ELSEVIER

Success factors of crowdfunding campaigns in medical research: perceptions and reality

Anna Aleksina[1], Stanislau Akulenka[1] and Ágnes Lublóy[1,2]

[1] Department of Finance and Accounting, Stockholm School of Economics in Riga, Strēlnieku iela 4a, Rīga, LV-1010, Latvia
[2] Department of Finance, Corvinus University of Budapest, Fővám tér 8, Budapest, 1093, Hungary

Crowdfunding in medical research is becoming more popular owing to increasing competition for the shrinking amount of government funding. To inform researchers applying for this complementary source of research funding, we investigate the determinants of successful crowdfunding campaigns in medical research. We find that establishing and maintaining professional contacts through social media is of major importance for successful crowdfunding campaigns; an additional tweet or retweet significantly increases the success of crowdfunding campaigns. In contrast to the stated preferences of prospective donors, we document that crowdfunding campaigns can achieve their fundraising goal regardless of the disease characteristics. Scientists could therefore request funding for any kind of project, including therapies for rare diseases and diseases with lower mortality rates.

Introduction

Rapid developments in medical research have opened new possibilities in the treatment of human disorders. Over decades, medical innovations have resulted in higher life expectancy for citizens and generated enormous economic value for nations [1]. As a result, governments in developed countries invest heavily in medical research. For example, the USA alone spent US$3.5 trillion on healthcare in 2017, out of which US$34.2 billion was spent on medical research by the government-supported National Institutes of Health (NIH), the largest source of funding for medical research in the world [2,3]. Despite the crucial role that medical innovation plays in the life of individuals and in the well-being of societies, since 2003 available NIH funds have been constantly decreasing in real terms [4]. The lower amount of inflation-adjusted funds has been coupled with a fierce competition for funding. As a result, the percentage of successfully funded medical research projects decreased from ~33% in 1997 to ~20% in 2016 [5].

The high level of competition for government funds and the limited funding from the private sector prompted researchers to look for alternative financing options. One such option is crowdfunding which has gained popularity in various fields, such as technology and art, and enabled campaign initiators to raise funds from a large number of contributors. Crowdfunding in healthcare in general and in medical research in particular is becoming more widespread among needy individuals and scientists as well [6]. In medical research, crowdfunding campaigns are usually donation-based; some campaigns nevertheless offer rewards to donors, such as lab T-shirts, signed copies of research papers and/or meetings with scientists [7]. The motives for crowdfunding in medical research are diverse. Researchers can turn to crowdfunding as a result of an unsuccessful grant application for government funding, for obtaining some additional funding for an ongoing research, for funding an early-phase research project where preliminary results serve as a precondition for grant applications or to raise the awareness of the general public about an important healthcare issue.

Considering the positive effect of medical research and innovation on individuals and society as a whole, more-widespread crowdfunding by medical researchers might significantly improve welfare and benefit the economy in the long term. In this study, we investigate the determinants of successful crowdfunding campaigns in medical research, with success being measured by the success rate – the ratio of actual funding raised to the fundraising target. The determinants identified in this research might serve as

Corresponding author: Lublóy, &. (agnes.lubloy@sseriga.edu)

https://doi.org/10.1016/j.drudis.2019.05.012

Please cite this article in press as: Aleksina, A. et al. Success factors of crowdfunding campaigns in medical research: perceptions and reality, Drug Discov Today (2019), https://doi.org/10.1016/j.drudis.2019.05.012

guidance for designing and implementing successful crowdfunding campaigns in medical research. In particular, we assess the impact of four groups of determinants on the success of medical research crowdfunding campaigns. First, we look at the characteristics of the disease. We expect the crowd to fund more common diseases, diseases that are deadlier, diseases that have severe impacts on the quality of life of patients and diseases where the need for a new treatment is high. Second, we investigate the peculiarities of medical research and the potential medical innovation. We hypothesize that highly innovative research approaches and proposals resulting in more effective treatment are prioritized by contributors. Third, we assess the impact of organizational details on the success rate to see whether donors consider factors such as the type of organization, the qualifications of the researchers and the availability of additional funding. Finally, we investigate whether the design of the crowdfunding campaign and communication with the crowd affects the success rate. Previous literature on crowdfunding in other domains unambiguously delineates the importance of communicating efficiently with potential donors [8–12].

This research sheds light on the most important factors influencing the success of crowdfunding campaigns in medical research. To the best of our knowledge, this is the first time in the literature when factors affecting the success of crowdfunding campaigns in medical research have been identified in a systematic way. Previous literature on crowdfunding either investigated success factors of campaigns in fields other than medical research such as art and technology [8,11]; assessed specific aspects of medical crowdfunding campaigns, such as the importance of building an audience [9]; or described cases of successful crowdfunding campaigns in medical research without systematically assessing the factors [10,13–16]. At the same time, this study allows comparison of the stated preferences of prospective donors as documented by Dragojlovic and Lynd [17] with the revealed preferences of contributors as identified in this research. Dragojlovic and Lynd [17] conducted an online survey of potential donors in North America to determine the characteristics of drug development research projects that are most likely to appeal to donors. To enable comparison of stated preferences with actual donation purposes, we incorporate 11 out of the 14 attributes [17]. The attribute list of Dragojlovic and Lynd [17] is complemented with several additional variables found to influence the success of crowdfunding campaigns in domains other than medical research.

