Social Science & Medicine 191 (2017) 48–56

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

# Crowdfunding our health: Economic risks and benefits

Matthew J. Renwick, Elias Mossialos*

*LSE Health, Department of Social Policy, London School of Economics and Political Science, London, United Kingdom*

ARTICLE INFO

*Article history:*
Received 13 November 2016
Received in revised form
9 June 2017
Accepted 28 August 2017
Available online 31 August 2017

*Keywords:*
Crowdfunding
Alternative financing
Health policy
Health economics
Global health

ABSTRACT

Crowdfunding is an expanding form of alternative financing that is gaining traction in the health sector. This article presents a typology for crowdfunded health projects and a review of the main economic benefits and risks of crowdfunding in the health market. We use evidence from a literature review, complimented by expert interviews, to extend the fundamental principles and established theories of crowdfunding to a health market context. Crowdfunded health projects can be classified into four types according to the venture's purpose and funding method. These are projects covering health expenses, fundraising health initiatives, supporting health research, or financing commercial health innovation. Crowdfunding could economically benefit the health sector by expanding market participation, drawing money and awareness to neglected health issues, improving access to funding, and fostering project accountability and social engagement. However, the economic risks of health-related crowdfunding include inefficient priority setting, heightened financial risk, inconsistent regulatory policies, intellectual property rights concerns, and fraud. Theorized crowdfunding behaviours such as signalling and herding can be observed in the market for health-related crowdfunding. Broader threats of market failure stemming from adverse selection and moral hazard also apply. Many of the discussed economic benefits and risks of crowdfunding health campaigns are shared more broadly with those of crowdfunding projects in other sectors. Where crowdfunding health care appears to diverge from theory is the negative externality inefficient priority setting may have towards achieving broader public health goals. Therefore, the market for crowdfunding health care must be economically stable, as well as designed to optimally and equitably improve public health.



## 1. Introduction

Crowdfunding has recently emerged as an innovative method of financing ventures that fall outside the purview of traditional capital markets (infoDev, 2013; Kirby and Worner, 2014). Crowdfunding is an alternative channel for financing a project that uses an online platform to solicit generally small contributions from numerous participants (i.e. the crowd). Crowdfunding is increasingly being used to bankroll health-related campaigns (Moran, 2017; Lancet Oncology, 2017; Young and Scheinberg, 2017).

Crowdfunding in the health market presents unique economic applications, benefits, and risks, which have been inadequately explored. The purpose of this article is to formulate a helpful typology for crowdfunded health campaigns and review the broad economic benefits and risks of crowdfunding in the health market. Our typology and assessment aims to equate the fundamental principles and theory of crowdfunding with evidence and examples of health-related crowdfunding. This process was informed by a rapid evidence review and from interviews with selected experts on crowdfunding.

## 2. Background

The fundamental principles and theory of crowdfunding, discussed below, guided the methodological development of our literature search and interview questions. In addition, these principles and theoretical lenses provide the sensitizing and inductive devices used in our empirical analysis.

### 2.1. Fundamental principles of crowdfunding

A crowdfunding transaction involves three key players: the project initiator who is seeking the funding, the funders who are offering the financing, and the platform provider who is linking the project initiator with funders through an online forum (Kuti, 2014).

* Corresponding author.
*E-mail address:* e.a.mossialos@lse.ac.uk (E. Mossialos).

http://dx.doi.org/10.1016/j.socscimed.2017.08.035

The project initiator is not always the beneficiary of the funding and may act as a representative for another individual. What separates crowdfunding from more traditional financing mechanisms is the online forum, which provides a uniquely accessible method of allowing average people to participate in the funding process and allowing small- and medium-sized enterprises (SMEs) to seek funding external from banks.

Three funding models typically characterize crowdfunding: reward-based, donation-based, and investment-based. Reward-based crowdfunding asks funders to contribute money in return for prizes (Belleflamme et al., 2015). Donation-based crowdfunding involves participants offering philanthropic contributions to a project (Belleflamme et al., 2015). Finally, investment-based crowdfunding is characterized by participants providing financing through high-interest loans or in return for an equity-stake in the company (Belleflamme et al., 2015). These tend to be much larger projects as they present earning potential for funders.

