linguistic fluency are also correlated with use of medical crowdfunding. Thus, we call for  
50 further research to explore the relationship between socio-economic variables and medical crowdfunding  
51 campaigning to explore these other socio-economic variables and campaigns for needs unrelated to  
52 cancer.

## 54 Strengths and Limitations of this Study

55 Developed large dataset of crowdfunding data

56 Presents methods for analyzing datasets of crowdfunding campaign information

57 Links data on crowdfunding campaigns to data on income, home ownership, and education levels

58 Unable to determine whether race, gender, ethnicity, nationality, or linguistic fluency impact use of  
59 crowdfunding

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## 65 Introduction

66 Individuals and groups have increasingly turned to online social networking and social media platforms to  
67 fundraise. This practice has come to be popularly known as crowdfunding. In particular, charitable  
68 crowdfunding has developed as a means for individuals or small groups to finance their personal needs.  
69 Entrepreneurs created online crowdfunding platforms to mediate interactions between campaigners and  
70 donors. These platforms host campaigns, including text, images, and video, facilitate outreach to potential  
71 donors via social media, and process donations.

72 The crowdfunding platform GoFundMe dominates the charitable crowdfunding sector. Before it  
73 recently acquired YouCaring, the second largest social crowdfunding platform, it controlled 90% of the  
74 charitable crowdfunding business in the United States (US) and 80% globally [1,2]. Launched in 2010,  
75 US\$ 5 billion has been raised via GoFundMe to date and this platform supports a community consisting  
76 of more than 50 million donors and users [1]. Campaigns for health-related purposes comprise the largest  
77 proportion of fundraisers hosted by GoFundMe [2,3]. These medical crowdfunding campaigns are  
78 thought to be used to pay for essential services for those lacking comprehensive medical insurance,  
79 elective procedures not covered by insurance, and unproven or experimental medical treatments. They are  
80 also used to pay for indirect needs related to receiving medical care, including travel to receive care,  
81 compensation for time off from work, and payments for medical equipment [3]. The use of crowdfunding  
82 platforms for medical purposes is expected to continue to grow and thus have a substantial impact on how  
83 individuals access health-related care [3,4].

84 Successful medical crowdfunders can benefit greatly from being better able to obtain health-  
85 related support via crowdfunding. However, this practice has also been the target of considerable  
86 criticism. These concerns include worries about fraudulent campaigns, loss of medical privacy, and  
87 encouraging the privatization of healthcare [3,4]. Arguably the most common and serious critique of  
88 medical crowdfunding is that it will exacerbate existing inequities in who is ultimately able to  
89 (financially) access health care. While differential access to health care is shaped by each community's

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3 90 health and social care system, insurance coverage, and demographics, in general those in positions of  
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5 91 socio-economic privilege, even in universal health systems, have relatively better access to health-related  
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7 92 care than their less privileged compatriots. Medical crowdfunding could exacerbate this problem, it is  
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9 93 argued, if crowdfunding serves to reward recipients according to their popularity, extent of social  
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11 94 networks, technological capabilities, or media savvy rather than need [5]. For example, Young and  
12  
13 95 Scheinberg [4 p. 1623] flag the “potential for unfairly advantaging those with the means to engage with  
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15 96 online tools and tap into large social networks, which may lead to an underrepresentation of cases with  
16  
17 97 the greatest need in which patients lack the tools to coordinate effective crowdfunding campaigns.”  
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19 98 Similarly, critics express that medical crowdfunding is likely to reinforce existing inequalities in class and  
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21 99 power [6] and reward those with social connections to wealthy persons, media connections, and the  
22  
23  
24 100 educational attainments needed to communicate effectively online [7].  
25

26 101       Importantly, criticism that medical crowdfunding mostly benefits those who are socio-  
27  
28 102 economically advantaged is largely speculative and not empirically supported. Quantitative studies of  
29  
30 103 medical crowdfunding are scarce due to the challenges of compiling, organizing, and analyzing data and  
31  
32 104 those studies that have been conducted using crowdfunding datasets have not addressed the issue of  
33  
34 105 equitable access to care. Here we present an exploratory analysis of a new dataset of crowdfunding  
35  
36 106 campaigns for cancer-related care by Canadian residents that is connected to a selection of demographic  
37  
38 107 information from the 2016 Canadian Census to explore the relationship between campaign use and socio-  
39  
40 108 economic status. We captured this medical crowdfunding dataset using an automated data crawling  
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42 109 program and machine learning techniques. We specifically examine crowdfunding campaigns for cancer-  
43  
44 110 related care as existing research has already documented the commonality of such campaigns in Canada  
45  
46 111 [8,9,10], and we contrast these campaigns against geo-demographic trends using an exploratory spatial  
47  
48 112 data analysis (ESDA) approach. ESDA facilitates the investigation of prior assumptions and guides the  
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50 113 identification of spatial patterns [11,12]. We use these patterns to raise important new research questions  
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52 114 about medical crowdfunding in the discussion.  
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## 115 **Materials and Methods**

116 We utilized four datasets in this exploratory analysis: 1) a medical crowdfunding dataset that included  
117 cancer-related campaigns posted by Canadians; 2) 2016 Census Profile for aggregate dissemination areas;  
118 3) aggregate dissemination area boundaries; and 4) forward sortation area boundaries.

119 We compiled a medical crowdfunding dataset by creating an automated web crawling algorithm.

120 To do this we developed a Python based automated web crawler that scraped a major crowdfunding  
121 platform looking for key words or strings of words – in this case, the keyword ‘cancer.’ The search  
122 took place on June 11, 2016 and was classified – meaning that borderline terms were flagged for the user  
123 who would then read the site and determine if it should be included. After relevant campaigns were  
124 identified, we used a SQL database server to store the site in HTML form for further analysis. Once the  
125 full HTML files from each campaign were retrieved, the pages were then parsed to remove HTML tags.  
126 Further cleaning and labeling took place using a machine learning algorithm designed to find and include  
127 any missing information or attributes of the campaigns related to cancer. The final records were stored in  
128 a Redis database for access by simple query for analysis. The dataset used in this study contains 1788  
129 records from May 2012 to June 2016 pertaining to cancer-related campaigns created by Canadians.

130 Aggregate dissemination areas (ADAs) are a new census product released by Statistics Canada as  
131 part of the 2016 Canadian Census. Delineation of ADAs considers boundaries of previous census  
132 products, including existing census divisions, census metropolitan areas, and census tracts [13]. Forward  
133 sortation areas (FSAs) are administrative boundaries determined by Canada Post [14]. They are  
134 alphanumerically represented by “the first three characters in a Canadian postal code” [14]. The records  
135 contained in our crowdfunding dataset described above have an FSA attribute. This geographic data unit  
136 enables ESDA. Boundaries of ADAs and FSAs were obtained from Statistics Canada [15].

137 Socio-economic status and its correlation with an individual's health or ability to obtain  
138 treatments have been previously assessed at a FSA level [16,17,18], which is why we opted to explore  
139 socio-economic status indicators. Variables related to income, education, and housing were chosen and

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3 140 obtained using the University of Toronto's Canadian Census Analyser at the ADA level (see Table 1 for  
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5 141 exact variables obtained) [19]. Further data pre-processing and transformations were required in order to  
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7 142 link socio-economic data to FSAs due to current data limitations.  
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11 144 \*\* insert Table 1 here \*\*  
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16 146 Profile and boundary datasets for FSAs are unavailable for the Statistics Canada 2016 Census  
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18 147 data. In lieu of the FSAs, we computed the weighted average of socio-economic variables based on the  
19  
20 148 percent of spatial overlap between ADAs and FSAs. To prepare for this conversion, ADAs were spatially  
21  
22 149 joined with data retrieved from the 2016 Census Profile. Each FSA is also joined with respective  
23  
24 150 campaign frequencies (see Figure 1 for the high-level description of conversion procedure utilized to add  
25  
26 151 socio-economic data at ADA-level to FSA-level). Once the relationship matrix was generated from the  
27  
28 152 function `GenerateWeights`, it was then retrieved and used to calculate weighted averages of socio-  
29  
30 153 economic variables contained in each intersecting ADA. These weighted socio-economic variables were  
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32 154 appended to each respective FSA.  
33

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35 155 \*\* insert Figure 1 here \*\*  
3637  
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39  
40 157 Using ArcMap from the ArcGIS suite (version 10.5), quintiles were created using natural breaks.  
41  
42 158 The data were categorized as quintiles as we trusted that five classes would be sufficient to showcase  
43  
44 159 meaningful differences while minimizing complexity of visual results. These quintiles were used in  
45  
46 160 cartographic representations to support ESDA tasks. Visual comparisons at regional and provincial levels  
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48 161 were then conducted with regards to income, education, and housing ownership. The creation of these  
49  
50 162 quintiles allowed project correspondents to examine the data for geographic trends. These cartographic  
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52 163 products enabled the significance of these socio-economic variables to be gauged for medical  
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54 164 crowdfunding.  
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3 165 Campaigns for each FSA were counted, and these frequencies were assigned to their respective  
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5 166 boundaries. These FSAs were subsequently linked with ADAs that feature census variables from the 2016  
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7 167 Canadian Census. These variables consisted of income, number of persons who have completed post-  
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9 168 secondary education, and home ownership. These linkages were informed by research conducted by  
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11 169 Rogers [20] in which these variables were shown to be commonly associated with vulnerability with  
12  
13 170 regard to health and healthcare. To link these datasets, the variables were weighted based on the percent  
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15 171 of areal overlap each ADA shares with each FSA. The resulting weighted attributes were then divided  
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17 172 into quintiles using a method similar to Sothorn et al. [21]. Resulting quintiles were then visualized in an  
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19 173 interactive cartographic display, or web map, enabling geographic comparisons to be made. This map can  
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21 174 be viewed at: <https://www.crowdfundingforhealth.org/chrpexplorer>. Figure 2 describes the process for  
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23 175 users of CHRP to explore the ESDA results. Figure 3 shows an image of the web map interface.

24  
25  
26 176 \*\* insert Figure 2 here \*\*

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30 178 \*\* insert Figure 3 here \*\*

### 31 32 179 33 34 180 *Patient and Public Involvement*

35  
36 181 As the information analyzed in this study was publicly available, patients were not recruited for or  
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38 182 actively involved in this study.

### 39 40 183 41 42 184 **Results**

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44 185 Our exploratory analysis utilizes socio-economic variables that have been linked with FSAs. These  
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46 186 include a layer of campaign counts per FSA, income, education, and housing (see Figures 4, 5, 6, & 7 for  
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48 187 screen captures).

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51 188 \*\* insert Figure 4 here \*\*

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53 189 \*\* insert Figure 5 here \*\*

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55 190 \*\* insert Figure 6 here \*\*

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3 191 \*\* insert Figure 7 here \*\*  
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5 192  
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7 193 In addition to the web map, a table was generated that showed the proportion of crowdfunding campaigns  
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9 194 that belong in each quintile for each socio-economic variable (see Tables 2, 3, 4, & 5).  
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12 195  
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14 196 \*\* insert Table 2 here \*\*

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16 197 \*\* insert Table 3 here \*\*

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18 198 \*\* insert Table 4 here \*\*

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20 199 \*\* insert Table 5 here \*\*  
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22 200  
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24 201 It is important to note that only 176 FSAs out of the 1620 FSAs in Canada contained at least one  
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26 202 crowdfunding campaign, with the population of these FSAs representing approximately 5% of the  
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28 203 national total. A separate table shows the distribution of the crowdfunding campaigns between each  
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30 204 Canadian province and territory and the average value of each socio-economic variable within each  
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32 205 administrative division (see Table 6).  
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35 206  
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37 207 \*\* insert Table 6 here \*\*  
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41 209 The average income of crowdfunding campaigners in this dataset is within middle to high level  
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43 210 FSAs, with 65.49% of campaigns being located in FSAs within the three highest quintiles in the income  
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45 211 category (see Table 3). These higher income levels are matched by higher rates of home ownership  
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47 212 among these campaigners, with housing ownership values being larger in the middle quintile (see Table  
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49 213 5). This group also tends to be well educated, with education values tending toward the higher quintiles  
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51 214 (see Table 4).  
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54 215 Collectively, our ESDA shows that use of cancer-related medical crowdfunding is occurring  
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56 216 unevenly across the country relative to population distribution. For example, Canadians' cancer-related  
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3 217 crowdfunding campaigns were also commonly located in close proximity to city centres (see Figure 3).  
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5 218 Provincial differences in campaign use also exist. Campaigns were more commonly posted in the  
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7 219 provinces of Ontario and British Columbia and less so in the Atlantic provinces. There is a noticeable  
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9 220 density of campaigns in the prairie provinces of Alberta and Saskatchewan.  
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## 12 222 **Discussion**

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15 223 Our ESDA-based findings support existing concerns that persons in positions of relative socio-economic  
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17 224 privilege disproportionately utilize crowdfunding to address health-related needs – in this case care  
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19 225 related to cancer. Individuals in the highest income FSAs were found to be the heaviest users of medical  
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21 226 crowdfunding for cancer-related campaigns, as were individuals in FSAs with high rates of home  
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23 227 ownership. These ESDA-based interpretations support the idea that wealthier individuals are more likely  
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25 228 to see crowdfunding as a way to draw together financial resources from elsewhere to meet their health  
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27 229 needs. We also observed that individuals in FSAs with higher rates of education turned more frequently to  
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29 230 medical crowdfunding. This ESDA-based interpretation supports existing claims that individuals who are  
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31 231 better educated, more familiar with online technologies, and better able to express themselves online are  
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33 232 more likely to take advantage of crowdfunding to address health-related needs. The positive correlation  
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35 233 between the amount raised in a campaign and number of times the campaign was shared supports the  
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37 234 speculation that social capital and tech-savviness are important constituents of crowdfunding campaign  
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39 235 success.  
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43 236 Our exploration of geo-demographic trends regarding Canadians' use of cancer-related  
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45 237 crowdfunding shows that this is a highly urban phenomenon. This is somewhat counterintuitive  
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47 238 considering the extensive health service gaps in rural Canadian communities that drive some residents to  
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49 239 consider alternative ways to access necessary care [22], such as crowdfunding for the costs of private  
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51 240 treatment or to relocate to an urban centre. Research regarding a potential urban-rural divide in  
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53 241 crowdfunding use is very limited and so it is difficult to know why there can be proportionately less use  
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55 242 in rural areas. This may be due to limited access to technology or lower levels of education in rural  
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3 243 Canadian communities [23,24]. Alternatively, it may be due to the strong voluntary and informal care  
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5 244 sectors that ‘tight-knit’ rural communities are so well known for that would lead to residents pulling  
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7 245 together to support those in need [22,25], which would lessen the need for drawing on disparate social  
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9 246 networks via crowdfunding. It is important to note, however, that our ESDA approach means that we  
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11 247 cannot conclusively state that our analysis documents a clear urban-rural divide. This is due in part to the  
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13 248 large aggregations of FSAs as well as the sparse population of Nunavut that can both over- and under-  
14  
15 249 estimate socio-economic variables. We thus flag this as an important issue for future medical  
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17 250 crowdfunding research.

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20 251 While our interpretations of the ESDA results support the general concern that medical  
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22 252 crowdfunding will tend to exacerbate socio-economic inequities in access to health-related care, only  
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24 253 certain dimensions of this critique were explored here. For example, while we found positive correlations  
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26 254 between cancer-related crowdfunding and wealth and education levels, we were not able to explore  
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28 255 whether other dimensions of socio-economic privilege are positively correlated. These dimensions  
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30 256 include race, gender, ethnicity, nationality, and linguistic fluency, all of which are factors that lead to  
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32 257 inequities in health status [26,27]. This leads us to make three important points. First, we acknowledge  
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34 258 that it is possible that only certain dimensions of socio-economic privilege correlate with using  
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36 259 crowdfunding to address health-related needs, and that some or all of those not explored here do not shape  
37  
38 260 medical crowdfunding use in the ways documented here. Second, and because of this, it is important to  
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40 261 explicitly state that this exploratory analysis supports the hypothesis of a more general correlation but  
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42 262 does not provide direct evidence supporting every dimension of this correlation. And third, we call for  
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44 263 further research to explore the relationship between socio-economic variables and medical crowdfunding  
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46 264 use in general or for cancer-related campaigns in order to assist with developing a more robust  
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48 265 understanding of any interrelationships.