Dragojlovic and Lynd [17] reported that potential donors are comparatively more inclined to support campaigns that aim to treat common diseases, diseases with early age of onset and projects where the proposed treatment will probably cure the disease. Moreover, potential donors are comparatively also more likely to support non-profit organizations, projects where the university of the lead researcher had an excellent reputation and where other funding was available. Stated preferences, however, might deviate from revealed preferences. Research in other domains shows that preferences estimated from survey experiments do not consistently overlap with the choices made in the real world. For example, the inconsistency between survey-based choices (stated preference) and actual choices (revealed preference) has been shown when consumers were selecting alternative-fuel vehicles [18]; picking organic or cloned milk [19]; or when young parents had to decide whether to vaccinate their newborn child [20]. Stated behavioral intentions might be inconsistent predictors of future decisions in medical research crowdfunding as well, especially as several factors increase the likelihood of inconsistency between the agent interests and observed actions in crowdfunding medical research [21]. For example, owing to limited personal experience with the complex medical peer-review process, limited skills in the field, as well as high costs associated with monitoring the projects [22], donors might prefer supporting the scientists they either know personally or professionally or from the media. Scientists and universities with strong reputations might also be preferred by donors – their reputations serve as an effective marketing tool. Public profiles of previous investors might also influence donor behavior. Many crowdfunding platforms, such as experiment.com, allow investors to create a personal profile. Empirical evidence shows that such public information can have a signaling effect for potential investors – it helps them to assess the quality of the projects [22]. Moreover, donors might have acquaintances who suffer from the disease and they are eager to provide financial support for campaigns focusing on the disease of their loved ones. Finally, information asymmetry, captured by the level of uncertainty in the information provided in the campaign description, might also exert influence on the actual behavior of the donors [23].

To preview our results, we find that establishing and maintaining professional contacts through social media is of major importance for successful crowdfunding campaigns; an additional tweet or retweet increases the success rate of a crowdfunding campaign by almost two percentage points. Our results suggest that researchers should carefully consider the platform on which they plan to launch their crowdfunding campaign; platforms with large numbers of users might pay off, even if they are profit-oriented and charge a fee. The fundraising goal should be realistic and attainable; we find empirical evidence that the higher the fundraising goal the lower the probability of succeeding. Moreover, we report that crowdfunding campaigns might achieve their fundraising goal regardless of the disease characteristics. Scientists thus could request funding for any kind of project, including therapies for rare diseases, diseases with early age of onset and diseases with low mortality rate. At the same time, when comparing the actual donation behavior documented in this research with the stated preferences of prospective donors as reported by Dragojlovic and Lynd [17], we find empirical evidence of inconsistency between stated and revealed preferences in crowdfunding. In this research, none of the attributes found previously influential [17] were useful in predicting the success rate of crowdfunding campaigns. Stated charitable attitudes and behavior alone thus cannot be used to forecast actual donation behavior in crowdfunding medical research.

Analytical approach

Crowdfunding campaigns

Data about crowdfunding campaigns in medical research are obtained from https://consano.org and https://experiment.com, two crowdfunding platforms specialized in funding scientific research. These two platforms were chosen after assessing the content and suitability of the crowdfunding platforms listed in references [15,24]. The main criteria for inclusion were as follows:

i The platform is among the largest crowdfunding platforms in the USA focusing on scientific (medical) research. The geographical constraint was imposed with the aim of

Please cite this article in press as: Aleksina, A. et al. Success factors of crowdfunding campaigns in medical research: perceptions and reality, Drug Discov Today (2019), https://doi.org/10.1016/j.drudis.2019.05.012

comparing the actual funding behavior with the stated preferences of potential donors from North America [17].

ii The platform covers a variety of diseases instead of a single one, such as cancer or diabetes.

iii Information about past projects is available.

iv The platform presents sufficient information about the medical research and the research team.

Consano is a non-profit crowdfunding platform devoted to medical research; the researchers can keep any funds raised, even if the target is not met [25]. In total, 64 projects were initiated on this platform, the amount raised exceeded US$1 million [26]. Experiment is profit-oriented and it charges an 8% platform fee [27]. This latter platform follows the 'all-or-nothing' model – only fully funded projects get the donations. By the end of 2017, 743 projects were funded, and US$7.6 million was pledged by 40 206 backers [28]. Neither Consano nor Experiment provide tangible rewards. Medical research crowdfunding campaigns from these two platforms were included in the sample if they were closed as of 12th February 2018. The final sample includes 109 projects: 81 projects from Experiment and 28 from Consano. This sample size is comparable to those used in several prior studies [9,11,15].