Well known crowdfunding platforms include Kickstarter, GoFundMe, Indiegogo, Crowdcube, and FundRazr. According to Massolution (2015), a US research firm, there are over 1250 crowdfunding platforms around the world, raising US $16.2 billion in 2014, up 167% from US $6.1 billion the previous year. Massolution estimated that this growth rate will have held for 2015 with expected crowdfunding volumes to reach US $34.4 billion by 2016. This progress is generated from growing uptake in North America and Europe as well as significant growth in Asia. The global crowdfunding market could be further augmented by up to US $96 billion, unlocked from emerging economies in Africa, Asia, and South America (infoDev, 2013). While dwarfed by the trillions of dollars financed through traditional capital markets, these figures demonstrate a growing and formidable niche market in the financial world (Belleflamme et al., 2015).

### 2.2. Crowdfunding theory

Behavioural and economic theory can aid in understanding the recent rise of crowdfunding, the main benefits from participating, and possible market failures. According to Agrawal et al. (2014), crowdfunding has developed as a result of the commercialization of modern-day Internet. Web 2.0 has lowered the transaction costs and financial risks of crowdfunding to the point where it is an economically viable method of financing small ventures. For instance, the Internet lowers search costs by facilitating cheap, effective, and efficient matching of funders and project initiators (Agrawal et al., 2014). Communication costs are also lower, allowing funders to easily gather information, monitor their investment, and engage with the project initiator, regardless of their geographic location (Agrawal et al., 2014). In addition, the large number of funders accessible through the Internet allows a project's risk to be spread over many contributors and permits funders to contribute small denominations (Agrawal et al., 2014).

In some circumstances, market participants may prefer crowdfunding over traditional funding sources (Agrawal et al., 2014). From the project initiator's perspective, crowdfunding can lower the cost of accessing capital by: matching project initiators with funders that have the highest willingness to pay; bundling multiple project goals together; and generating valuable social media attention. Project initiators may also view crowdfunding as a way of engaging their customer base and accessing valuable market information from funders such as customer preferences (Agrawal et al., 2014; Gerber and Hui, 2013). Funders may participate because they can access affordable investment opportunities without being an accredited investor, acquire products before mainstream uptake, participate in the crowdfunding community, support a project that is important to them, and formalize their contribution through a reputable platform (Agrawal et al., 2014). The crowdfunding platforms themselves are motivated by the profit potential generated from nominal and percentage transaction charges on contributions (Agrawal et al., 2014; Belleflamme et al., 2015).

However, the market for crowdfunding is susceptible to market inefficiencies that may impede economically valuable transactions or even cause market failure. The primary dilemma appears to be asymmetrical information (Agrawal et al., 2014; Belleflamme et al., 2015; Belleflamme and Lambert, 2014; Schweinbacher and Larralde, 2012). In reality, the project creator will know more about the project than the funder. This discrepancy in information availability is amplified in the crowdfunding setting. Project initiators are often geographically isolated from their funders whom are often inexperienced in the project field (Agrawal et al., 2014; Agrawal et al., 2015). Thus, the relationship between funders and the project initiator is described as that of a principal and agent (Fig. 1) (Ley and Weaven, 2011). The project initiator (i.e. the agent) is essentially paid to carry out the project's stated goals on behalf of the funders (i.e. the principal).

Two chief negative outcomes can arise from a principal-agent relationship: moral hazard and adverse selection (Agrawal et al., 2014). Moral hazard would describe a situation where a project initiator acts in self-interest and fails to deliver on project goals (Agrawal et al., 2014; Strausz, 2016). Given the nature of crowdfunding, funders cannot easily hold the initiator accountable or may not be privy to information regarding the project's progress and success. Adverse selection might occur when high-quality project initiators consistently choose to access funding through more traditional avenues like banks, leaving only low-quality ventures in the crowdfunding market pool (Agrawal et al., 2014). Both moral hazard and adverse selection could drive funders out of the market. Consequently, signalling is an important aspect of crowdfunding (Belleflamme et al., 2015). Project initiators will actively signal to potential investors that they have a high-quality campaign and are committed to fulfilling their stated long-term goals by promoting on social media, brandishing past successful projects, and offering prizes to early contributors.