### 51 266 *Limitations*

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54 267 Only the first three digits of postal codes were included in the dataset of crowdfunding campaigns, which  
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56 268 were then linked to FSAs. FSAs are smaller in urban areas and may be geographically vast in rural areas.

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3 269 Linking ADAs to FSAs could result in broad generalizations and aggregation errors and lead to ecological  
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5 270 fallacies. This implies that findings from our study are limited, as only broad claims can be stated. The  
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7 271 aforementioned generalizations could be less impacted in urban areas with smaller FSAs comparatively to  
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9 272 rural areas. While this has implications for our results, the impact may be reduced considering that as of  
10  
11 273 2011, over 80% of Canada's population lives in urban environments [28].

12  
13  
14 274 We acknowledge that a medical crowdfunding campaign recipient may be different from  
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16 275 campaign's creator. This necessitates further research with regard to the issues explored in this analysis  
17  
18 276 because campaigners may reside in or report different FSAs than the individual or family in need of  
19  
20 277 financial assistance. Further to this, postal codes are self-reported by campaign creators, which allows  
21  
22 278 typos and misstate to be made. Nothing can be done to address this as a limitation beyond acknowledging  
23  
24 279 our awareness of the potential for errors to exist in postal code reporting.

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27 280 FSAs encoded in the campaign entries dictated the primary level of aggregation for our study,  
28  
29 281 thus necessitating us to limit selection of socio-economic variables. If spatial and non-spatial attributes  
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31 282 were improved, more socio-economic status variables could be involved, such as sex or immigration  
32  
33 283 status. This would aid in obtaining more robust results. Another limitation encountered was the fact that  
34  
35 284 the census profiles at the FSA-level were unavailable due to accuracy issues (Statistics Canada, 2018)  
36  
37 285 [29]. To substitute, a methodology to link and weight the chosen socio-economic variables from the  
38  
39 286 ADA-level to FSA-level had to be developed.

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42 287 As our dataset was acquired for a snapshot in time, we acknowledge that campaigns have been  
43  
44 288 instantiated at different times and have been underway for varying durations. These comparisons may  
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46 289 impact results because the campaign duration captured in the current dataset may not be representative of  
47  
48 290 the overall success of the campaign. Future work may look to compare individual campaigns that have  
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50 291 either been run for the same length of time or have completed their respective lifecycles on major  
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52 292 crowdfunding platforms.

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## 294 **Conclusions**

295 The findings reported here provide the first data-informed support for more speculative concerns that  
296 charitable crowdfunding will tend to advantage relatively socio-economically privileged individuals.  
297 While supporters of medical crowdfunding point to its potential to help people access necessary health  
298 care and avoid debt or even medical bankruptcy, this paper demonstrates that this potential is not  
299 distributed equitably across society. While these findings do not eliminate the advantages of medical  
300 crowdfunding, they show its limits in serving as a systematic and fair solution to structural deficiencies in  
301 health systems. Additional research, including using the methods described here, would help to  
302 demonstrate whether these findings are reproduced for other socio-economic factors, in countries other  
303 than Canada, and for health needs beyond cancer.

304

## 305 **Contributorship Statement**

306 AvD, AL, and RM contributed to developing the methods, conducting the analysis, and writing  
307 the manuscript. JS and VAC contributed to method design, securing project funding, and writing  
308 the manuscript. PCW contributed to data acquisition and writing the manuscript. NS contributed  
309 to method design and writing the manuscript.

310

## 311 **Competing Interests**

312 We declare no competing interests.

313

## 314 **Funding**

1  
2  
3 315 This study was funded by the Canadian Institutes of Health Research. VAC holds the Canada Research  
4  
5 316 Chair in Health Services Geographies and a Scholar Award from the Michael Smith Foundation for  
6  
7 317 Health Research.  
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10 318

## 13 319 **Data Sharing Statement**

16 320 All crowdfunding data is available from the authors on request.  
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397 **Tables**

Variable	Data Obtained
<b>Population and dwelling counts</b>	Population, 2016
<b>Income</b> (Total Sex / Total)	Income statistics in 2015 for the population aged 15 years and over in private households - 100% data / Number of after-tax income recipients aged 15 years and over in private households - 100% data / Median after-tax income in 2015 among recipients (\$)
<b>Education</b> (Total Sex / Total)	Highest certificate, diploma or degree for the population aged 15 years and over in private households - 25% sample data / Postsecondary certificate, diploma or degree
<b>Housing</b> (Total Sex / Total)	Private households by tenure - 25% sample data / Owner

398 **Table 1. Variables Obtained from 2016 Census Profiles for Aggregate Dissemination Areas.**  
 399 Retrieved from the Canadian Census Analyser, University of Toronto

400

Quintile	Number of FSA	Percentage (FSA)	Number of Campaigns	Percentage (Campaigns)
1 - 5	114	64.77%	247	13.81%
6 - 17	36	20.45%	337	18.85%
18 - 41	16	9.09%	402	22.48%
42 - 76	6	3.41%	362	20.25%
77 - 138	4	2.27%	440	24.61%
<b>Total</b>	176	100.00%	1788	100.00%

401 **Table 2. Frequency of Campaigns per FSA. Proportion of Campaigns belonging to each Quintile.**

402

Quintile	Number of FSA	Percentage (FSA)	Number of Campaigns	Percentage (Campaigns)
\$0.00 - \$12699.19	3	1.70%	104	5.82%
\$12699.19 - \$28556.91	54	30.68%	513	28.69%
\$28556.91 - \$33333.84	63	35.80%	449	25.11%
\$33333.84 - \$38980.26	45	25.57%	593	33.17%
\$38980.26 - \$51498.11	11	6.25%	129	7.21%
<b>Total</b>	176	100.00%	1788	100.00%

403 **Table 3. Income, Median After-Tax (2015). Proportion of Campaigns belonging to each Quintile.**

404

Quintile	Number of FSA	Percentage (FSA)	Number of Campaigns	Percentage (Campaigns)
1 - 1397	12	6.82%	159	8.89%
13979 - 2980	41	23.30%	308	17.23%
2980 - 4156	72	40.91%	755	42.23%
4156 - 6087	46	26.14%	524	29.31%
6087 - 10046	5	2.84%	42	2.35%
<b>Total</b>	176	100.00%	1788	100.00%

405 **Table 4. Education, Post-Secondary. Proportion of Campaigns belonging to each Quintile.**

406

Quintile	Number of FSA	Percentage (FSA)	Number of Campaigns	Percentage (Campaigns)
1 - 1393	17	9.66%	180	10.07%
1393 - 2429	38	21.59%	283	15.83%
2429 - 3218	68	38.64%	711	39.77%
3218 - 4579	48	27.27%	571	31.94%
4579 - 7121	5	2.84%	43	2.40%
<b>Total</b>	176	100.00%	1788	100.00%

34 **Table 5. Housing, Owner. Proportion of Campaigns belonging to each Quintile.**

Province/ Territory	Number of FSAs	Number of Campaigns	Percentage (FSA)	Percentage (Campaigns)	Population	Income, Median After-Tax (Average)	Education, Post- Secondary (Average)	Housing, Owner (Average)
<b>British Columbia</b>	32	401	18.18%	22.43%	268112	\$28,716.63	3728	2599
<b>Alberta</b>	21	310	11.93%	17.34%	203643	\$36,012.35	3393	2846
<b>Saskatchewan</b>	14	85	7.95%	4.75%	138065	\$34,795.72	3613	3194
<b>Manitoba</b>	9	66	5.11%	3.69%	83126	\$31,275.32	3211	3032
<b>Ontario</b>	47	576	26.70%	32.21%	436637	\$31,865.32	3942	3105
<b>Quebec</b>	18	139	10.23%	7.77%	158832	\$30,057.44	3923	2675
<b>New Brunswick</b>	12	55	6.82%	3.08%	75339	\$26,745.83	2287	2310
<b>Nova Scotia</b>	9	69	5.11%	3.86%	73961	\$31,392.79	3908	2425
<b>Prince Edward Island</b>	2	25	1.14%	1.40%	15301	\$27,888.67	2984	2582
<b>Newfoundland &amp; Labrador</b>	9	53	5.11%	2.96%	69103	\$26,503.28	2868	2809
<b>Yukon</b>	1	5	0.57%	0.28%	16962	\$41,664.80	3278	2599
<b>Northwest Territories</b>	1	3	0.57%	0.17%	823	\$51,498.11	415	228
<b>Nunavut</b>	1	1	0.57%	0.06%	3	\$63.72	0	0
<b>Total</b>	176	1788	100.00%	100.00%	1539908	\$30,652.31	2889	2339

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408 **Table 6. Number of Campaigns, Population, and Socio-economic Values per Province.**

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3 409 **Figure Legends**

410 **Figure 1: High-Level Description of Conversion Procedure Utilized to add Socio-Economic Data at**  
411 **ADA-Level to FSA-Level.** This figure denotes the methodology employed to associate socio-economic  
412 data at the ADA-level with the crowdfunding data collected at the FSA-level.

413 **Figure 2: Sample Interaction Sequence to Support Adding Context to Campaign Markers in the**  
414 **Interactive Web Mapping Tool.** This figure provides a set of sample instructions to users of the CHRP  
415 web map to better understand the datasets displayed.

416 **Figure 3: Screen Capture of Web Map Application (Main Page).** This figure shows the home page of  
417 the CHRP. The data shown in this figure denotes the locations of all crowdfunding campaigns involved  
418 with this study. Basic information associated with each of the campaigns can be viewed here.

419 **Figure 4: Screen Capture of Web Map Application (with the Exploratory layer of Frequency**  
420 **Counts of Campaigns per FSA Displayed).** This figure shows the CHRP displaying one of its  
421 exploratory layers. The variable of interest here is number of crowdfunding campaigns per forward  
422 sortation area.

423 **Figure 5: Screen Capture of Web Map Application (with the Exploratory layer of Income (Median,**  
424 **After-Tax, 2015) Displayed).** This figure shows the CHRP displaying one of its exploratory layers. The  
425 variable of interest here is income (median, after-tax, 2015). The income data was obtained from the 2016  
426 Canadian Census at the ADA-level.

427 **Figure 6: Screen Capture of Web Map Application (with Exploratory layer of Education (Number**  
428 **of People with a Post-Secondary Education) Displayed).** This figure shows the CHRP displaying one  
429 of its exploratory layers. The variable of interest here is education (number of individuals that identify as  
430 having post-secondary education). The education data was obtained from the 2016 Canadian Census at  
431 the ADA-level.

432 **Figure 7: Screen Capture of Web Map Application (with the Exploratory layer of Housing**  
433 **(Number of People that own homes) Displayed).** This figure shows the CHRP displaying one of its  
434 exploratory layers. The dataset of interest here is housing (number of individuals that own homes). The  
435 housing data was obtained from the 2016 Canadian Census at the ADA-level.

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7 Algorithm GenerateWeights(ADA dataset, FSA dataset)
8 begin
9   a = Number of FSA, b = Number of ADA
10  Initialize relationship matrix of size a rows by b columns
11  For each i ∈ {FSA1...FSAa):
12    Select all from ADA that intersect with FSAi
13    For each j ∈ {intersecting ADA retrieved in selection}:
14      Calculate percent area that ADAj occupies in FSAi
15      Add weight to matrix at the position corresponding with the respective FSA
16      and ADA IDs.
17    Store relationship matrix as CSV for reuse
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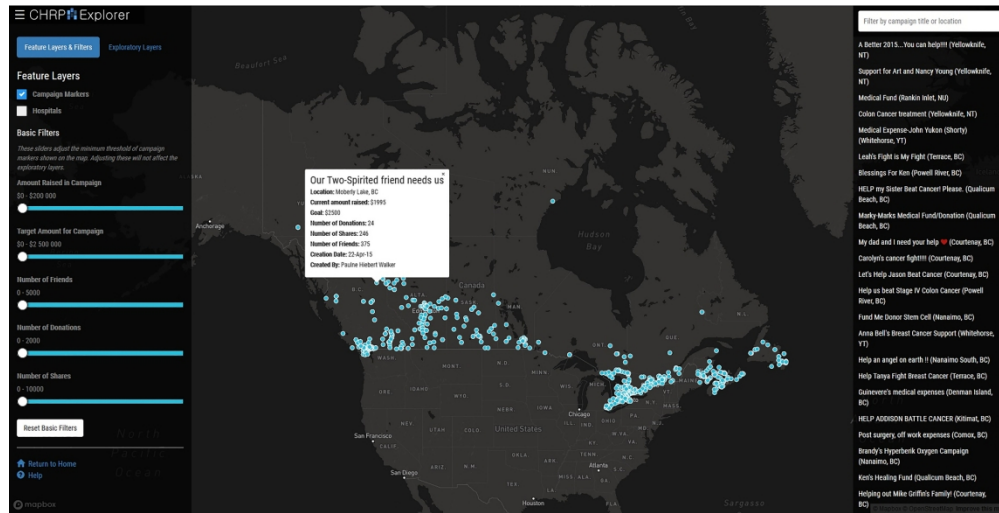
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The User:

1. Views the "CHRP Explorer" web mapping application
2. Clicks and drags the map to populate the campaign list sidebar
3. Clicks on campaign markers or hovers over sidebar listings to learn more about individual Canadian medical crowdfunding campaigns
4. Uses the basic filters slider to filter campaigns to have at least \$10,000 raised, more than 300 friends, and at least 100 donations
5. Clicks the "Exploratory" tab to change the panel contents
6. Selects "Income" under the "Campaign - Socioeconomic Variable Comparison Layers by Forward sortation area" section
7. Zooms into a geographic area of interest and clicks on a coloured area to view the median income average for that FSA the campaign is associated with

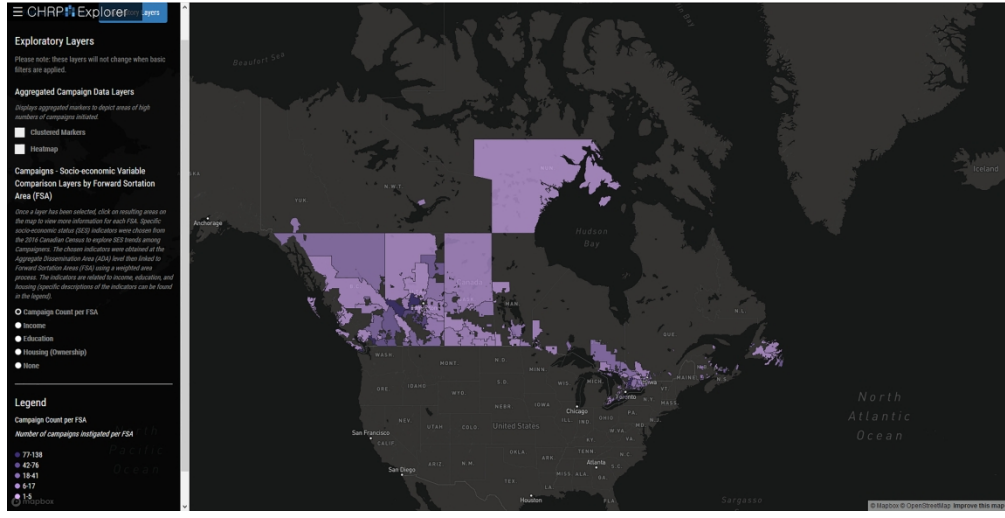
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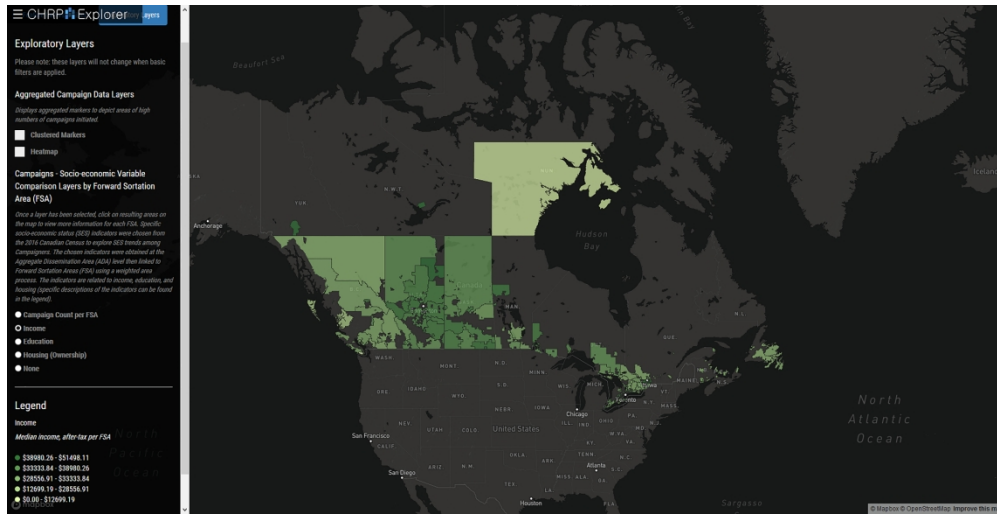
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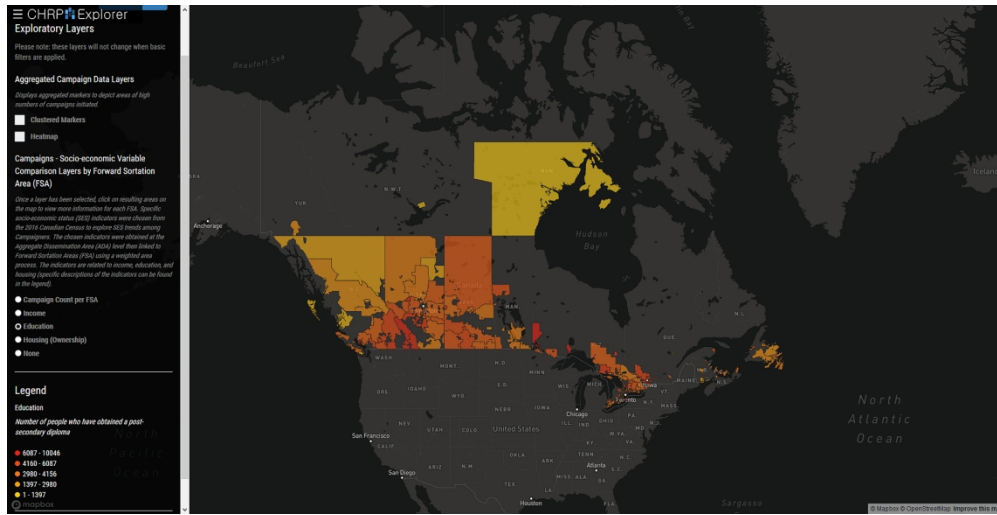