Potential factors influencing the success of crowdfunding campaigns

The success rate of campaigns, defined as the percentage of the target sum raised, is used as a dependent variable, allowing comparison of crowdfunding campaigns with different funding goals. Independent variables cover the attributes defined by Dragojlovic and Lynd [17]; those attributes were selected after carefully reviewing the crowdfunding literature and consulting university fundraising experts. From the 14 attributes defined [17], two attributes were excluded as a result of data unavailability: the source of the fundraising appeal and matching donations. In addition, the subjective attribute of university reputation was replaced by the number of scientists with PhDs serving as a proxy for the prestige and credibility of the crowdfunding team.

Independent variables are divided into four groups: disease characteristics, peculiarities of the medical research, organizational details, characteristics of communication and design (Table 1). Dragojlovic and Lynd's attribute list [17] was complemented with some additional variables. To deal with the diverse dataset, among the disease characteristics we differentiate between campaigns related to humans and animals (Table 1, Panel A), whereas among the medical research characteristics we differentiate between campaigns targeting research and developing a cure for a disease (Table 1, Panel B).

Furthermore, we added several variables describing the design of the crowdfunding campaigns and how researchers communicate with the crowd (Table 1, Panel D). The inclusion of these predictors is supported by recent empirical evidence showing the importance of building a network [8–12,29–32]. Having a large online social network and sharing information about crowdfunding campaigns on these networks increases the probability of reaching potential donors and thus the success of crowdfunding campaigns. In the literature, the size of the social network is commonly proxied with the number of Facebook friends and/or with the number of Twitter followers. The number of Facebook friends and the number of tweets and retweets are found to be positively associated with the success of crowdfunding campaigns [8,9,30]; the latter variable is included in our model. Having a large audience is a necessary but not sufficient condition for success; researchers should also communicate efficiently with potential donors. This efficient communication can take several forms. Empirical evidence shows the importance of comments left by backers on the campaign's website [8,11,33]; the necessity of utilizing multimedia tools and adding photos and videos to the campaign [8,11,12,31,33,34]; posting regular updates and disclosing intermediate research findings [8,30,35,36]; and the negative influence of excessive amounts of information on the fund raised [37] – all these aspects are captured by variables defined in Table 1, Panel D.

Data were collected manually. Variables were obtained from the descriptions of the crowdfunding campaigns with three exceptions: age of onset, 10-year mortality rate and disease frequency. Such information was typically not included in the campaign description; these variables were determined from databases and journal articles. The final dataset including the methodology of data collection, the source of additional information and the value for each variable is provided in Table S1 (see supplementary material online). In case of missing data, the mean-substitution approach was employed [38].

Ordinary least squares (OLS) regressions were employed to identify the success factors of medical crowdfunding campaigns. In this research, OLS regressions were preferred over binary response models: the information embedded in the extent of underfunding vs overfunding was exploited. The success rate shows a large variability, it ranges from 3% to 489% – had we focused on reaching the target only, information would have been lost. In the first model, independent variables enter the regression as shown in Table 1. In the second model, in line with the stated preference survey of Dragojlovic and Lynd [17], categorical variables are used for fundraising goal, mortality rate and disease frequency.

Determinants of successful campaigns

Table 2 describes the characteristics of crowdfunding campaigns. For binary variables, the mean value provides information about the proportion of observations having a value of 1. Descriptive statistics of the categorical variables used in the second model are shown in Table S2 (see supplementary material online). OLS regression results of the first model are shown in Table 3. Similar conclusions can be drawn from the second model (Table S3, see supplementary material online).

Communication plays an important role in launching a successful crowdfunding campaign. The coefficient of the tweets&retweets (twit winsorized) variable is positive and significant; an additional tweet or retweet increases the success rate of a campaign by 1.79 percentage points. The positive and significant effect of the number of tweets on the success of crowdfunding campaigns is in line with the observation of Perlstein [10], who estimates that in the pharmacological Crowd4Discovery crowdfunding campaign 60% of the donors were part of his social networks in Facebook and Twitter. In a small sample of 34 crowdfunding campaigns for cardiovascular research it was also shown that successful campaigns are associated with high numbers of shares through Facebook or Twitter [39]. Koole *et al.* [16] argue that, although initial donations come from the investigators' private inner circles in a large Dutch eHealth research crowdfunding project, public awareness resulting from multiple media campaigns and strong support from a

Please cite this article in press as: Aleksina, A. et al. Success factors of crowdfunding campaigns in medical research: perceptions and reality, Drug Discov Today (2019), https://doi.org/10.1016/j.drudis.2019.05.012