Herding behaviour is another consequence of information asymmetry that has been observed in the crowdfunding market (Agrawal et al., 2014; Belleflamme et al., 2015; E. Lee and Lee, 2012). Herding occurs when funders collectively make inferences about project quality based on decisions of other funders. There is a tendency for funders to swarm projects that are receiving strong support because the crowd perceives these projects to be higher quality. Several studies suggest that herding behaviour in crowdfunding can lead to efficient outcomes in certain circumstances (Burtch et al., 2013; Freedman and Jin, 2008; J. Zhang and Liu, 2012), while another study found that irrational herding dominates the market (Chen and Lin, 2014). Herding is particularly problematic when collective funder decisions are made at the expense of conducting individual due diligence. A free-rider scenario could arise when funders choose to postpone funding until a project has been vetted by early contributors and reached a certain threshold indicating quality (Agrawal et al., 2014; Belleflamme et al., 2015; Boudreau et al., 2015). The market could fail if everyone acts as a free-rider resulting in no projects being fully funded.

## 3. Research methodology

Our research has two key objectives: determine how crowdfunding is applied in the health sector and assess the important economic benefits and risks of crowdfunding in the health market. Our research methodology was a rapid evidence review of peer- and non-peer reviewed literature that was supplemented with

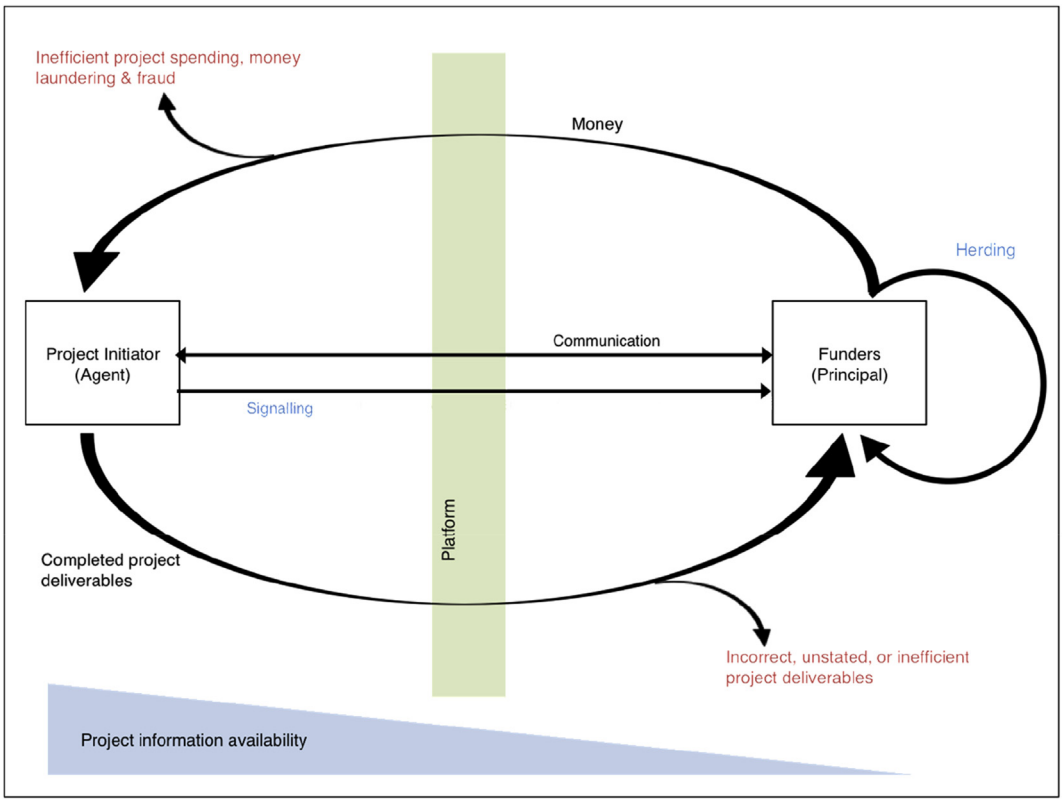


**Fig. 1.** Information asymmetry in crowdfunding.

targeted interviews with crowdfunding experts. The literature search and interview questions were informed and directed by the principles and theories of crowdfunding discussed above.