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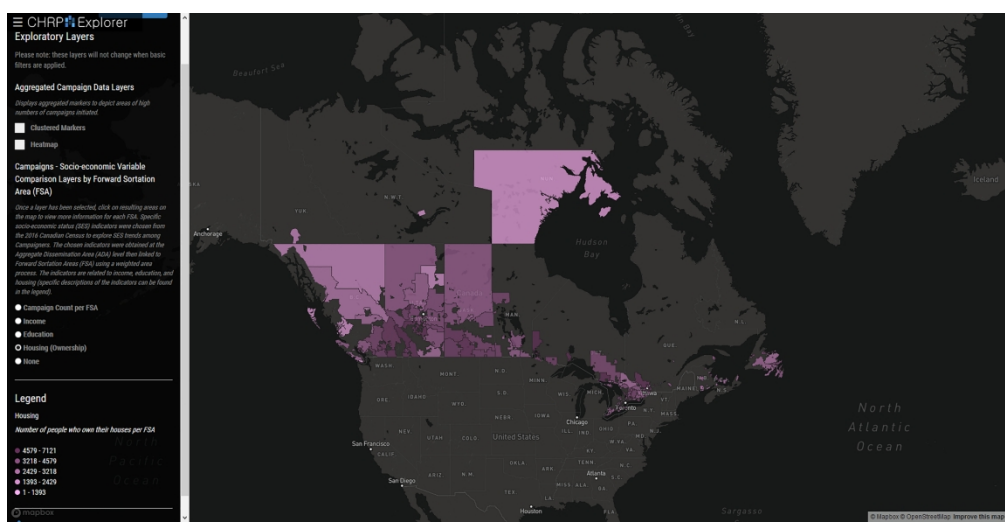
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## Standards for Reporting Qualitative Research (SRQR)\*

<http://www.equator-network.org/reporting-guidelines/srqr/>

Page/line no(s).

### Title and abstract

<p><b>Title</b> - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended</p>	p. 1
<p><b>Abstract</b> - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions</p>	p. 2

### Introduction

<p><b>Problem formulation</b> - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement</p>	p. 4
<p><b>Purpose or research question</b> - Purpose of the study and specific objectives or questions</p>	p. 4

### Methods

<p><b>Qualitative approach and research paradigm</b> - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**</p>	pp. 5-7
<p><b>Researcher characteristics and reflexivity</b> - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability</p>	N/A
<p><b>Context</b> - Setting/site and salient contextual factors; rationale**</p>	pp. 5-7
<p><b>Sampling strategy</b> - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**</p>	pp. 5-7
<p><b>Ethical issues pertaining to human subjects</b> - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues</p>	N/A
<p><b>Data collection methods</b> - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**</p>	pp. 5-7

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2		
3	<b>Data collection instruments and technologies</b> - Description of instruments (e.g.,	
4	interview guides, questionnaires) and devices (e.g., audio recorders) used for data	
5	collection; if/how the instrument(s) changed over the course of the study	pp. 5-7
6		
7	<b>Units of study</b> - Number and relevant characteristics of participants, documents,	
8	or events included in the study; level of participation (could be reported in results)	pp. 5-7
9		
10	<b>Data processing</b> - Methods for processing data prior to and during analysis,	
11	including transcription, data entry, data management and security, verification of	
12	data integrity, data coding, and anonymization/de-identification of excerpts	Pp. 5-7
13		
14	<b>Data analysis</b> - Process by which inferences, themes, etc., were identified and	
15	developed, including the researchers involved in data analysis; usually references a	
16	specific paradigm or approach; rationale**	Pp. 5-7
17		
18	<b>Techniques to enhance trustworthiness</b> - Techniques to enhance trustworthiness	
19	and credibility of data analysis (e.g., member checking, audit trail, triangulation);	
20	rationale**	Pp. 5-7

## Results/findings

23	<b>Synthesis and interpretation</b> - Main findings (e.g., interpretations, inferences, and	
24	themes); might include development of a theory or model, or integration with	
25	prior research or theory	pp. 7-9
26		
27	<b>Links to empirical data</b> - Evidence (e.g., quotes, field notes, text excerpts,	
28	photographs) to substantiate analytic findings	pp. 7-9

## Discussion

32	<b>Integration with prior work, implications, transferability, and contribution(s) to</b>	
33	<b>the field</b> - Short summary of main findings; explanation of how findings and	
34	conclusions connect to, support, elaborate on, or challenge conclusions of earlier	
35	scholarship; discussion of scope of application/generalizability; identification of	
36	unique contribution(s) to scholarship in a discipline or field	pp. 9-10
37		
38	<b>Limitations</b> - Trustworthiness and limitations of findings	pp. 10-11

## Other

42	<b>Conflicts of interest</b> - Potential sources of influence or perceived influence on	
43	study conduct and conclusions; how these were managed	p. 12
44		
45	<b>Funding</b> - Sources of funding and other support; role of funders in data collection,	
46	interpretation, and reporting	p. 13

\*The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

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\*\*The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

**Reference:**

O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. **Standards for reporting qualitative research: a synthesis of recommendations.** *Academic Medicine*, Vol. 89, No. 9 / Sept 2014  
DOI: 10.1097/ACM.0000000000000388

For peer review only

# BMJ Open

## Spatially Exploring the Intersection of Socio-Economic Status and Canadian Cancer-Related Medical Crowdfunding Campaigns

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-026365.R1
Article Type:	Research
Date Submitted by the Author:	09-Mar-2019
Complete List of Authors:	van Duynhoven , Alysha; Simon Fraser University Lee, Anthony; Simon Fraser University Michel , Ross; Simon Fraser University Snyder, Jeremy; Simon Fraser University Crooks, Valorie; Simon Fraser University Chow-White, Peter; Simon Fraser University Schuurman, Nadine; Simon Fraser University
<b>Primary Subject Heading</b>:	Health services research
Secondary Subject Heading:	Ethics, Health policy
Keywords:	Crowdfunding, Equity, Spatial Analysis

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Manuscripts

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1 **Spatially Exploring the Intersection of Socio-Economic Status and Canadian Cancer-Related**  
2 **Medical Crowdfunding Campaigns**

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15 Keywords: Crowdfunding; Equity; Cancer; Spatial Analysis  
16 Word Count: 2947



## 29 Abstract

30 **Objectives:** Medical crowdfunding is a rapidly growing practice where individuals leverage social  
31 networks to raise money for health-related needs. This practice has allowed many to access health care  
32 and avoid medical debt but has also raised a number of ethical concerns. A dominant criticism of this  
33 practice is that it is likely to increase inequities in access to healthcare if persons from relatively wealthy  
34 backgrounds, media connections, tech savvy, and educational attainments are best positioned to use and  
35 succeed with crowdfunding. However, limited data has been published to support this claim. Our  
36 objective in this paper is to assess this concern using socio-economic data and information from  
37 crowdfunding campaigns.

38 **Setting:** To assess this concern, we present an exploratory spatial analysis of a new dataset of  
39 crowdfunding campaigns for cancer-related care by Canadian residents.

40 **Participants:** Four datasets were used: 1) a medical crowdfunding dataset that included cancer-related  
41 campaigns posted by Canadians; 2) 2016 Census Profile for aggregate dissemination areas; 3) aggregate  
42 dissemination area boundaries; and 4) forward sortation area boundaries.

43 **Results:** Our exploratory spatial analysis demonstrates that use of crowdfunding for cancer-related needs  
44 in Canada corresponds with high income, home ownership, and high educational attainment. Campaigns  
45 were also commonly located near city centres.

46 **Conclusions:** These findings support concerns that those in positions of relative socio-economic privilege  
47 disproportionately utilize crowdfunding to address health-related needs. This study was not able to  
48 determine whether other socio-economic dimensions such as race, gender, ethnicity, nationality, and  
49 linguistic fluency are also correlated with use of medical crowdfunding. Thus, we call for further research  
50 to explore the relationship between socio-economic variables and medical crowdfunding campaigning to  
51 explore these other socio-economic variables and campaigns for needs unrelated to cancer.

## 53 Strengths and Limitations of this Study

54 Developed large dataset of crowdfunding data

55 Presents methods for analyzing datasets of crowdfunding campaign information

56 Links data on crowdfunding campaigns to data on income, home ownership, and education levels

57 Unable to determine whether race, gender, ethnicity, nationality, or linguistic fluency impact use of  
58 crowdfunding

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## 65 Introduction

66 Individuals and groups have increasingly turned to online social networking and social media platforms to  
67 fundraise. This practice has come to be popularly known as crowdfunding. In particular, charitable  
68 crowdfunding, as opposed to entrepreneurial fundraising intended to raise money for businesses, has  
69 developed as a means for individuals or small groups to finance their personal needs. These platforms  
70 host campaigns, including text, images, and video, facilitate outreach to potential donors via social media,  
71 and process donations.

72 The crowdfunding platform GoFundMe dominates the charitable crowdfunding sector. Before it  
73 recently acquired YouCaring, the second largest social crowdfunding platform, it controlled 90% of the  
74 charitable crowdfunding business in the United States (US) and 80% globally [1,2]. Launched in 2010,  
75 US\$ 5 billion has been raised via GoFundMe to date and this platform supports a community consisting  
76 of more than 50 million donors and users [1]. Campaigns for health-related purposes comprise the largest  
77 proportion of fundraisers hosted by GoFundMe [2,3]. These medical crowdfunding campaigns are  
78 thought to be used to pay for essential services for those lacking comprehensive medical insurance,  
79 elective procedures not covered by insurance, and unproven or experimental medical treatments. They are  
80 also used to pay for indirect needs related to receiving medical care, including travel to receive care,  
81 compensation for time off from work, and payments for medical equipment [3]. The use of crowdfunding  
82 platforms for medical purposes is expected to continue to grow and thus have a substantial impact on how  
83 individuals access health-related care [3,4].

84 Successful medical crowdfunders can benefit greatly from being better able to obtain health-  
85 related support via crowdfunding. However, this practice has also been the target of considerable  
86 criticism. These concerns include worries about fraudulent campaigns, loss of medical privacy, and  
87 encouraging the privatization of healthcare [3,4]. Arguably the most common and serious critique of  
88 medical crowdfunding is that it will exacerbate existing inequities in who is ultimately able to  
89 (financially) access health care. While differential access to health care is shaped by each community's

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3 90 health and social care system, insurance coverage, and demographics, in general those in positions of  
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5 91 socio-economic privilege, even in universal health systems, have relatively better access to health-related  
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7 92 care than their less privileged compatriots. Medical crowdfunding could exacerbate this problem, it is  
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9 93 argued, if crowdfunding serves to reward recipients according to their popularity, extent of social  
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11 94 networks, technological capabilities, or media savvy rather than need [5]. For example, Young and  
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13 95 Scheinberg [4 p. 1623] flag the “potential for unfairly advantaging those with the means to engage with  
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15 96 online tools and tap into large social networks, which may lead to an underrepresentation of cases with  
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17 97 the greatest need in which patients lack the tools to coordinate effective crowdfunding campaigns.”  
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19 98 Similarly, critics express that medical crowdfunding is likely to reinforce existing inequalities in class and  
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21 99 power [6] and reward those with social connections to wealthy persons, media connections, and the  
22  
23 100 educational attainments needed to communicate effectively online [7]. Others note that placing the  
24  
25 101 distribution of medical funds in the hands of private crowdfunding platforms has problematic effects, as  
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27 102 when these companies prohibit fundraisers for certain services and procedures such as abortion or  
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29 103 promote and donate to specific fundraisers (as in the case of the parents of Charlie Gard fundraising for an  
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31 104 unproven medical treatment) [8,9,10].

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35 105 Empirical support for the criticism that medical crowdfunding mostly benefits those who are  
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37 106 socio-economically advantaged is thus far limited. Lukk, Schneiderhan, and Soares reviewed 319  
38  
39 107 crowdfunding campaigns by Canadians for services related to education and healthcare [11]. They found  
40  
41 108 that older and visible minority Canadians were relatively less successful in these campaigns. Berliner and  
42  
43 109 Kenworthy examined 200 medical crowdfunding campaigns and found correlations between success in  
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45 110 meeting medical crowdfunding goals and the inclusion of photos and videos, campaign updates, and  
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47 111 interactions including comments, social media shares, and ‘liking’ a campaign [12]. A review of 850  
48  
49 112 campaigns for services related to organ transplantation found that campaigns with positive emotional  
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51 113 sentiment tend to be relatively successful [13]. An analysis of 410 crowdfunding campaigns for medical  
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53 114 transition and gender affirming surgeries and treatments demonstrated that campaigners that are young,

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3 115 white, and transgender men raise more than others in this area but that campaigns for medical transition  
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5 116 perform less well than medical crowdfunding campaigns generally [14].  
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7 117 Here we present an exploratory analysis of a new dataset of crowdfunding campaigns for cancer-  
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9 118 related care by Canadian residents that is connected to a selection of demographic information from the  
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11 119 2016 Canadian Census to explore the relationship between campaign use and socio-economic status. We  
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13 120 captured this medical crowdfunding dataset using an automated data crawling program and machine  
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15 121 learning techniques. We specifically examine crowdfunding campaigns for cancer-related care as existing  
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17 122 research has already documented the commonality of such campaigns in Canada [15,16,17], and we  
18  
19 123 contrast these campaigns against geo-demographic trends using an exploratory spatial data analysis  
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21 124 (ESDA) approach. ESDA facilitates the investigation of prior assumptions and guides the identification of  
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23 125 spatial patterns [18,19]. We use these patterns to raise important new research questions about medical  
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25 126 crowdfunding in the discussion.  
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## 29 127 **Materials and Methods**