TABLE 1

Factors influencing the success of crowdfunding campaigns

Variable	Name	Explanation
Panel A: Disease characteristics		
Human/animal	human	Binary variable: 1 if the campaign is about humans, 0 if it involves tests on animals.
Age of onset[a]	–age 5 age 5–age 40 age 40–age 50 age 50–age 70	Age at which most patients acquire symptoms of a disease. Binary variable: 1 if the symptoms are typically acquired by age of 5, 40, 50 or 70, respectively, 0 otherwise. The age of onset below 5 years is used as a reference group
Disease frequency[a]	freq	Disease frequency per 100 000 people
Impact on quality of life[a]	quality	Binary variable: 1 if the impact of the disease on the quality of life of a patient is severe, 0 if moderate. The impact is severe if the disease causes severe pain and discomfort and prevents patients from living at home owing to their disabilities. The impact is moderate if the disease causes moderate pain and discomfort, and patients face difficulties in conducting their daily activities
Need for new treatments[a]	treat_low treat_medium treat_high	Binary variable: 1 if the need for new treatments is low, medium or high, respectively, 0 otherwise. The need is high if there are no currently approved treatments for the disease; medium if a treatment is available, but only increases the length and/or quality of life by a small amount. The need is low if a treatment which significantly increases the length and/or quality of life of patients is available. The reference category is the medium need for new treatments
Mortality rate[a]	mortality	Proportion of patients with this disease who die within 10 years after receiving the diagnosis
Panel B: Medical research characteristics		
Cure/research	cure	Binary variable: 1 if the campaign aims at developing a cure for a disease, 0 if it aims at researching the phenomenon
Innovation level[a]	innovation	Binary variable: 1 if the innovation level of the proposed medical research is high, 0 if it is low. The innovation level is considered as high if the researchers come up with an innovative approach that has never been used previously to cure the disease or was used in a very different context. The innovation level is considered as low if researchers test approaches from previous medical research on new treatment groups or medical problems
Effectiveness of proposed treatment[a]	effectiveness	Binary variable: 1 if the proposed treatment will most probably cure the disease, 0 if patients will significantly benefit from the treatment but the disease is not cured
Development stage[a]	devel_st_early devel_st_mid devel_st_late	Binary variable: 1 if a development stage is early, mid or late, respectively, 0 otherwise. In case of developing a cure for a disease, the development stage is early if the research team tests the effectiveness and toxicity of a large number of possible drugs in the lab using human cells; mid if they perform tests on mice; late if the drug is tested on humans. In case of researching a phenomenon, the development stage is early if there is only an general idea about experiment to be conducted; mid if the idea has already been tested and first results are available; late if several experiments has been conducted, and additional funding is needed to answer questions which were developed during the experiments. The reference category is the early development stage
Fundraising goal[a]	Funding goal	The fundraising goal of the campaign, in US$
Panel C: Organizational characteristics		
Type of organization[a]	org	Binary variable: 1 if the organization is for-profit, 0 if it is non-profit
Number of people with PhD	phd	Number of people in the research team with a PhD
Availability of other funding[a]	additional fund	Binary variable: 1 if additional funding is available, 0 otherwise
Panel D: Communication and design		
Tweets & retweets	twit	Number of tweets sharing the campaign from open accounts plus the number of retweets, excluding repeated tweets from the same account
Comments	comments	Number of comments on the project page, excluding comments posted after the closing date
Photo	photo	Binary variable: 1 if there are photos on the campaign page, 0 otherwise
Video	video	Binary variable: 1 if there is a video on the campaign page, 0 otherwise
Updates	updates	Number of updates on a project, excluding updates posted after the closing date
Intermediate results	interim results	Binary variable: 1 if intermediate results are available, 0 otherwise
Length	length	Length of the campaign description measured by the number of words
Platform	platform	Binary variable: 1 if a project was posted on experiment.com, 0 if it is from consano.org

[a] Variable adopted from the survey in [17].

Please cite this article in press as: Aleksina, A. et al. Success factors of crowdfunding campaigns in medical research: perceptions and reality, Drug Discov Today (2019), https://doi.org/10.1016/j.drudis.2019.05.012

TABLE 2

Descriptive statistics of crowdfunding campaigns (*n* = 109)

Variable	Mean	Std Dev.	Min	Max
Panel A: Disease characteristics				
Human/animal (1 human; 0 animal)	0.89	0.31	0.00	1
–age 5	0.03	0.16	0.00	1
age 5–age 40	0.28	0.45	0.00	1
age 40–age 50	0.05	0.21	0.00	1
age 50–age 70	0.64	0.48	0.00	1
freq (per 100 000 people)	568.46	1372.21	0.04	13 000
freq winsorized (per 100 000 people)	*453.79*	*568.36*	*0.73*	*3000*
quality (1 severe; 0 moderate)	0.72	0.45	0.00	1
treat_low	0.26	0.44	0.00	1
treat_medium	0.56	0.50	0.00	1
treat_high	0.18	0.39	0.00	1
mortality (10 years, in %)	43.45	21.09	0.00	100
Panel B: Medical research characteristics				
cure (1 cure; 0 research)	0.35	0.48	0.00	1
innovation (1 high; 0 low)	0.72	0.45	0.00	1
effectiveness (1 cure; 0 benefit)	0.94	0.25	0.00	1
devel_st_early	0.78	0.42	0.00	1
devel_st_mid	0.21	0.41	0.00	1
devel_st_late	0.01	0.10	0.00	1
funding goal	19 179.34	96 002.68	350.00	1 000 000
funding goal winsorized	*10 470.63*	*15 147.36*	*800.00*	*75 000*
Panel C: Organizational characteristics				
org (1 for-profit; 0 non-profit)	0.06	0.25	0.00	1
phd (number of researchers)	0.72	1.02	0.00	5
additional fund (1 yes; 0 no)	0.28	0.45	0.00	1
Panel D: Communication and design				
twit	28.27	206.64	0.00	2155
twit winsorized	*9.38*	*22.30*	*0.00*	*115*
comments	16.84	36.81	0.00	303
comments winsorized	*15.26*	*26.67*	*0.00*	*139*
photo	0.77	0.42	0.00	1
video	0.64	0.48	0.00	1
updates	3.78	5.65	0.00	28
interim results	0.28	0.45	0.00	1
length	900.92	323.20	427.00	1706
platform (1 Experiment; 0 Consano)	0.74	0.44	0.00	1

For the four variables with outliers, figures in italics show the descriptive statistics after winsorization.

professional organization resulted in extra donations. Byrnes *et al*. [9] showed that engagement of a large audience is of major importance to successful crowdfunding in science. In order to engage, scientists first have to build an audience for their research through the press and online social media. Once the audience is built, scientists should maintain public presence through tweets, emails or press releases. As a result of these tweets, emails and press appearances, people will view the project page and donate. Vachelard *et al*. [12] argued that the success of the crowdfunding campaign heavily depends on the social network of the fundraisers. The fundraising team should reach out to their connections before launching the crowdfunding campaign, suggested the authors. Receiving media attention is also an efficient tool for building an audience; it increased the probability of meeting the funding goal when raising funds for medication adherence and storage tools from the crowd [40].

Our results suggest that fundraisers should select the crowdfunding platform carefully. If a campaign is launched on Experiment, the success rate of the campaign is 38.86 percentage points higher than launching the campaign on Consano. On the one hand, Experiment is a larger platform than Consano with 20 project categories, a few of them being related to medical research. Owing to the larger pool of project categories and projects, a higher number of potential donors visits the website. Potential donors might spill over from those other categories into the category of medical research. On the other hand, total funding per successful project, on average, is smaller on Experiment than on Consano (US$10 229 vs US$15 625), which makes it easier to raise the target sum [26,28]. In the case of Experiment, the fundraisers do not receive the pledged funds until the target is met; a rule which motivates fundraisers to set realistic financial goals. The importance of the platform selection was also stressed by Schäfer *et al*. [41]; projects launched on science-only crowdfunding platforms 'were reported to have a higher success rate than projects hosted on general platforms.

The variable of fundraising goal is significant at 5% with a negative beta coefficient; the success rate of the campaign is marginally smaller if the target sum is higher. Similar conclusions have been drawn by analyzing nonscientific campaigns listed on

Please cite this article in press as: Aleksina, A. et al. Success factors of crowdfunding campaigns in medical research: perceptions and reality, Drug Discov Today (2019), https://doi.org/10.1016/j.drudis.2019.05.012

TABLE 3

OLS regression results

Variables	Coefficients	*P* value	95% CI
Disease characteristics			
human/animal	4.89	0.91	[−23.26–26.22]
age5–age 40	0.90	0.81	[−59.32–75.89]
age 40–age 50	18.58	0.33	[−100.81–34.14]
age 50–age 70	−28.38*	0.93	[−64.65–59.4]
freq winsorized	0.01	0.50	[−0.01–0.02]
quality	24.60	0.13	[−8.2–61.33]
treat_low	24.99	0.08	[−2.78–51.59]
treat_high	20.35	0.17	[−11.43–64.98]
mortality (10 years)	0.16	0.44	[−0.25–0.58]
Medical research characteristics			
cure	3.13	0.75	[−16.17–22.42]
innovation	**−20.12***	**0.03**	**[−38.45–1.8]**
effectiveness	7.58	0.55	[−17.45–32.61]
devel_st_mid	13.12	0.35	[−14.62–40.86]
devel_st_late	−17.62	0.30	[−50.87–15.62]
funding goal winsorized	**−0.0008***	**0.04**	**[−0.0016–0.0000]**
Organizational characteristics			
org	−26.79	0.33	[−81.18–27.6]
phd	5.56	0.33	[−5.77–16.89]
additional fund	2.37	0.83	[−19.23–23.97]
Communication and design			
length	−0.01	0.44	[−0.03–0.01]
comments winsorized	−0.56	0.07	[−1.17–0.04]
twit winsorized	**1.79*****	**0.00**	**[0.84–2.75]**
photo	−14.06	0.18	[−34.69–6.57]
video	7.31	0.51	[−14.51–29.13]
updates	1.43	0.19	[−0.71–3.57]
results	−3.90	0.72	[−25.02–17.23]
platform	**38.86***	**0.01**	**[9.46–68.27]**

Coefficients that are significant at least at the 5% level are highlighted in bold. The R-squared of the model is 0.5873 and the adjusted R-squared is 0.4565.
*$P < 0.05$.
**$P < 0.01$.
***$P < 0.001$.