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31 128 We utilized four datasets in this exploratory analysis: 1) a medical crowdfunding dataset that included  
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33 129 cancer-related campaigns posted by Canadians; 2) 2016 Census Profile for aggregate dissemination areas;  
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35 130 3) aggregate dissemination area boundaries; and 4) forward sortation area boundaries. In consultation  
36  
37 131 with the Simon Fraser University Research Ethics Board we determined that ethics approval was not  
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39 132 required for this project under locally relevant Tri-Council policy (article 2.2) as the data being collected  
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41 133 and used was publicly accessible with no reasonable expectation of privacy given the nature of  
42  
43 134 crowdfunding as an activity [20]. While not required by local research ethics regulations, we have chosen  
44  
45 135 not to publish any identifiable details from the scraped campaigns in the interest of the privacy of  
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47 136 campaign recipients.  
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50  
51 137 We compiled a medical crowdfunding dataset by creating an automated web crawling algorithm.  
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53 138 To do this we developed a Python based automated web crawler that scraped the GoFundMe platform  
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55 139 looking for key words or strings of words – in this case, the keyword ‘cancer’ – and postal codes  
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3 140 identifying campaigns as originating within Canada. The search took place on June 11, 2006. Any  
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5 141 ambiguous posts were read by the researchers to determine if they fit the classification and  
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7 142 should be included. After relevant campaigns were identified, we used a SQL database server to store  
8  
9 143 the site in HTML form for further analysis. Once the full HTML files from each campaign were retrieved,  
10  
11 144 the pages were then parsed to remove HTML tags. Further cleaning and labeling took place using a  
12  
13 145 machine learning algorithm designed to find and include any missing information or attributes of the  
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15 146 campaigns related to cancer. From this process campaigns not listed in the ‘medical’ category were  
16  
17 147 excluded. The final records were stored in a Redis database for access by simple query for analysis. The  
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19 148 dataset used in this study contains 1788 records from May 2012 to June 2016 pertaining to cancer-related  
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21 149 campaigns created by Canadians.  
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25 150 Aggregate dissemination areas (ADAs) are a new census product released by Statistics Canada as  
26  
27 151 part of the 2016 Canadian Census. Delineation of ADAs considers boundaries of previous census  
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29 152 products, including existing census divisions, census metropolitan areas, and census tracts [21]. Forward  
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31 153 sortation areas (FSAs) are administrative boundaries determined by Canada Post [22]. They are  
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33 154 alphanumerically represented by “the first three characters in a Canadian postal code” [22]. The records  
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35 155 contained in our crowdfunding dataset described above have an FSA attribute. This geographic data unit  
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37 156 enables ESDA. Boundaries of ADAs and FSAs were obtained from Statistics Canada [23].  
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40 157 Socio-economic status and its correlation with an individual's health or ability to obtain  
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42 158 treatments have been previously assessed at a FSA level [24,25,26], which is why we opted to explore  
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44 159 socio-economic status indicators. Variables related to income, education, and housing were chosen and  
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46 160 obtained using the University of Toronto’s Canadian Census Analyser at the ADA level (see Table 1 for  
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48 161 exact variables obtained) [27]. Further data pre-processing and transformations were required in order to  
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50 162 link socio-economic data to FSAs due to current data limitations.  
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55 164 \*\* insert Table 1 here \*\*  
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5 166 Profile and boundary datasets for FSAs are unavailable for the Statistics Canada 2016 Census  
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7 167 data. In lieu of the FSAs, we computed the weighted average of socio-economic variables based on the  
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9 168 percent of spatial overlap between ADAs and FSAs. To prepare for this conversion, ADAs were spatially  
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11 169 joined with data retrieved from the 2016 Census Profile. Each FSA is also joined with respective  
12  
13 170 campaign frequencies (see Figure 1 for the high-level description of conversion procedure utilized to add  
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15 171 socio-economic data at ADA-level to FSA-level). Once the relationship matrix was generated from the  
16  
17 172 function `GenerateWeights`, it was then retrieved and used to calculate weighted averages of socio-  
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19 173 economic variables contained in each intersecting ADA. These weighted socio-economic variables were  
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21 174 appended to each respective FSA.  
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25 175 \*\* insert Figure 1 here \*\*  
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30 177 Using ArcMap from the ArcGIS suite (version 10.5), quintiles were created using natural breaks.  
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32 178 The data were categorized as quintiles as we trusted that five classes would be sufficient to showcase  
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34 179 meaningful differences while minimizing complexity of visual results. These quintiles were used in  
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36 180 cartographic representations to support ESDA tasks. Visual comparisons at regional and provincial levels  
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38 181 were then conducted with regards to income, education, and housing ownership. The creation of these  
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40 182 quintiles allowed project correspondents to examine the data for geographic trends. These cartographic  
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42 183 products enabled the significance of these socio-economic variables to be gauged for medical  
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44 184 crowdfunding.  
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47 185 Campaigns for each FSA were counted, and these frequencies were assigned to their respective  
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49 186 boundaries. These FSAs were subsequently linked with ADAs that feature census variables from the 2016  
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51 187 Canadian Census. These variables consisted of income, number of persons who have completed post-  
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53 188 secondary education, and home ownership. These linkages were informed by research conducted by  
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55 189 Rogers [28] in which these variables were shown to be commonly associated with vulnerability with  
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3 190 regard to health and healthcare. To link these datasets, the variables were weighted based on the percent  
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5 191 of areal overlap each ADA shares with each FSA. The resulting weighted attributes were then divided  
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7 192 into quintiles using a method similar to Sothorn et al. [29]. Resulting quintiles were then visualized in an  
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9 193 interactive cartographic display, or web map, enabling geographic comparisons to be made. This map can  
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11 194 be viewed at: <https://www.crowdfundingforhealth.org/chrpexplorer>. Figure 2 describes the process for  
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13 195 users of CHRP to explore the ESDA results. Figure 3 shows an image of the web map interface.

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15  
16 196 \*\* insert Figure 2 here \*\*  
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18 197  
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20 198 \*\* insert Figure 3 here \*\*  
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#### 22 199 23 24 200 *Patient and Public Involvement*

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26 201 As the information analyzed in this study was publicly available, patients were not recruited for or  
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28 202 actively involved in this study.  
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#### 30 203 31 32 33 204 **Results**

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35 205 Our exploratory analysis utilizes socio-economic variables that have been linked with FSAs. These  
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37 206 include a layer of campaign counts per FSA, income, education, and housing (see Figures 4, 5, 6, & 7 for  
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39 207 screen captures).

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41 208 \*\* insert Figure 4 here \*\*  
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43 209 \*\* insert Figure 5 here \*\*  
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45 210 \*\* insert Figure 6 here \*\*  
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47 211 \*\* insert Figure 7 here \*\*  
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52 213 In addition to the web map, a table was generated that showed the proportion of crowdfunding campaigns  
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54 214 that belong in each quintile for each socio-economic variable (see Tables 2, 3, 4, & 5).  
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\*\* insert Table 2 here \*\*

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It is important to note that only 176 FSAs out of the 1620 FSAs in Canada contained at least one

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crowdfunding campaign, with the population of these FSAs representing approximately 5% of the

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national total. A separate table shows the distribution of the crowdfunding campaigns between each

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Canadian province and territory and the average value of each socio-economic variable within each

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administrative division (see Table 6).

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\*\* insert Table 6 here \*\*

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The average income of crowdfunding campaigners in this dataset is within middle to high level

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FSAs, with 65.49% of campaigns being located in FSAs within the three highest quintiles in the income

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category (see Table 3). These higher income levels are matched by higher rates of home ownership

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among these campaigners, with housing ownership values being larger in the middle quintile (see Table

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5). This group also tends to be well educated, with education values tending toward the higher quintiles

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(see Table 4).

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Collectively, our ESDA shows that use of cancer-related medical crowdfunding is occurring

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unevenly across the country relative to population distribution. For example, Canadians' cancer-related

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crowdfunding campaigns were also commonly located in close proximity to city centres (see Figure 3).

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Provincial differences in campaign use also exist. Campaigns were more commonly posted in the

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provinces of Ontario and British Columbia and less so in the Atlantic provinces. There is a noticeable

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density of campaigns in the prairie provinces of Alberta and Saskatchewan.



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5 242 **Discussion**

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7 243 Our ESDA-based findings support existing concerns that persons in positions of relative socio-economic  
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9 244 privilege disproportionately utilize crowdfunding to address health-related needs – in this case care  
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11 245 related to cancer. Individuals in the highest income FSAs were found to be the heaviest users of medical  
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13 246 crowdfunding for cancer-related campaigns, as were individuals in FSAs with high rates of home  
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15 247 ownership. These ESDA-based interpretations support the idea that wealthier individuals are more likely  
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17 248 to see crowdfunding as a way to draw together financial resources from elsewhere to meet their health  
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19 249 needs. We also observed that individuals in FSAs with higher rates of education turned more frequently to  
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21 250 medical crowdfunding. This ESDA-based interpretation supports existing claims that individuals who are  
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23 251 better educated, more familiar with online technologies, and better able to express themselves online are  
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25 252 more likely to take advantage of crowdfunding to address health-related needs. The positive correlation  
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27 253 between the amount raised in a campaign and number of times the campaign was shared supports the  
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29 254 speculation that social capital and tech-savviness are important constituents of crowdfunding campaign  
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31 255 success.

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35 256 Our exploration of geo-demographic trends regarding Canadians' use of cancer-related  
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37 257 crowdfunding shows that this is a highly urban phenomenon. This is somewhat counterintuitive  
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39 258 considering the extensive health service gaps in rural Canadian communities that drive some residents to  
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41 259 consider alternative ways to access necessary care [30], such as crowdfunding for the costs of private  
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43 260 treatment or to relocate to an urban centre. Research regarding a potential urban-rural divide in  
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45 261 crowdfunding use is very limited and so it is difficult to know why there can be proportionately less use  
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47 262 in rural areas. This may be due to limited access to technology or lower levels of education in rural  
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49 263 Canadian communities [31,32]. Alternatively, it may be due to the strong voluntary and informal care  
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51 264 sectors that 'tight-knit' rural communities are so well known for that would lead to residents pulling  
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53 265 together to support those in need [30,33], which would lessen the need for drawing on disparate social  
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55 266 networks via crowdfunding. It is important to note, however, that our ESDA approach means that we

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3 267 cannot conclusively state that our analysis documents a clear urban-rural divide. This is due in part to the  
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5 268 large aggregations of FSAs as well as the sparse population of Nunavut that can both over- and under-  
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7 269 estimate socio-economic variables. We thus flag this as an important issue for future medical  
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9 270 crowdfunding research. Furthermore, factors distinctive to the Canadian cultural, geographic, and  
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11 271 healthcare context may mean that these specific results are not applicable elsewhere. These factors  
12  
13 272 include widespread access to basic cancer care through the Canadian single payer health system, cultural  
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15 273 differences in charitable giving, and the geographically disparate nature of Canadian communities. These  
16  
17 274 differences may be less acute in European communities with greater access to public health insurance and  
18  
19 275 greater in the US and other countries with more limited public provision of care but requires additional  
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21 276 investigation in other settings.  
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24 277 While our interpretations of the ESDA results support the general concern that medical  
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26 278 crowdfunding will tend to exacerbate socio-economic inequities in access to health-related care, only  
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28 279 certain dimensions of this critique were explored here. For example, while we found positive correlations  
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30 280 between cancer-related crowdfunding and wealth and education levels, we were not able to explore  
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32 281 whether other dimensions of socio-economic privilege are positively correlated. These dimensions  
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34 282 include race, gender, ethnicity, nationality, and linguistic fluency, all of which are factors that lead to  
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36 283 inequities in health status [34,35]. This leads us to make three important points. First, we acknowledge  
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38 284 that it is possible that only certain dimensions of socio-economic privilege correlate with using  
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40 285 crowdfunding to address health-related needs, and that some or all of those not explored here do not shape  
41  
42 286 medical crowdfunding use in the ways documented here. Second, and because of this, it is important to  
43  
44 287 explicitly state that this exploratory analysis supports the hypothesis of a more general correlation but  
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46 288 does not provide direct evidence supporting every dimension of this correlation. And third, we call for  
47  
48 289 further research to explore the relationship between socio-economic variables and medical crowdfunding  
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50 290 use in general or for cancer-related campaigns in order to assist with developing a more robust  
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52 291 understanding of any interrelationships.  
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56 292 *Limitations*  
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3 293 Only the first three digits of postal codes were included in the dataset of crowdfunding campaigns, which  
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5 294 were then linked to FSAs. FSAs are smaller in urban areas and may be geographically vast in rural areas.  
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7 295 Linking ADAs to FSAs could result in broad generalizations and aggregation errors and lead to ecological  
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9 296 fallacies. This implies that findings from our study are limited, as only broad claims can be stated. The  
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11 297 aforementioned generalizations could be less impacted in urban areas with smaller FSAs comparatively to  
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13 298 rural areas. While this has implications for our results, the impact may be reduced considering that as of  
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15 299 2011, over 80% of Canada's population lives in urban environments [36].

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18 300 We acknowledge that a medical crowdfunding campaign recipient may be different from  
19  
20 301 campaign's creator. This necessitates further research with regard to the issues explored in this analysis  
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22 302 because campaigners may reside in or report different FSAs than the individual or family in need of  
23  
24 303 financial assistance. Further to this, postal codes are self-reported by campaign creators, which allows  
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26 304 typos and mistakes to be made. Nothing can be done to address this as a limitation beyond acknowledging  
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28 305 our awareness of the potential for errors to exist in postal code reporting. Campaigners may also have  
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30 306 moved to an urban centre in order to access care, thus introducing an urban bias into our sample.

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33 307 FSAs encoded in the campaign entries dictated the primary level of aggregation for our study,  
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35 308 thus necessitating us to limit selection of socio-economic variables. If spatial and non-spatial attributes  
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37 309 were improved, more socio-economic status variables could be involved, such as sex or immigration  
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39 310 status. This would aid in obtaining more robust results. Another limitation encountered was the fact that  
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41 311 the census profiles at the FSA-level were unavailable due to accuracy issues (Statistics Canada, 2018)  
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43 312 [37]. To substitute, a methodology to link and weight the chosen socio-economic variables from the  
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45 313 ADA-level to FSA-level had to be developed.

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49 314 As our dataset was acquired for a snapshot in time, we acknowledge that campaigns have been  
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51 315 instantiated at different times and have been underway for varying durations. These comparisons may  
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53 316 impact results because the campaign duration captured in the current dataset may not be representative of  
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55 317 the overall success of the campaign. For example, less successful campaigns may be deleted more quickly

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3 318 than more successful campaigns, more successful campaigns may not be removed at all, or less  
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5 319 technologically adept individuals may not think to delete completed campaigns. Future work may look to  
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7 320 compare individual campaigns that have either been run for the same length of time or have completed  
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9 321 their respective lifecycles on major crowdfunding platforms.  
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### 13 14 15 323 **Conclusions**

16  
17 324 The findings reported here support concerns that charitable crowdfunding will tend to advantage  
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19 325 relatively socio-economically privileged individuals. While supporters of medical crowdfunding point to  
20  
21 326 its potential to help people access necessary health care and avoid debt or even medical bankruptcy, this  
22  
23 327 paper demonstrates that this potential is not distributed equitably across society. While these findings do  
24  
25 328 not eliminate the advantages of medical crowdfunding, they show its limits in serving as a systematic and  
26  
27 329 fair solution to structural deficiencies in health systems. Additional research, including using the methods  
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29 330 described here, would help to demonstrate whether these findings are reproduced for other socio-  
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31 331 economic factors, in countries other than Canada, and for health needs beyond cancer.  
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### 36 37 38 333 **Contributorship Statement**

39  
40  
41 334 AvD, AL, and RM contributed to developing the methods, conducting the analysis, and writing  
42  
43 335 the manuscript. JS and VAC contributed to method design, securing project funding, and writing  
44  
45 336 the manuscript. PCW contributed to data acquisition and writing the manuscript. NS contributed  
46  
47 337 to method design and writing the manuscript.  
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### 52 53 54 339 **Competing Interests**

1  
2  
3 340 We declare no competing interests.  
4  
5

6 341

## 7 8 9 342 **Funding**

10  
11 343 This study was funded by the Canadian Institutes of Health Research. VAC holds the Canada Research

12  
13 344 Chair in Health Services Geographies and a Scholar Award from the Michael Smith Foundation for

14  
15 345 Health Research.  
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## 20 21 347 **Data Sharing Statement**

22  
23 348 All crowdfunding data is available from the authors on request.  
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435 **Tables**

Variable	Data Obtained
<b>Population and dwelling counts</b>	Population, 2016
<b>Income</b> (Total Sex / Total)	Income statistics in 2015 for the population aged 15 years and over in private households - 100% data / Number of after-tax income recipients aged 15 years and over in private households - 100% data / Median after-tax income in 2015 among recipients (\$)
<b>Education</b> (Total Sex / Total)	Highest certificate, diploma or degree for the population aged 15 years and over in private households - 25% sample data / Postsecondary certificate, diploma or degree
<b>Housing</b> (Total Sex / Total)	Private households by tenure - 25% sample data / Owner

436 **Table 1. Variables Obtained from 2016 Census Profiles for Aggregate Dissemination Areas.**

437 Retrieved from the Canadian Census Analyser, University of Toronto

438

Income Quintile	Number of FSA	Percentage (FSA)	Number of Campaigns	Percentage (Campaigns)
1 - 5	114	64.77%	247	13.81%
6 - 17	36	20.45%	337	18.85%
18 - 41	16	9.09%	402	22.48%
42 - 76	6	3.41%	362	20.25%
77 - 138	4	2.27%	440	24.61%
<b>Total</b>	176	100.00%	1788	100.00%

439 **Table 2. Frequency of Campaigns per FSA. Proportion of Campaigns belonging to each Quintile.**

440

Income Quintile	Number of FSA	Percentage (FSA)	Number of Campaigns	Percentage (Campaigns)
\$0.00 - \$12699.19	3	1.70%	104	5.82%
\$12699.19 - \$28556.91	54	30.68%	513	28.69%
\$28556.91 - \$33333.84	63	35.80%	449	25.11%
\$33333.84 - \$38980.26	45	25.57%	593	33.17%
\$38980.26 - \$51498.11	11	6.25%	129	7.21%
<b>Total</b>	176	100.00%	1788	100.00%

441 **Table 3. Income, Median After-Tax (2015). Proportion of Campaigns belonging to each Quintile.**



442

Income Quintile	Number of FSA	Percentage (FSA)	Number of Campaigns	Percentage (Campaigns)
1 - 1397	12	6.82%	159	8.89%
1397 - 2980	41	23.30%	308	17.23%
2980 - 4156	72	40.91%	755	42.23%
4156 - 6087	46	26.14%	524	29.31%
6087 - 10046	5	2.84%	42	2.35%
<b>Total</b>	176	100.00%	1788	100.00%

443 **Table 4. Education, Post-Secondary. Proportion of Campaigns belonging to each Quintile.**

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Income Quintile	Number of FSA	Percentage (FSA)	Number of Campaigns	Percentage (Campaigns)
1 - 1393	17	9.66%	180	10.07%
1393 - 2429	38	21.59%	283	15.83%
2429 - 3218	68	38.64%	711	39.77%
3218 - 4579	48	27.27%	571	31.94%
4579 - 7121	5	2.84%	43	2.40%
<b>Total</b>	176	100.00%	1788	100.00%

445 **Table 5. Housing, Owner. Proportion of Campaigns belonging to each Quintile.**

445

Province/ Territory	Number of FSAs	Number of Campaigns	Percentage (FSA)	Percentage (Campaigns)	Population	Income, Median After-Tax (Average)	Education, Post- Secondary (Average)	Housing, Owner (Average)
Alberta	21	310	11.93%	17.34%	203643	\$36,012.35	3393	2846
British Columbia	32	401	18.18%	22.43%	268112	\$28,716.63	3728	2599
Manitoba	9	66	5.11%	3.69%	83126	\$31,275.32	3211	3032
New Brunswick	12	55	6.82%	3.08%	75339	\$26,745.83	2287	2310
Newfoundland & Labrador	9	53	5.11%	2.96%	69103	\$26,503.28	2868	2809
Northwest Territories	1	3	0.57%	0.17%	823	\$51,498.11	415	228
Nova Scotia	9	69	5.11%	3.86%	73961	\$31,392.79	3908	2425
Nunavut	1	1	0.57%	0.06%	3	\$63.72	0	0
Ontario	47	576	26.70%	32.21%	436637	\$31,865.32	3942	3105
Prince Edward Island	2	25	1.14%	1.40%	15301	\$27,888.67	2984	2582
Quebec	18	139	10.23%	7.77%	158832	\$30,057.44	3923	2675
Saskatchewan	14	85	7.95%	4.75%	138065	\$34,795.72	3613	3194
Yukon	1	5	0.57%	0.28%	16962	\$41,664.80	3278	2599
<b>Total</b>	176	1788	100.00%	100.00%	1539908	\$30,652.31	2889	2339

446 Table 6. Number of Campaigns, Population, and Socio-economic Values per Province.

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3 447 **Figure Legends**  
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5 448 **Figure 1: High-Level Description of Conversion Procedure Utilized to add Socio-Economic Data at**  
6 449 **ADA-Level to FSA-Level.** This figure denotes the methodology employed to associate socio-economic  
7 450 data at the ADA-level with the crowdfunding data collected at the FSA-level.  
8

9 451 **Figure 2: Sample Interaction Sequence to Support Adding Context to Campaign Markers in the**  
10 452 **Interactive Web Mapping Tool.** This figure provides a set of sample instructions to users of the CHRP  
11 453 web map to better understand the datasets displayed.  
12

13 454 **Figure 3: Screen Capture of Web Map Application (Main Page).** This figure shows the home page of  
14 455 the CHRP. The data shown in this figure denotes the locations of all crowdfunding campaigns involved  
15 456 with this study. Basic information associated with each of the campaigns can be viewed here.  
17

18 457 **Figure 4: Screen Capture of Web Map Application (with the Exploratory layer of Frequency**  
19 458 **Counts of Campaigns per FSA Displayed).** This figure shows the CHRP displaying one of its  
20 459 exploratory layers. The variable of interest here is number of crowdfunding campaigns per forward  
21 460 sortation area.  
24

25 461 **Figure 5: Screen Capture of Web Map Application (with the Exploratory layer of Income (Median,**  
26 462 **After-Tax, 2015) Displayed).** This figure shows the CHRP displaying one of its exploratory layers. The  
27 463 variable of interest here is income (median, after-tax, 2015). The income data was obtained from the 2016  
28 464 Canadian Census at the ADA-level.  
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33 465 **Figure 6: Screen Capture of Web Map Application (with Exploratory layer of Education (Number**  
34 466 **of People with a Post-Secondary Education) Displayed).** This figure shows the CHRP displaying one  
35 467 of its exploratory layers. The variable of interest here is education (number of individuals that identify as  
36 468 having post-secondary education). The education data was obtained from the 2016 Canadian Census at  
37 469 the ADA-level.  
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43 470 **Figure 7: Screen Capture of Web Map Application (with the Exploratory layer of Housing**  
44 471 **(Number of People that own homes) Displayed).** This figure shows the CHRP displaying one of its  
45 472 exploratory layers. The dataset of interest here is housing (number of individuals that own homes). The  
46 473 housing data was obtained from the 2016 Canadian Census at the ADA-level.  
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7 Algorithm GenerateWeights(ADA dataset, FSA dataset)
8 begin
9   a = Number of FSA, b = Number of ADA
10  Initialize relationship matrix of size a rows by b columns
11  For each i ∈ {FSA1...FSAa):
12    Select all from ADA that intersect with FSAi
13    For each j ∈ {intersecting ADA retrieved in selection}:
14      Calculate percent area that ADAj occupies in FSAi
15      Add weight to matrix at the position corresponding with the respective FSA
16      and ADA IDs.
17    Store relationship matrix as CSV for reuse
18  end
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The User:

1. Views the "CHRP Explorer" web mapping application
2. Clicks and drags the map to populate the campaign list sidebar
3. Clicks on campaign markers or hovers over sidebar listings to learn more about individual Canadian medical crowdfunding campaigns
4. Uses the basic filters slider to filter campaigns to have at least \$10,000 raised, more than 300 friends, and at least 100 donations
5. Clicks the "Exploratory" tab to change the panel contents
6. Selects "Income" under the "Campaign - Socioeconomic Variable Comparison Layers by Forward sortation area" section
7. Zooms into a geographic area of interest and clicks on a coloured area to view the median income average for that FSA the campaign is associated with

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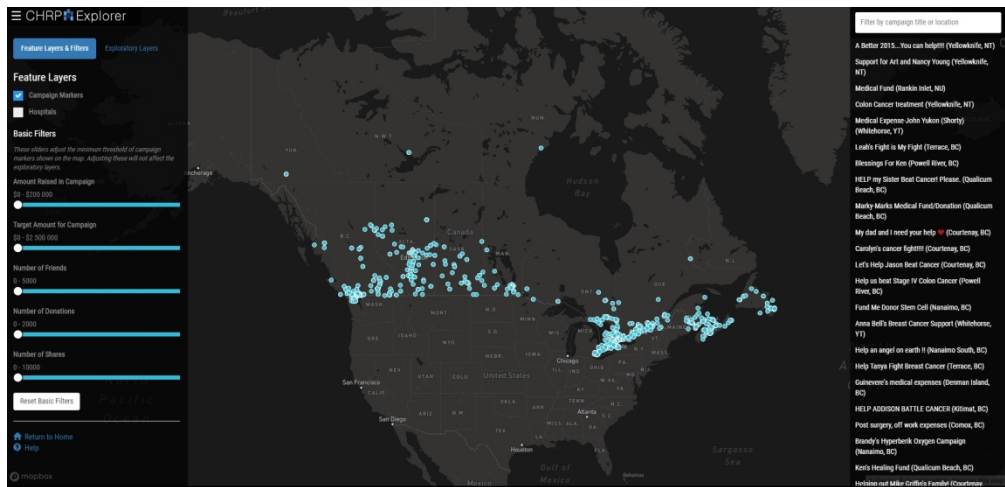


Figure 3

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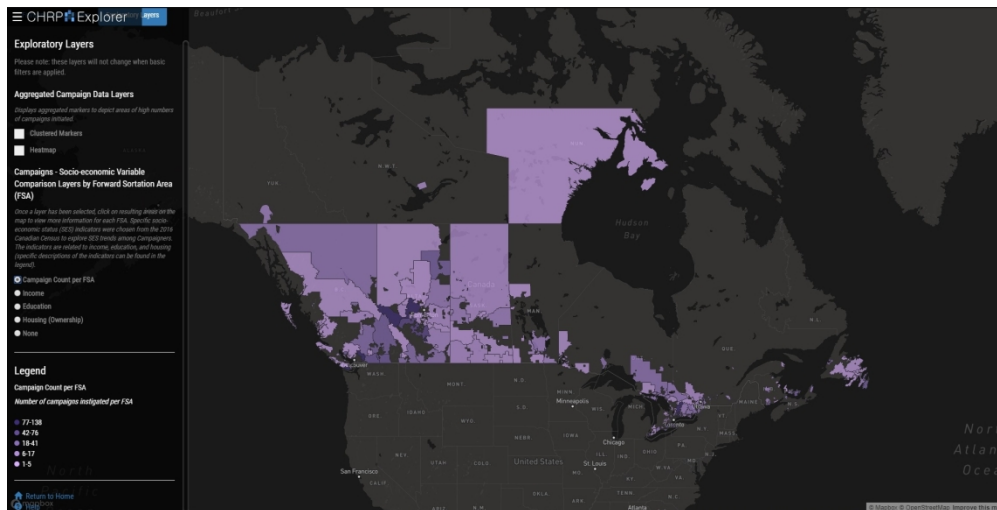


Figure 4

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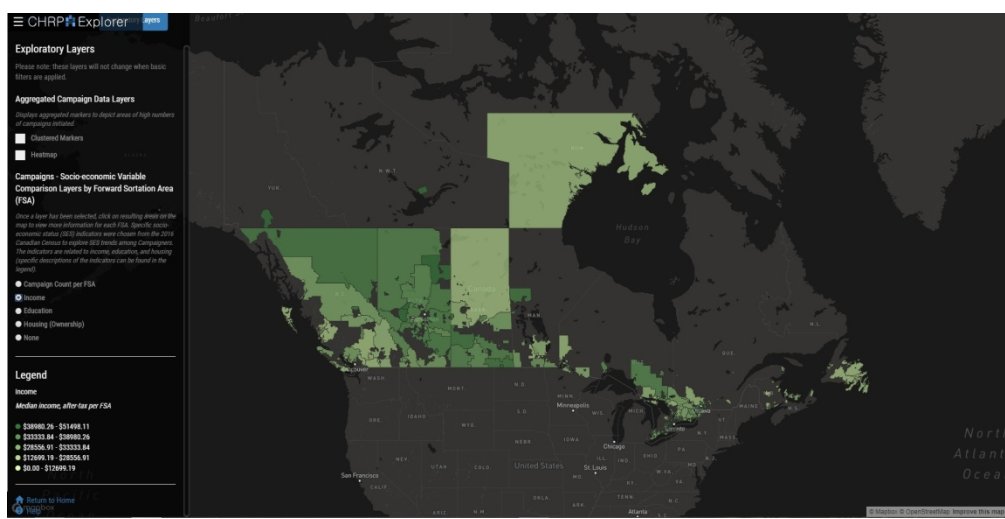


Figure 5

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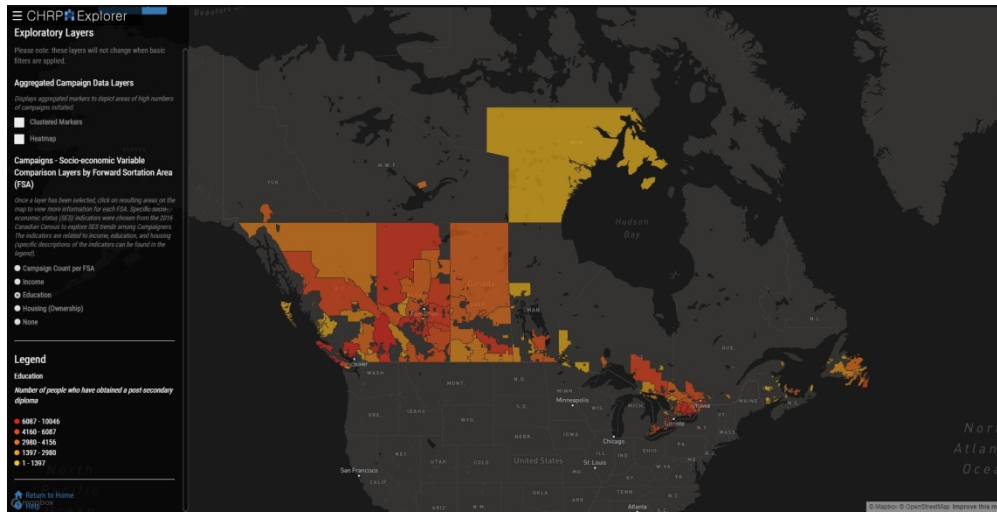


Figure 6

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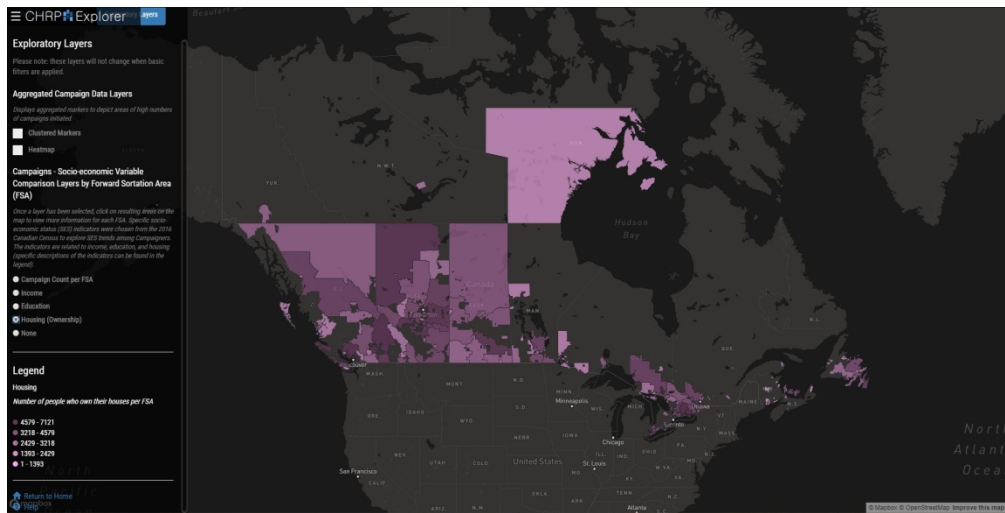


Figure 7

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## Standards for Reporting Qualitative Research (SRQR)\*

<http://www.equator-network.org/reporting-guidelines/srqr/>

Page/line no(s).