Kickstarter and on the French KissKissBankBank platform [8,11]. In a sample of 371 scientific projects, it was also found that projects are more likely to be successfully funded when the target sum is lower [41]. The variable of innovation is significant at 5% with a negative beta coefficient; the more innovative the project is, the lower the probability of raising the target sum. Donors are risk averse; therefore, they are more likely to avoid projects where researchers employ an innovative approach.

When comparing the actual donation behavior documented in this research with the stated preferences of potential donors as documented by Dragojlovic and Lynd [17] we find empirical evidence of inconsistency between stated and revealed preferences in crowdfunding. Dragojlovic and Lynd [17] reported that potential donors were comparatively more inclined to support campaigns that aim to treat diseases with early age of onset and diseases that are more frequent. Moreover, potential backers showed strong preference for supporting projects where the proposed treatment is most likely to cure the disease. Potential donors were comparatively also more likely to support non-profit organizations, projects where the university of the lead researcher had an excellent reputation and where other funding was available. Potential donors were also stated to prioritize projects, albeit to a lesser extent, where the impact on the quality of life of patients is severe and the mortality is high. In this research, none of these attributes was useful in predicting the success rate of crowdfunding campaigns. Stated charitable attitudes and behavior cannot therefore be used to forecast actual donation behavior in crowdfunding medical research.

Several factors could explain why stated and revealed preferences differ and why disease characteristics are irrelevant in crowdfunding medical research. First, donors might be part of the fundraisers' personal or professional network and provide financial support to the scientists they know without considering the disease characteristics. This argument is supported by Perlstein [10], he was connected to 60% of their donors through social media. Second, donors might have friends or relatives who suffer from the disease and they are eager to provide financial support

Please cite this article in press as: Aleksina, A. et al. Success factors of crowdfunding campaigns in medical research: perceptions and reality, Drug Discov Today (2019), https://doi.org/10.1016/j.drudis.2019.05.012

with the hope of easing the burden on their loved ones. Third, donors might be biased toward crowdfunding campaigns launched by recognized and prestigious universities or influential and highly respected scientists. Fourth, donors' actual funding behavior can deviate from the planned one owing to herding bias. If numerous people share information about a crowdfunding campaign on social networks, for example via tweets, donors might follow the consensus and end up funding that campaign.

Crowdfunding medical research is becoming more and more popular; it serves as an additional tool for financing research initiatives. The revealed preferences documented in this research might help scientists to pursue a successful crowdfunding campaign. Our findings highlight the importance of establishing and maintaining professional contacts through social media; an additional tweet or retweet increases the success rate of crowdfunding campaigns by one percentage point. Three main tasks for keeping a successful professional network are building a network, maintaining the network and activating selected contacts [42]. Tweeting is a tool for activating members in personal and professional networks; scientists should put effort into establishing networks and keeping them up-to-date beforehand.

Our results suggest that researchers should select the crowdfunding platform carefully. Platforms with wider publicity are to be preferred over specialized, smaller platforms; the pool of potential donors is larger and thus the possibility of achieving the fundraising target is higher. More popular platforms might pay off, even if they are profit-oriented and charge a fee. At the same time, researchers should not set unrealistic funding goals because they might discourage donors from providing financial support. Researchers can request funding for any kind of project, including therapies for rare diseases; crowdfunding campaigns might reach their fundraising goal regardless of the disease characteristics. Our results are in line with the findings of Sauermann *et al.* [43]; by assessing >700 campaigns from Experiment the authors report that conventional signals of project riskiness and quality, the latter proxied by prior publications, exert no influence on funding success. The finding that disease characteristics do not matter matches the concern listed by Del Savio [44]. In crowdfunding, financial resource allocation is based on the judgement of donors not being experts in medical science. As a result, the public fails to allocate resources efficiently and prioritize research delivering the highest total value to the society. Nevertheless, it might be easier to build and engage an audience where the disease characteristics overlap with the stated preferences of the potential donors. Stated preferences reflect the attributes that donors and generally the wider public care about: diseases with high mortality rate, diseases with early age of onset, frequent diseases and diseases causing severe pain and discomfort. Stated preferences are generally in line with the principles of resource allocation in healthcare: resources should be allocated where the largest total improvement is expected; that is, more people are affected, the quantity of life lived significantly increases and the quality of life substantially improves [45,46].