### Title and abstract

<p><b>Title</b> - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended</p>	p. 1
<p><b>Abstract</b> - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions</p>	p. 2

### Introduction

<p><b>Problem formulation</b> - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement</p>	p. 4
<p><b>Purpose or research question</b> - Purpose of the study and specific objectives or questions</p>	p. 4

### Methods

<p><b>Qualitative approach and research paradigm</b> - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**</p>	pp. 5-7
<p><b>Researcher characteristics and reflexivity</b> - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability</p>	N/A
<p><b>Context</b> - Setting/site and salient contextual factors; rationale**</p>	pp. 5-7
<p><b>Sampling strategy</b> - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**</p>	pp. 5-7
<p><b>Ethical issues pertaining to human subjects</b> - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues</p>	N/A
<p><b>Data collection methods</b> - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**</p>	pp. 5-7

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2		
3	<b>Data collection instruments and technologies</b> - Description of instruments (e.g.,	
4	interview guides, questionnaires) and devices (e.g., audio recorders) used for data	
5	collection; if/how the instrument(s) changed over the course of the study	pp. 5-7
6		
7	<b>Units of study</b> - Number and relevant characteristics of participants, documents,	
8	or events included in the study; level of participation (could be reported in results)	pp. 5-7
9		
10	<b>Data processing</b> - Methods for processing data prior to and during analysis,	
11	including transcription, data entry, data management and security, verification of	
12	data integrity, data coding, and anonymization/de-identification of excerpts	Pp. 5-7
13		
14	<b>Data analysis</b> - Process by which inferences, themes, etc., were identified and	
15	developed, including the researchers involved in data analysis; usually references a	
16	specific paradigm or approach; rationale**	Pp. 5-7
17		
18	<b>Techniques to enhance trustworthiness</b> - Techniques to enhance trustworthiness	
19	and credibility of data analysis (e.g., member checking, audit trail, triangulation);	
20	rationale**	Pp. 5-7

## Results/findings

23	<b>Synthesis and interpretation</b> - Main findings (e.g., interpretations, inferences, and	
24	themes); might include development of a theory or model, or integration with	
25	prior research or theory	pp. 7-9
26		
27	<b>Links to empirical data</b> - Evidence (e.g., quotes, field notes, text excerpts,	
28	photographs) to substantiate analytic findings	pp. 7-9

## Discussion

32	<b>Integration with prior work, implications, transferability, and contribution(s) to</b>	
33	<b>the field</b> - Short summary of main findings; explanation of how findings and	
34	conclusions connect to, support, elaborate on, or challenge conclusions of earlier	
35	scholarship; discussion of scope of application/generalizability; identification of	
36	unique contribution(s) to scholarship in a discipline or field	pp. 9-10
37		
38	<b>Limitations</b> - Trustworthiness and limitations of findings	pp. 10-11

## Other

42	<b>Conflicts of interest</b> - Potential sources of influence or perceived influence on	
43	study conduct and conclusions; how these were managed	p. 12
44		
45	<b>Funding</b> - Sources of funding and other support; role of funders in data collection,	
46	interpretation, and reporting	p. 13

\*The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

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\*\*The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

**Reference:**

O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. **Standards for reporting qualitative research: a synthesis of recommendations.** *Academic Medicine*, Vol. 89, No. 9 / Sept 2014  
DOI: 10.1097/ACM.0000000000000388

For peer review only

# BMJ Open

## Spatially Exploring the Intersection of Socio-Economic Status and Canadian Cancer-Related Medical Crowdfunding Campaigns

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2018-026365.R2
Article Type:	Research
Date Submitted by the Author:	17-May-2019
Complete List of Authors:	van Duynhoven , Alysha; Simon Fraser University Lee, Anthony; Simon Fraser University Michel , Ross; Simon Fraser University Snyder, Jeremy; Simon Fraser University Crooks, Valorie; Simon Fraser University Chow-White, Peter; Simon Fraser University Schuurman, Nadine; Simon Fraser University
<b>Primary Subject Heading</b>:	Health services research
Secondary Subject Heading:	Ethics, Health policy
Keywords:	Crowdfunding, Equity, Spatial Analysis

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Manuscripts

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3 1 **Spatially Exploring the Intersection of Socio-Economic Status and Canadian Cancer-Related**  
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5 2 **Medical Crowdfunding Campaigns**  
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26 14  
27 15 Keywords: Crowdfunding; Equity; Cancer; Spatial Analysis

28  
29 16 Word Count: 3622  
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## 29 Abstract

30 **Objectives:** Medical crowdfunding is a rapidly growing practice where individuals leverage social  
31 networks to raise money for health-related needs. This practice has allowed many to access health care  
32 and avoid medical debt but has also raised a number of ethical concerns. A dominant criticism of this  
33 practice is that it is likely to increase inequities in access to healthcare if persons from relatively wealthy  
34 backgrounds, media connections, tech savvy, and educational attainments are best positioned to use and  
35 succeed with crowdfunding. However, limited data has been published to support this claim. Our  
36 objective in this paper is to assess this concern using socio-economic data and information from  
37 crowdfunding campaigns.

38 **Setting:** To assess this concern, we present an exploratory spatial analysis of a new dataset of  
39 crowdfunding campaigns for cancer-related care by Canadian residents.

40 **Participants:** Four datasets were used: 1) a medical crowdfunding dataset that included cancer-related  
41 campaigns posted by Canadians; 2) 2016 Census Profile for aggregate dissemination areas; 3) aggregate  
42 dissemination area boundaries; and 4) forward sortation area boundaries.

43 **Results:** Our exploratory spatial analysis demonstrates that use of crowdfunding for cancer-related needs  
44 in Canada corresponds with high income, home ownership, and high educational attainment. Campaigns  
45 were also commonly located near city centres.

46 **Conclusions:** These findings support concerns that those in positions of relative socio-economic privilege  
47 disproportionately utilize crowdfunding to address health-related needs. This study was not able to  
48 determine whether other socio-economic dimensions such as race, gender, ethnicity, nationality, and  
49 linguistic fluency are also correlated with use of medical crowdfunding. Thus, we call for further research  
50 to explore the relationship between socio-economic variables and medical crowdfunding campaigning to  
51 explore these other socio-economic variables and campaigns for needs unrelated to cancer.

## 53 Strengths and Limitations of this Study

54 Developed large dataset of crowdfunding data

55 Presents methods for analyzing datasets of crowdfunding campaign information

56 Links data on crowdfunding campaigns to data on income, home ownership, and education levels

57 Unable to determine whether race, gender, ethnicity, nationality, or linguistic fluency impact use of  
58 crowdfunding

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## 65 Introduction

66 Individuals and groups have increasingly turned to online social networking and social media  
67 platforms to fundraise. This practice has come to be popularly known as crowdfunding. In  
68 particular, charitable crowdfunding, as opposed to entrepreneurial fundraising intended to raise  
69 money for businesses, has developed as a means for individuals or small groups to finance their  
70 personal needs. These platforms host campaigns, including text, images, and video, facilitate  
71 outreach to potential donors via social media, and process donations.

72 The crowdfunding platform GoFundMe dominates the charitable crowdfunding sector.  
73 Before it recently acquired YouCaring, the second largest social crowdfunding platform, it  
74 controlled 90% of the charitable crowdfunding business in the United States (US) and 80%  
75 globally [1,2]. Launched in 2010, US\$ 5 billion has been raised via GoFundMe to date and this  
76 platform supports a community consisting of more than 50 million donors and users [1].  
77 Campaigns for health-related purposes comprise the largest proportion of fundraisers hosted by  
78 GoFundMe [2,3]. These medical crowdfunding campaigns are thought to be used to pay for  
79 essential services for those lacking comprehensive medical insurance, elective procedures not  
80 covered by insurance, and unproven or experimental medical treatments. They are also used to  
81 pay for indirect needs related to receiving medical care, including travel to receive care,  
82 compensation for time off from work, and payments for medical equipment [3]. The use of  
83 crowdfunding platforms for medical purposes is expected to continue to grow and thus have a  
84 substantial impact on how individuals access health-related care [3,4].

85 Successful medical crowdfunders can benefit greatly from being better able to obtain  
86 health-related support via crowdfunding. However, this practice has also been the target of  
87 considerable criticism. These concerns include worries about fraudulent campaigns, loss of

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3 88 medical privacy, and encouraging the privatization of healthcare [3,4]. Arguably the most  
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5 89 common and serious critique of medical crowdfunding is that it will exacerbate existing  
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7 90 inequities in who is ultimately able to (financially) access health care. While differential access  
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9 91 to health care is shaped by each community's health and social care system, insurance coverage,  
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11 92 and demographics, in general those in positions of socio-economic privilege, even in universal  
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13 93 health systems, have relatively better access to health-related care than their less privileged  
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15 94 compatriots. Medical crowdfunding could exacerbate this problem, it is argued, if crowdfunding  
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17 95 serves to reward recipients according to their popularity, extent of social networks, technological  
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19 96 capabilities, or media savvy rather than need [5]. For example, Young and Scheinberg [4 p.  
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21 97 1623] flag the "potential for unfairly advantaging those with the means to engage with online  
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23 98 tools and tap into large social networks, which may lead to an underrepresentation of cases with  
24  
25 99 the greatest need in which patients lack the tools to coordinate effective crowdfunding  
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27 100 campaigns." Similarly, critics express that medical crowdfunding is likely to reinforce existing  
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29 101 inequalities in class and power [6] and reward those with social connections to wealthy persons,  
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31 102 media connections, and the educational attainments needed to communicate effectively online  
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33 103 [7]. Others note that placing the distribution of medical funds in the hands of private  
34  
35 104 crowdfunding platforms has problematic effects, as when these companies prohibit fundraisers  
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37 105 for certain services and procedures such as abortion or promote and donate to specific  
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39 106 fundraisers (as in the case of the parents of Charlie Gard fundraising for an unproven medical  
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41 107 treatment) [8,9,10].  
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49 108 Empirical support for the criticism that medical crowdfunding mostly benefits those who  
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51 109 are socio-economically advantaged is thus far limited. Lukk, Schneiderhan, and Soares reviewed  
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53 110 319 crowdfunding campaigns by Canadians for services related to education and healthcare [11].  
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3 111 They found that older and visible minority Canadians were relatively less successful in these  
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5 112 campaigns. Berliner and Kenworthy examined 200 medical crowdfunding campaigns and found  
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7 113 correlations between success in meeting medical crowdfunding goals and the inclusion of photos  
8  
9 114 and videos, campaign updates, and interactions including comments, social media shares, and  
10  
11 115 ‘liking’ a campaign [12]. A review of 850 campaigns for services related to organ transplantation  
12  
13 116 found that campaigns with positive emotional sentiment tend to be relatively successful [13]. An  
14  
15 117 analysis of 410 crowdfunding campaigns for medical transition and gender affirming surgeries  
16  
17 118 and treatments demonstrated that campaigners that are young, are white, and transgender men  
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19 119 raise more than others in this area but that campaigns for medical transition perform less well  
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21  
22 120 than medical crowdfunding campaigns generally [14].  
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26 121 Here we present an exploratory analysis of a new dataset of crowdfunding campaigns for  
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28 122 cancer-related care by Canadian residents that is connected to a selection of demographic  
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30 123 information from the 2016 Canadian Census to explore the relationship between campaign use  
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32 124 and socio-economic status. We captured this medical crowdfunding dataset using an automated  
33  
34 125 data crawling program and machine learning techniques. We specifically examine crowdfunding  
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36 126 campaigns for cancer-related care as existing research has already documented the commonality  
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38 127 of such campaigns in Canada [15,16,17], and we contrast these campaigns against geo-  
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40 128 demographic trends using an exploratory spatial data analysis (ESDA) approach. ESDA  
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42 129 facilitates the investigation of prior assumptions and guides the identification of spatial patterns  
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44 130 [18,19]. We use these patterns to raise important new research questions about medical  
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46 131 crowdfunding in the discussion.  
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## 52 132 **Materials and Methods**

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3 133 We utilized four datasets in this exploratory analysis: 1) a medical crowdfunding dataset that  
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5 134 included cancer-related campaigns posted by Canadians; 2) the 2016 Census Profile for  
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7 135 aggregate dissemination areas; 3) aggregate dissemination area boundaries; and 4) forward  
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9 136 sortation area boundaries. In consultation with the Simon Fraser University Research Ethics  
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11 137 Board we determined that ethics approval was not required for this project under the locally  
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13 138 relevant Tri-Council policy (article 2.2) as the data being collected and used was publicly  
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15 139 accessible with no reasonable expectation of privacy given the nature of crowdfunding as an  
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17 140 activity [20]. While not required by local research ethics regulations, we have chosen not to  
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19 141 publish any identifiable details from the scraped campaigns in the interest of the privacy of  
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21 142 campaign recipients.

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26 143 We compiled a medical crowdfunding dataset by creating an automated web crawling  
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28 144 algorithm. To do this we developed a Python based automated web crawler that scraped the  
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30 145 GoFundMe platform looking for key words or strings of words – in this case, the keyword  
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32 146 ‘cancer’ – and postal codes identifying campaigns as originating within Canada. We chose the  
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34 147 key term ‘cancer’ as it is a higher order concept that captures many subtypes. Furthermore, it is a  
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36 148 term that will be more familiar and more likely to be used by crowdfunders and donors than  
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38 149 subtype names. Our goal was to capture a large selection of cancer-related campaigns rather than  
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40 150 an exhaustive sample of such campaigns, making the higher order term well suited to our aims.

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45 151 The search took place on June 11, 2016. Any ambiguous posts were read by the  
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47 152 researchers to determine if they fit the classification and should be included. After relevant  
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49 153 campaigns were identified, we used a SQL database server to store the site in HTML form for  
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51 154 further analysis. Once the full HTML files from each campaign were retrieved, the pages were  
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54 155 then parsed to remove HTML tags. Further cleaning and labeling took place using a machine

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3 156 learning algorithm designed to find and include any missing information or attributes of the  
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5 157 campaigns related to cancer. Through this process, campaigns not listed in the ‘medical’  
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8 158 category were excluded and the main campaign content attributes were extracted and irrelevant  
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10 159 content (e.g., footers) were removed. The final records were stored in a Redis database for access  
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12 160 by simple query for analysis. The dataset used in this study contains 1788 records from May  
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15 161 2012 to June 2016 pertaining to cancer-related campaigns created by Canadians.

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17 162 Aggregate dissemination areas (ADAs) are a new census product released by Statistics  
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19 163 Canada as part of the 2016 Canadian Census. Delineation of ADAs considers boundaries of  
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21 164 previous census products, including existing census divisions, census metropolitan areas, and  
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23 165 census tracts [21]. Forward sortation areas (FSAs) are administrative boundaries determined by  
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25 166 Canada Post [22]. They are alphanumerically represented by “the first three characters in a  
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27 167 Canadian postal code” [22]. The records contained in our crowdfunding dataset described above  
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29 168 have an FSA attribute. This geographic data unit enables ESDA. Boundaries of ADAs and FSAs  
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31 169 were obtained from Statistics Canada [23].  
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36 170 Socio-economic status and its correlation with an individual's health or ability to obtain  
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38 171 treatments have been previously assessed at a FSA level [24,25,26], which is why we opted to  
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40 172 explore socio-economic status indicators. Variables related to income, education, and housing  
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42 173 were chosen and obtained using the University of Toronto’s Canadian Census Analyser at the  
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44 174 ADA level (see Table 1 for exact variables obtained) [27]. Further data pre-processing and  
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46 175 transformations were required in order to link socio-economic data to FSAs due to current data  
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48 176 limitations.  
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54 178 \*\* insert Table 1 here \*\*  
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6 180 Profile and boundary datasets for FSAs are unavailable for the Statistics Canada 2016  
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8 181 Census data. In lieu of the FSAs, we computed the weighted average of socio-economic  
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10 182 variables based on the percent of spatial overlap between ADAs and FSAs. To prepare for this  
11  
12 183 conversion, ADAs were spatially joined with data retrieved from the 2016 Census Profile. Each  
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14 184 FSA is also joined with respective campaign frequencies (see Figure 1 for the high-level  
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16 185 description of conversion procedure utilized to add socio-economic data at ADA-level to FSA-  
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18 186 level). Once the relationship matrix was generated from the function GenerateWeights, it was  
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20 187 then retrieved and used to calculate weighted averages of socio-economic variables contained in  
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22 188 each intersecting ADA. These weighted socio-economic variables were appended to each  
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24 189 respective FSA.  
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29 190 \*\* insert Figure 1 here \*\*  
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34 192 Using ArcMap from the ArcGIS suite (version 10.5), quintiles were created using natural  
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36 193 breaks. The data were categorized as quintiles as we trusted that five classes would be sufficient  
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38 194 to showcase meaningful differences while minimizing complexity of visual results. These  
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40 195 quintiles were used in cartographic representations to support ESDA tasks. Visual comparisons  
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42 196 at regional and provincial levels were then conducted with regards to income, education, and  
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44 197 housing ownership. The creation of these quintiles allowed project correspondents to examine  
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46 198 the data for geographic trends. These cartographic products enabled the significance of these  
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48 199 socio-economic variables to be gauged for medical crowdfunding.  
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53 200 Campaigns for each FSA were counted, and these frequencies were assigned to their  
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55 201 respective boundaries. These FSAs were subsequently linked with ADAs that feature census  
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3 202 variables from the 2016 Canadian Census. These variables consisted of income, number of  
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5 203 persons who have completed post-secondary education, and home ownership. These linkages  
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7 204 were informed by research conducted by Rogers [28] in which these variables were shown to be  
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9 205 commonly associated with vulnerability with regard to health and healthcare. To link these  
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11 206 datasets, the variables were weighted based on the percent of areal overlap each ADA shares  
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13 207 with each FSA. The resulting weighted attributes were then divided into quintiles using a method  
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15 208 similar to Sothorn et al. [29]. Resulting quintiles were then visualized in an interactive  
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17 209 cartographic display, or web map, enabling geographic comparisons to be made. This map can  
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19 210 be viewed at: <https://www.crowdfundingforhealth.org/chrpexplorer>. Figure 2 describes the  
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21 211 process for users of CHRP to explore the ESDA results. Figure 3 shows an image of the web  
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23 212 map interface.

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28 213 \*\* insert Figure 2 here \*\*  
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33 215 \*\* insert Figure 3 here \*\*  
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### 38 217 *Patient and Public Involvement*

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40 218 As the information analyzed in this study was publicly available, patients were not recruited for  
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42 219 or actively involved in this study. Patients and the public were not involved in the design or  
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44 220 planning of the study.  
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### 47 221 48 49 222 **Results** 50 51 52 53 54 55 56 57

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3 223 Our exploratory analysis utilizes socio-economic variables that have been linked with FSAs.  
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5 224 These include a layer of campaign counts per FSA, income, education, and housing (see Figures  
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7 225 4, 5, 6, & 7 for screen captures).  
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10 226 \*\* insert Figure 4 here \*\*  
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12 227 \*\* insert Figure 5 here \*\*  
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14 228 \*\* insert Figure 6 here \*\*  
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17 229 \*\* insert Figure 7 here \*\*  
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21 231 In addition to the web map, a table was generated that showed the proportion of crowdfunding  
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23 232 campaigns that belong in each quintile for each socio-economic variable (see Tables 2, 3, 4, &  
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25 233 5).  
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31 235 \*\* insert Table 2 here \*\*  
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42 240 It is important to note that only 176 FSAs out of the 1620 FSAs in Canada contained at least one  
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44 241 crowdfunding campaign, with the population of these FSAs representing approximately 5% of  
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46 242 the national total. A separate table shows the distribution of the crowdfunding campaigns  
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48 243 between each Canadian province and territory and the average value of each socio-economic  
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50 244 variable within each administrative division (see Table 6).  
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246 \*\* insert Table 6 here \*\*

247  
248 The average income of crowdfunding campaigners in this dataset is within middle to high  
249 level FSAs, with 65.49% of campaigns located in FSAs within the three highest quintiles in the  
250 income category (see Table 3). These higher income levels are matched by higher rates of home  
251 ownership among these campaigners, with housing ownership values being larger in the middle  
252 quintile (see Table 5). This group also tends to be well educated, with education values tending  
253 toward the higher quintiles (see Table 4).

254 Collectively, our ESDA shows that use of cancer-related medical crowdfunding is  
255 occurring unevenly across the country relative to population distribution. For example,  
256 Canadians' cancer-related crowdfunding campaigns were also commonly located near city  
257 centres (see Figure 3). Provincial differences in campaign use also exist. Campaigns were more  
258 commonly posted in the provinces of Ontario and British Columbia and less so in the Atlantic  
259 provinces. There is a noticeable density of campaigns in the prairie provinces of Alberta and  
260 Saskatchewan.

## 262 Discussion

263 Our ESDA-based findings support existing concerns that persons in positions of relative socio-  
264 economic privilege disproportionately utilize crowdfunding to address health-related needs – in  
265 this case care related to cancer. Individuals in the highest income FSAs were found to be the  
266 heaviest users of medical crowdfunding for cancer-related campaigns, as were individuals in  
267 FSAs with high rates of home ownership. These ESDA-based interpretations support the idea  
268 that wealthier individuals are more likely to see crowdfunding as a way to draw together

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3 269 financial resources from elsewhere to meet their health needs. We also observed that individuals  
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5 270 in FSAs with higher rates of education turned more frequently to medical crowdfunding. This  
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7 271 ESDA-based interpretation supports existing claims that individuals who are better educated,  
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9 272 more familiar with online technologies, and better able to express themselves online are more  
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11 273 likely to take advantage of crowdfunding to address health-related needs. The positive  
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13 274 correlation between the amount raised in a campaign and number of times the campaign was  
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15 275 shared supports the speculation that social capital and tech-savviness are important constituents  
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17 276 of crowdfunding campaign success.

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21 277 Our exploration of geo-demographic trends regarding Canadians' use of cancer-related  
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23 278 crowdfunding shows that this is a highly urban phenomenon. This is somewhat counterintuitive  
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25 279 considering the extensive health service gaps in rural Canadian communities that drive some  
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27 280 residents to consider alternative ways to access necessary care [30], such as crowdfunding for the  
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29 281 costs of private treatment or to relocate to an urban centre. Research regarding a potential urban-  
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31 282 rural divide in crowdfunding use is very limited and so it is difficult to know why there can be  
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33 283 proportionately less use in rural areas. This may be due to limited access to technology or lower  
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35 284 levels of education in rural Canadian communities [31,32]. Alternatively, it may be due to strong  
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37 285 voluntary and informal care sectors in 'tight-knit' rural communities that would lead to residents  
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39 286 pulling together to support those in need [30,33], which would lessen the need for drawing on  
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41 287 disparate social networks via crowdfunding. It is important to note, however, that our ESDA  
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43 288 approach means that we cannot conclusively state that our analysis documents a clear urban-rural  
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45 289 divide. This is due in part to the large aggregations of FSAs as well as the sparse population of  
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47 290 Nunavut that can both over- and under-estimate socio-economic variables. We thus flag this as  
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49 291 an important issue for future medical crowdfunding research. Furthermore, factors distinctive to  
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3 292 the Canadian cultural, geographic, and healthcare context may mean that these specific results  
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5 293 are not applicable elsewhere. These factors include widespread access to basic cancer care  
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8 294 through the Canadian single payer health system, cultural differences in charitable giving, and  
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10 295 the geographically disparate nature of Canadian communities. These differences may be less  
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12 296 acute in European communities with greater access to public health insurance and greater in the  
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14 297 US and other countries with more limited public provision of care but requires additional  
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16 298 investigation in other settings.

19 299 While our interpretations of the ESDA results support the general concern that medical  
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21 300 crowdfunding will tend to exacerbate socio-economic inequities in access to health-related care,  
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23 301 only certain dimensions of this critique were explored here. For example, while we found  
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25 302 positive correlations between cancer-related crowdfunding and wealth and education levels, we  
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27 303 were not able to explore whether other dimensions of socio-economic privilege are positively  
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29 304 correlated. These dimensions include race, gender, ethnicity, nationality, and linguistic fluency,  
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31 305 all of which are factors that lead to inequities in health status [34,35]. This leads us to make three  
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33 306 important points. First, we acknowledge that it is possible that only certain dimensions of socio-  
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35 307 economic privilege correlate with using crowdfunding to address health-related needs, and that  
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37 308 some or all of those not explored here do not shape medical crowdfunding use in the ways  
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39 309 documented here. Second, and because of this, it is important to explicitly state that this  
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41 310 exploratory analysis supports the hypothesis of a more general correlation but does not provide  
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43 311 direct evidence supporting every dimension of this correlation. And third, we call for further  
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45 312 research to explore the relationship between socio-economic variables and medical  
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47 313 crowdfunding use in general or for cancer-related campaigns in order to assist with developing a  
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49 314 more robust understanding of any interrelationships.  
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3 315 *Limitations*  
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5 316 Only the first three digits of postal codes were included in the dataset of crowdfunding  
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7 317 campaigns, which were then linked to FSAs. FSAs are smaller in urban areas and may be  
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9 318 geographically vast in rural areas. Linking ADAs to FSAs could result in broad generalizations  
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11 319 and aggregation errors and lead to ecological fallacies. This implies that findings from our study  
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13 320 are limited, as only broad claims can be stated. The aforementioned generalizations could be less  
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15 321 impacted in urban areas with smaller FSAs comparatively to rural areas. While this has  
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17 322 implications for our results, the impact may be reduced considering that as of 2011, over 80% of  
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19 323 Canada's population lives in urban environments [36].  
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24 324 We acknowledge that a medical crowdfunding campaign recipient may be different from  
25  
26 325 campaign's creator. This necessitates further research with regard to the issues explored in this  
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28 326 analysis because campaigners may reside in or report different FSAs than the individual or  
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30 327 family in need of financial assistance. Further to this, postal codes are self-reported by campaign  
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32 328 creators, which allows mistakes to be made. Nothing can be done to address this as a limitation  
33  
34 329 beyond acknowledging our awareness of the potential for errors to exist in postal code reporting.  
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36 330 Campaigners may also have moved to an urban centre in order to access care, thus introducing  
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38 331 an urban bias into our sample.  
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43 332 FSAs encoded in the campaign entries dictated the primary level of aggregation for our  
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45 333 study, thus necessitating us to limit selection of socio-economic variables. If spatial and non-  
46  
47 334 spatial attributes were improved, more socio-economic status variables could be involved, such  
48  
49 335 as sex or immigration status. This would aid in obtaining more robust results. Another limitation  
50  
51 336 encountered was the fact that the census profiles at the FSA-level were unavailable due to  
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3 337 accuracy issues (Statistics Canada, 2018) [37]. To substitute, a methodology to link and weight  
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5 338 the chosen socio-economic variables from the ADA-level to FSA-level had to be developed.  
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8 339 At the time this analysis was conducted, the Census profile for the FSA level was not  
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10 340 published. To handle this, we selected the SES variables from the ADA level. Performing an  
11  
12 341 intersection operation between FSAs and ADAs, SES variables were added to FSAs based on the  
13  
14 342 percentage of area shared. By taking the weighted average of SES variables from the ADAs that  
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16 343 intersect with each FSA, values such as those for shown for Nunavut are impacted by the error  
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18 344 accumulation from this procedure, where populations are sparse. Likewise, if there were any  
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20 345 issues with values in the ADA-level SES data, these will propagate to the weighted SES  
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22 346 variables linked to the FSAs. This means that data issues from the ADA Census profile  
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24 347 product or low populations contribute to and exacerbate errors. The Nunavut values are correct  
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26 348 with respect to this method applied. This is a systematic limitation that is exaggerated by the  
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28 349 sparse population of Nunavut and affects all data reported in the tables at varying degrees.  
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34 350 As our dataset was acquired for a snapshot in time, we acknowledge that campaigns have  
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36 351 been instantiated at different times and have been underway for varying durations. These  
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38 352 comparisons may impact results because the campaign duration captured in the current dataset  
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40 353 may not be representative of the overall success of the campaign. For example, less successful  
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42 354 campaigns may be deleted more quickly than more successful campaigns, more successful  
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44 355 campaigns may not be removed at all, or less technologically adept individuals may not think to  
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46 356 delete completed campaigns. Future work may look to compare individual campaigns that have  
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48 357 either been run for the same length of time or have completed their respective lifecycles on major  
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50 358 crowdfunding platforms.  
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## 360 **Conclusions**

361 The findings reported here support concerns that charitable crowdfunding will tend to advantage  
362 relatively socio-economically privileged individuals. While supporters of medical crowdfunding  
363 point to its potential to help people access necessary health care and avoid debt or even medical  
364 bankruptcy, this paper demonstrates that this potential is not distributed equitably across society.  
365 While medical crowdfunding still benefits many, these findings show its limits in serving as a  
366 systematic and fair solution to structural deficiencies in health systems. Additional research,  
367 including using the methods described here, would help to demonstrate whether these findings  
368 are reproduced for other socio-economic factors, in countries other than Canada, and for health  
369 needs beyond cancer.

370

## 371 **Contributorship Statement**

372 AvD, AL, and RM contributed to developing the methods, conducting the analysis, and writing  
373 the manuscript. JS and VAC contributed to method design, securing project funding, and writing  
374 the manuscript. PCW contributed to data acquisition and writing the manuscript. NS contributed  
375 to method design and writing the manuscript.

376

## 377 **Competing Interests**

378 We declare no competing interests.

379

## 380 **Funding**

1  
2  
3 381 This study was funded by the Canadian Institutes of Health Research. VAC holds the Canada Research  
4  
5 382 Chair in Health Services Geographies and a Scholar Award from the Michael Smith Foundation for  
6  
7 383 Health Research.  
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10 384

## 13 385 **Data Sharing Statement**

16 386 All crowdfunding data is available from the authors on request.  
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For peer review only

473 **Tables**

<b>Variable</b>	<b>Data Obtained</b>
<b>Population and dwelling counts</b>	Population, 2016
<b>Income</b> (Total Sex / Total)	Income statistics in 2015 for the population aged 15 years and over in private households - 100% data / Number of after-tax income recipients aged 15 years and over in private households - 100% data / Median after-tax income in 2015 among recipients (\$)
<b>Education</b> (Total Sex / Total)	Highest certificate, diploma or degree for the population aged 15 years and over in private households - 25% sample data / Postsecondary certificate, diploma or degree
<b>Housing</b> (Total Sex / Total)	Private households by tenure - 25% sample data / Owner

474 **Table 1. Variables Obtained from 2016 Census Profiles for Aggregate Dissemination Areas.**

475 Retrieved from the Canadian Census Analyser, University of Toronto

476

<b>Income Quintile</b>	<b>Number of FSA</b>	<b>Percentage (FSA)</b>	<b>Number of Campaigns</b>	<b>Percentage (Campaigns)</b>
1 - 5	114	64.77%	247	13.81%
6 - 17	36	20.45%	337	18.85%
18 - 41	16	9.09%	402	22.48%
42 - 76	6	3.41%	362	20.25%
77 - 138	4	2.27%	440	24.61%
<b>Total</b>	176	100.00%	1788	100.00%

477 **Table 2. Frequency of Campaigns per FSA. Proportion of Campaigns belonging to each Quintile.**

478

<b>Income Quintile</b>	<b>Number of FSA</b>	<b>Percentage (FSA)</b>	<b>Number of Campaigns</b>	<b>Percentage (Campaigns)</b>
\$0.00 - \$12699.19	3	1.70%	104	5.82%
\$12699.19 - \$28556.91	54	30.68%	513	28.69%
\$28556.91 - \$33333.84	63	35.80%	449	25.11%
\$33333.84 - \$38980.26	45	25.57%	593	33.17%
\$38980.26 - \$51498.11	11	6.25%	129	7.21%
<b>Total</b>	176	100.00%	1788	100.00%

479 **Table 3. Income, Median After-Tax (2015). Proportion of Campaigns belonging to each Quintile.**

480

Income Quintile	Number of FSA	Percentage (FSA)	Number of Campaigns	Percentage (Campaigns)
1 - 1397	12	6.82%	159	8.89%
1397 - 2980	41	23.30%	308	17.23%
2980 - 4156	72	40.91%	755	42.23%
4156 - 6087	46	26.14%	524	29.31%
6087 - 10046	5	2.84%	42	2.35%
<b>Total</b>	176	100.00%	1788	100.00%

481 **Table 4. Education, Post-Secondary. Proportion of Campaigns belonging to each Quintile.**

482

Income Quintile	Number of FSA	Percentage (FSA)	Number of Campaigns	Percentage (Campaigns)
1 - 1393	17	9.66%	180	10.07%
1393 - 2429	38	21.59%	283	15.83%
2429 - 3218	68	38.64%	711	39.77%
3218 - 4579	48	27.27%	571	31.94%
4579 - 7121	5	2.84%	43	2.40%
<b>Total</b>	176	100.00%	1788	100.00%

34 **Table 5. Housing, Owner. Proportion of Campaigns belonging to each Quintile.**

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Province/ Territory	Number of FSAs	Number of Campaigns	Percentage (FSA)	Percentage (Campaigns)	Population	Income, Median After-Tax (Average)	Education, Post- Secondary (Average)	Housing, Owner (Average)
Alberta	21	310	11.93%	17.34%	203643	\$36,012.35	3393	2846
British Columbia	32	401	18.18%	22.43%	268112	\$28,716.63	3728	2599
Manitoba	9	66	5.11%	3.69%	83126	\$31,275.32	3211	3032
New Brunswick	12	55	6.82%	3.08%	75339	\$26,745.83	2287	2310
Newfoundland & Labrador	9	53	5.11%	2.96%	69103	\$26,503.28	2868	2809
Northwest Territories	1	3	0.57%	0.17%	823	\$51,498.11	415	228
Nova Scotia	9	69	5.11%	3.86%	73961	\$31,392.79	3908	2425
Nunavut	1	1	0.57%	0.06%	3	\$63.72	0	0
Ontario	47	576	26.70%	32.21%	436637	\$31,865.32	3942	3105
Prince Edward Island	2	25	1.14%	1.40%	15301	\$27,888.67	2984	2582
Quebec	18	139	10.23%	7.77%	158832	\$30,057.44	3923	2675
Saskatchewan	14	85	7.95%	4.75%	138065	\$34,795.72	3613	3194
Yukon	1	5	0.57%	0.28%	16962	\$41,664.80	3278	2599
<b>Total</b>	176	1788	100.00%	100.00%	1539908	\$30,652.31	2889	2339

484 Table 6. Number of Campaigns, Population, and Socio-economic Values per Province.

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3 485 **Figure Legends**

486 **Figure 1: High-Level Description of Conversion Procedure Utilized to add Socio-Economic Data at**  
487 **ADA-Level to FSA-Level.** This figure denotes the methodology employed to associate socio-economic  
488 data at the ADA-level with the crowdfunding data collected at the FSA-level.