This research has several limitations. First, we focused on platforms that cover a variety of diseases; the success factors on platforms specializing on a single disease might slightly differ. Second, the number of observations is small, whereas the number of independent variables is high. It is, however, argued that linear regressions require only two subjects per variable for estimating the regression coefficients, standard errors and confidence intervals with a relative bias of <10% [47]. Third, some variables found important in previous research, such as having females or junior researchers in the crowdfunding team, were not assessed [31,43,48,49]. Fourth, we disregard when information became available to the potential backers. Although the number of comments, tweets and updates evolve over time, in the model the values observed at the end of the campaign are included. Fifth, information about disease frequency, age of onset and mortality were obtained from scientific journals. Although two researchers independently determined the value of these variables, the estimate might be biased.

Concluding remarks

Central funding agencies should keep on fostering fundamental discoveries, innovative research approaches and their application as a basis for improving the health and wealth of nations. These funding agencies should continue ensuring efficient allocation of resources and prioritize research that delivers the highest total value to society, considering the quality and the quantity of life lived, summed up across all individuals. Crowdfunding has the potential to complement but not to replace existing government funding. We showed that crowdfunding in medical research disregards the disease characteristics and the total value delivered to the society. In crowdfunding, scientists with large social networks, either personal or professional, are more likely to achieve their fundraising goal. Scientists who managed to develop good networking skills and/or their research became covered broadly across the media and have greater chances to succeed. From this respect, crowdfunding imposes a negative externality on the society – campaigns are not evaluated on their merit, they deliver to society as a whole. This negative externality is nevertheless outweighed by the positive externality that crowdfunding in medical research delivers to society. Through crowdfunding, additional financial resources are channeled into the system and more medical research projects are carried out in total.

Acknowledgments

We thank the faculty members at Stockholm School of Economics in Riga for helpful comments and suggestions on earlier versions of this paper.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.drudis.2019.05.012.

References

1 Murphy, K.M. and Topel, R.H. (2006) The value of health and longevity. *J. Polit. Econ.* 114, 871–904

2 Centres for Medicare and Medicaid Services. National health expenditures 2017 highlight. Available at: https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/downloads/highlights.pdf.

3 National Institutes of Health. NIH budget history. NIH budget mechanism detail FY 2001–2017. Available at: https://report.nih.gov/NIHDatabook/Charts/Default.aspx?showm=Y&chartId=153&catId=1.

4 Kuehn, B.M. (2014) Budget woes, sequester place researchers in a bind: young researchers hard hit. *JAMA* 311, 15–16

Please cite this article in press as: Aleksina, A. et al. Success factors of crowdfunding campaigns in medical research: perceptions and reality, Drug Discov Today (2019), https://doi.org/10.1016/j.drudis.2019.05.012