489 **Figure 2: Sample Interaction Sequence to Support Adding Context to Campaign Markers in the**  
490 **Interactive Web Mapping Tool.** This figure provides a set of sample instructions to users of the CHRP  
491 web map to better understand the datasets displayed.

492 **Figure 3: Screen Capture of Web Map Application (Main Page).** This figure shows the home page of  
493 the CHRP. The data shown in this figure denotes the locations of all crowdfunding campaigns involved  
494 with this study. Basic information associated with each of the campaigns can be viewed here. Permission  
495 has been granted to reproduce this image and it is not under copyright.

496 **Figure 4: Screen Capture of Web Map Application (with the Exploratory layer of Frequency**  
497 **Counts of Campaigns per FSA Displayed).** This figure shows the CHRP displaying one of its  
498 exploratory layers. The variable of interest here is number of crowdfunding campaigns per forward  
499 sortation area. Permission has been granted to reproduce this image and it is not under copyright.

500 **Figure 5: Screen Capture of Web Map Application (with the Exploratory layer of Income (Median,**  
501 **After-Tax, 2015) Displayed).** This figure shows the CHRP displaying one of its exploratory layers. The  
502 variable of interest here is income (median, after-tax, 2015). The income data was obtained from the 2016  
503 Canadian Census at the ADA-level. Permission has been granted to reproduce this image and it is not  
504 under copyright.

505 **Figure 6: Screen Capture of Web Map Application (with Exploratory layer of Education (Number**  
506 **of People with a Post-Secondary Education) Displayed).** This figure shows the CHRP displaying one  
507 of its exploratory layers. The variable of interest here is education (number of individuals that identify as  
508 having post-secondary education). The education data was obtained from the 2016 Canadian Census at  
509 the ADA-level. Permission has been granted to reproduce this image and it is not under copyright.

510 **Figure 7: Screen Capture of Web Map Application (with the Exploratory layer of Housing**  
511 **(Number of People that own homes) Displayed).** This figure shows the CHRP displaying one of its  
512 exploratory layers. The dataset of interest here is housing (number of individuals that own homes). The  
513 housing data was obtained from the 2016 Canadian Census at the ADA-level. Permission has been  
514 granted to reproduce this image and it is not under copyright.

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7 Algorithm GenerateWeights(ADA dataset, FSA dataset)
8 begin
9   a = Number of FSA, b = Number of ADA
10  Initialize relationship matrix of size a rows by b columns
11  For each i ∈ {FSA1...FSAa):
12    Select all from ADA that intersect with FSAi
13    For each j ∈ {intersecting ADA retrieved in selection}:
14      Calculate percent area that ADAj occupies in FSAi
15      Add weight to matrix at the position corresponding with the respective FSA
16      and ADA IDs.
17    Store relationship matrix as CSV for reuse
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The User:

1. Views the "CHRP Explorer" web mapping application
2. Clicks and drags the map to populate the campaign list sidebar
3. Clicks on campaign markers or hovers over sidebar listings to learn more about individual Canadian medical crowdfunding campaigns
4. Uses the basic filters slider to filter campaigns to have at least \$10,000 raised, more than 300 friends, and at least 100 donations
5. Clicks the "Exploratory" tab to change the panel contents
6. Selects "Income" under the "Campaign - Socioeconomic Variable Comparison Layers by Forward sortation area" section
7. Zooms into a geographic area of interest and clicks on a coloured area to view the median income average for that FSA the campaign is associated with

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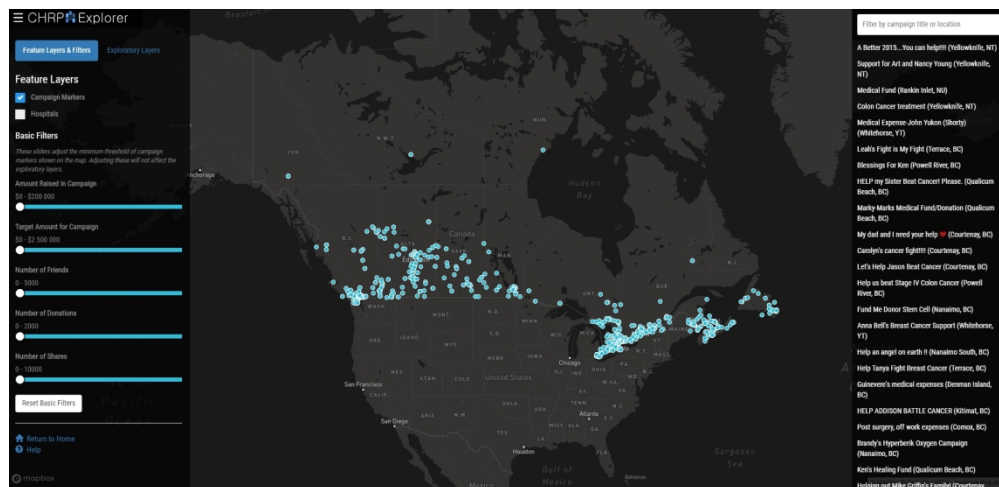


Figure 3

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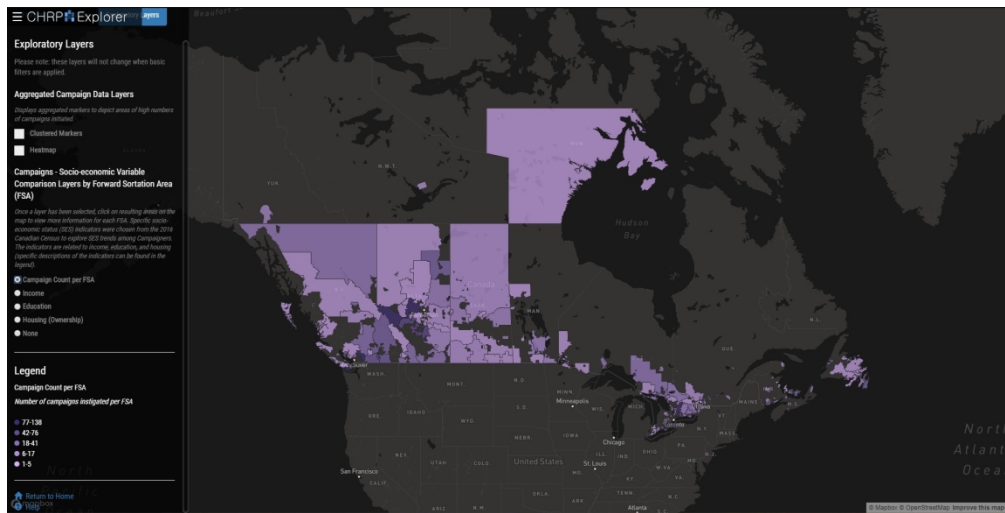


Figure 4

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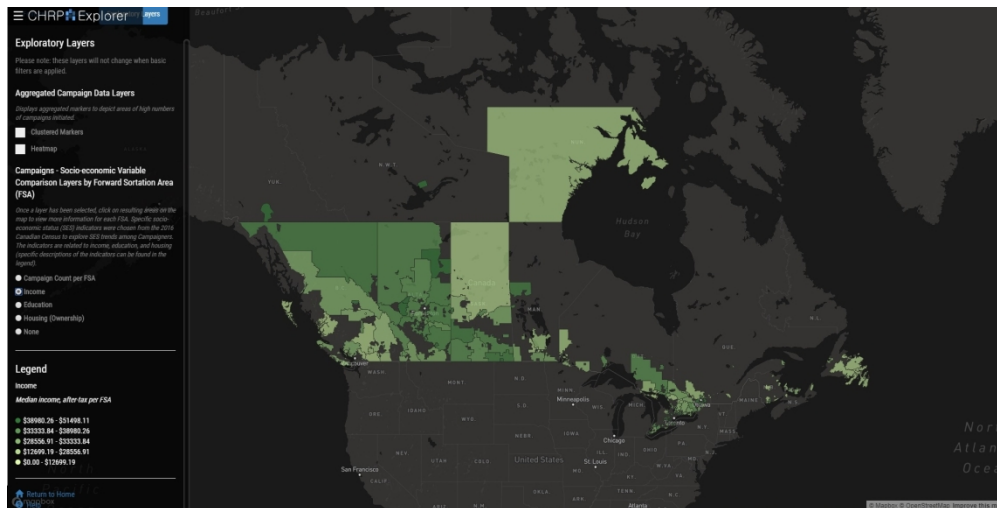


Figure 5

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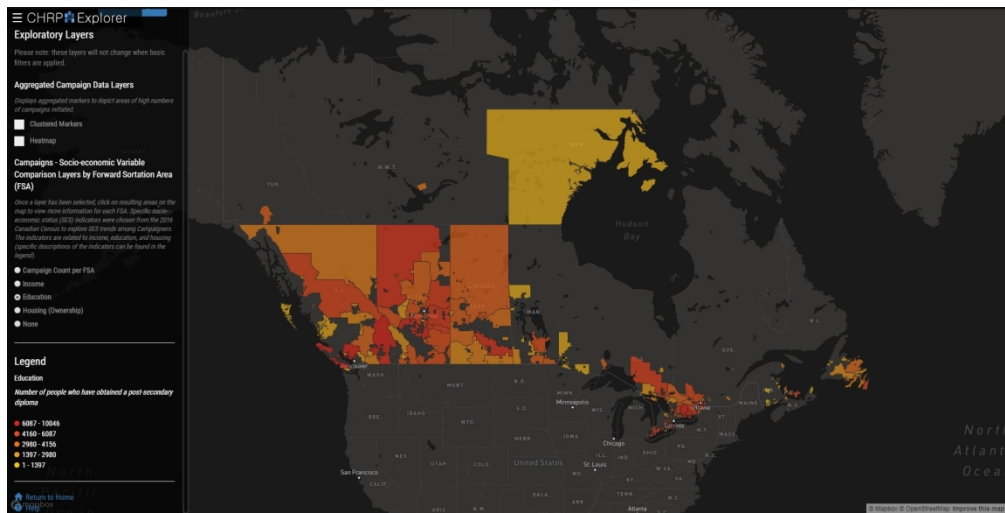


Figure 6

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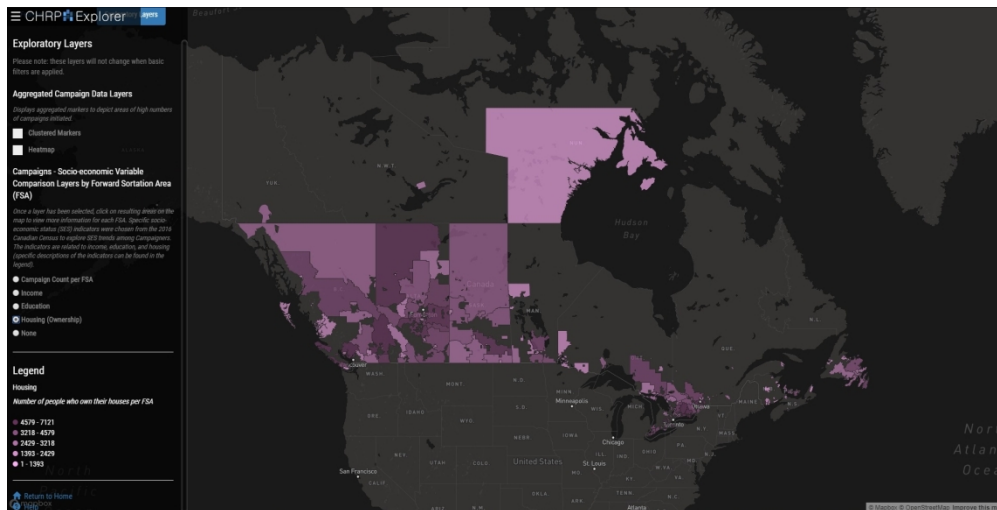


Figure 7

168x85mm (288 x 288 DPI)

## Standards for Reporting Qualitative Research (SRQR)\*

<http://www.equator-network.org/reporting-guidelines/srqr/>

Page/line no(s).

### Title and abstract

<p><b>Title</b> - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended</p>	p. 1
<p><b>Abstract</b> - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions</p>	p. 2

### Introduction

<p><b>Problem formulation</b> - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement</p>	p. 4
<p><b>Purpose or research question</b> - Purpose of the study and specific objectives or questions</p>	p. 4

### Methods

<p><b>Qualitative approach and research paradigm</b> - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**</p>	pp. 5-7
<p><b>Researcher characteristics and reflexivity</b> - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability</p>	N/A
<p><b>Context</b> - Setting/site and salient contextual factors; rationale**</p>	pp. 5-7
<p><b>Sampling strategy</b> - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**</p>	pp. 5-7
<p><b>Ethical issues pertaining to human subjects</b> - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues</p>	N/A
<p><b>Data collection methods</b> - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**</p>	pp. 5-7

1 2 3 4 5	<b>Data collection instruments and technologies</b> - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	pp. 5-7
6 7 8	<b>Units of study</b> - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	pp. 5-7
9 10 11 12	<b>Data processing</b> - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	Pp. 5-7
13 14 15 16	<b>Data analysis</b> - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	Pp. 5-7
17 18 19 20	<b>Techniques to enhance trustworthiness</b> - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	Pp. 5-7

## Results/findings

23 24 25 26	<b>Synthesis and interpretation</b> - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	pp. 7-9
27 28 29	<b>Links to empirical data</b> - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	pp. 7-9

## Discussion

32 33 34 35 36 37	<b>Integration with prior work, implications, transferability, and contribution(s) to the field</b> - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	pp. 9-10
38 39	<b>Limitations</b> - Trustworthiness and limitations of findings	pp. 10-11

## Other

42 43 44	<b>Conflicts of interest</b> - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	p. 12
45 46	<b>Funding</b> - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	p. 13

\*The authors created the SRQR by searching the literature to identify guidelines, reporting standards, and critical appraisal criteria for qualitative research; reviewing the reference lists of retrieved sources; and contacting experts to gain feedback. The SRQR aims to improve the transparency of all aspects of qualitative research by providing clear standards for reporting qualitative research.

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\*\*The rationale should briefly discuss the justification for choosing that theory, approach, method, or technique rather than other options available, the assumptions and limitations implicit in those choices, and how those choices influence study conclusions and transferability. As appropriate, the rationale for several items might be discussed together.

**Reference:**

O'Brien BC, Harris IB, Beckman TJ, Reed DA, Cook DA. **Standards for reporting qualitative research: a synthesis of recommendations.** *Academic Medicine*, Vol. 89, No. 9 / Sept 2014  
DOI: 10.1097/ACM.0000000000000388

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