5 National Institutes of Health. Research grants: competing applications and awards. Available at: https://report.nih.gov/nihdatabook/charts/Default.aspx?chartId=159&catId=2.
6 Bassani, G. *et al.* (2018) Crowdfunding in healthcare. *J. Technol. Transf.* 2018, 1–21
7 Hughes, V. (2012) Strapped for funding, medical researchers pitch to the crowd. *Nat. Med.* 18, 1307
8 Mollick, E. (2014) The dynamics of crowdfunding: an exploratory study. *J. Bus. Venturing* 29, 1–16
9 Byrnes, J.E. *et al.* (2014) To crowdfund research, scientists must build an audience for their work. *PloS One* 9, e110329
10 Perlstein, E.O. (2013) p. 560, SpringerPlus
11 Petitjean, M. (2018) What explains the success of reward-based crowdfunding campaigns as they unfold? Evidence from the French crowdfunding platform KissKissBankBank. *Financ. Res. Lett.* 26, 9–14
12 Vachelard, J. *et al.* (2016) A guide to scientific crowdfunding. *PLoS Biol.* 14, e1002373
13 Fumagalli, D.C. and Gouw, A.M. (2015) Focus: personalized medicine: crowdfunding for personalized medicine research. *Yale J. Biol. Med.* 88, 413–414
14 Dahlhausen, K. *et al.* (2016) Crowdfunding campaigns help researchers launch projects and generate outreach. *J. Microbiol. Biol. Educ.* 17, 32–37
15 Dragojlovic, N. and Lynd, L.D. (2014) Crowdfunding drug development: the state of play in oncology and rare diseases. *Drug Discov. Today* 19, 1775–1780
16 Koole, M.A. *et al.* (2018) A successful crowdfunding project for eHealth research on grown-up congenital heart disease patients. *Int. J. Cardiol.* 273, 96–99
17 Dragojlovic, N. and Lynd, L.D. (2016) What will the crowd fund? Preferences of prospective donors for drug development fundraising campaigns. *Drug Discov. Today* 21, 1863–1868
18 Brownstone, D. *et al.* (2000) Joint mixed logit models of stated and revealed preferences for alternative-fuel vehicles. *Transport Res. B Meth.* 34, 315–338
19 Brooks, K. and Lusk, J.L. (2010) Stated and revealed preferences for organic and cloned milk: combining choice experiment and scanner data. *Am. J. Agr. Econ.* 92, 1229–1241
20 Lambooij, M.S. *et al.* (2015) Consistency between stated and revealed preferences: a discrete choice experiment and a behavioural experiment on vaccination behaviour compared. *BMC Med. Res. Methodol.* 15, 19
21 Beshears, J. *et al.* (2008) How are preferences revealed? *J. Public Econ.* 92, 1787–1794
22 Vismara, S. (2018) Information cascades among investors in equity crowdfunding. *Entrepreneursh. Theory Pract.* 42, 467–497
23 Ahlers, G.K.C. *et al.* (2015) Signaling in equity crowdfunding. *Entrepreneursh. Theory Pract.* 39, 955–980
24 Cadogan, D. (2014) Funding for research? Look to the crowd: crowdfunding resources for academia. *Coll. Res. Libr.* 75, 268–271
25 Consano frequently asked questions. Available at: https://consano.org/about/faq/.
26 Consano projects. Available at: https://consano.org/donate/projects/.
27 Experiment frequently asked questions. Available at: https://experiment.com/faq.
28 Experiment community statistics. Available at: https://experiment.com/stats.
29 Hui, J.S. *et al.* (2014) Understanding and leveraging social networks for crowdfunding: opportunities and challenges. In *Proceedings 2014 Conference on Designing Interactive Systems 2014*. 677–680
30 Borst, I. *et al.* (2018) From friendfunding to crowdfunding: relevance of relationships, social media, and platform activities to crowdfunding performance. *New Media Soc.* 4, 1396–1414
31 Colombo, M.G. *et al.* (2015) Internal social capital and the attraction of early contributions in crowdfunding. *Entrepreneursh. Theory Pract.* 39, 75–100
32 Zheng, H. *et al.* (2014) The role of multidimensional social capital in crowdfunding: a comparative study in China and US. *Inform. Manage.* 51, 488–496
33 Berliner, L.S. and Kenworthy, N.J. (2017) Producing a worthy illness: personal crowdfunding amidst financial crisis. *Soc. Sci. Med.* 187, 233–242
34 Makris, G.C. (2015) Crowdfunding: from startup businesses to startup science. *BMJ* 350, 18
35 Xu, A. *et al.* (2014) Show me the money! An analysis of project updates during crowdfunding campaigns In *Proceedings SIGCHI Conference Human Factors Computing Systems 2014*. 591–600
36 Block, J. *et al.* (2018) Which updates during an equity crowdfunding campaign increase crowd participation? *Small Bus. Econ.* 50, 3–27
37 Moy, N. *et al.* (2018) How much is too much? The effects of information quantity on crowdfunding performance. *PloS One* 13, e0192012
38 Schafer, J.L. and Graham, J.W. (2002) Missing data: our view of the state of the art. *Psychol. Methods* 7, 147
39 Krittanawong, C. *et al.* (2018) Crowdfunding for cardiovascular research. *Int. J. Cardiol.* 250, 268–269
40 Holmes, T.M. *et al.* (2019) Crowdfunding pharmacy-and medication-related products: How successful is it? *J. Am. Pharm. Assoc.* 59, S57–S62
41 Schäfer, M.S. *et al.* (2018) Selling science 2.0: what scientific projects receive crowdfunding online? *Public Underst. Sci.* 5, 496–514
42 Nardi, B.A. *et al.* (2002) NetWORKers and their activity in intensional networks. *Comput. Supported Coop. Work J.* 11, 205–242
43 Sauermann, H. *et al.* (2019) Crowdfunding scientific research: descriptive insights and correlates of funding success. *PloS One* 14, e0208384
44 Del Savio, L. (2017) The place of crowdfunding in the discovery of scientific and social value of medical research. *Bioethics* 31, 384–392
45 Angelis, A. *et al.* (2017) Resource allocation and priority setting in health care: a multi-criteria decision analysis problem of value? *Glob. Policy* 8, 76–83
46 Brazier, J. *et al.* (1999) A review of the use of health status measures in economic evaluation. *J. Health Servs. Res. Poicy* 4, 174–184
47 Austin, P.C. and Steyerberg, E.W. (2015) The number of subjects per variable required in linear regression analyses. *J. Clin. Epidemiol.* 68, 627–636
48 Greenberg, J. and Mollick, E. (2017) Activist choice homophily and the crowdfunding of female founders. *Adm. Sci. Q.* 62, 341–374
49 Frydrych, D. *et al.* (2014) Exploring entrepreneurial legitimacy in reward-based crowdfunding. *Venture Capital* 16, 247–269

Please cite this article in press as: Aleksina, A. et al. Success factors of crowdfunding campaigns in medical research: perceptions and reality, Drug Discov Today (2019), https://doi.org/10.1016/j.drudis.2019.05.012