We reviewed peer-reviewed articles with use of EconLit, MEDLINE (PubMed), Embase (Ovid), Scopus, and Web of Science. We used the following search terms across the above databases: “crowdfund”, “theory”, “model”, “platform”, “reward”, “donation”, “investment”, “equity”, “loan”, “market failure”, “principle-agent”, “information asymmetry”, “moral hazard”, “adverse selection”, “herd”, “signal”, “output”, “impact”, “benefit”, “risk”, and “challenge”.

The search was restricted to papers published between January 1, 2006 and May 10, 2017, in English, and either journal articles, comments, editorials, or reviews. Following the initial compilation of search results and removal of duplicates, we further excluded papers that did not centrally focus on the topic of crowdfunding. Our search identified a total of 281 unique peer-reviewed papers focusing on crowdfunding.

A selection of non-peer reviewed literature was incorporated and identified through a Google search and from citations in key papers. In total, 51 non-peer reviewed texts were included and consisted of policy documents, working papers, conference presentations, and consulting reports. Upon reviewing 332 relevant documents, 43 texts were identified as specifically discussing health-related crowdfunding (Supplementary Material). Finally, a review of 25 key crowdfunding websites was conducted to link real world examples to the literature and theory.

We performed a series of hour-long telephone interviews with experts in the field of crowdfunding to validate and complement our conclusions drawn from the literature review. We used a combination of convenient and judgment sampling to select interviewees that were accessible and would have professional insight into the political and regulatory environment of crowdfunding (Marshall, 1996). We chose crowdfunding policy experts from the US and UK, as these are the two largest crowdfunding markets. In addition, we solicited input from the OECD to gain a global policy perspective and the European Crowdfunding Network to gather an industry perspective. Five out of the nine contacted experts were interviewed. We employed a semi-structured interview protocol (Supplementary Material) that covered the benefits and challenges of health-related crowdfunding, the role of regulations and policy, and future market prospects. We then allowed for unstructured dialogue of relevant topics. We did not believe it was beneficial for this exploratory review to conduct a larger, systematic interview process of stakeholders. Due to our small sample size, we did not use a coding system for interpreting the interviews.

## 4. Results

### 4.1. A typology for crowdfunding in the global health sector

Based on our review, we propose a typology for crowdfunded health projects, which can be classified into four categories based on the purpose and funding-type of the project (Table 1). The first can be termed health expenses, which are donation-based campaigns to fund out-of-pocket expenses for patients unable to afford particular medical services or products (Sisler, 2012). Examples of crowdfunded health expenses include cataract surgery, chemotherapy, motorized wheelchairs, and household accessibility adaptations. GoFundMe, one of the largest donation-based crowdfunding forums in the world, raised US $147 million for medically-related projects in 2014, up from US $6 million in 2012 (Cunha, 2015). Their health section for donations is the platform's most popular category and generated 26% of all donations in 2014.

**Table 1**
A typology of crowdfunded health projects.

| Project type | Definition | Financing method | Project examples | Platform examples |
|---|---|---|---|---|
| Health expenses | Crowdfunded health projects that finance an individual's out-of-pocket expenses for medical services and products | Donation-based | Surgery, chemotherapy, rehabilitative care, and mobility & accessibility adaptations | GoFundMe; Indiegogo; Watsi; Crowdfund Health; YouCaring; GiveForward |
| Health initiatives | Crowdfunded not-for-profit health initiatives that provide benefit to the wider public or a specific group of people. | Donation-based; Reward-based | Charitable fundraising, patient education programs, and disease awareness campaigns | KickStarter; Indiegogo, MedStartr |
| Health research | Crowdfunded not-profit-profit health research that typically focuses on treatments for rare or neglected diseases. | Donation-based | Basic health science research, genomic studies, and preclinical & early clinical studies | MyProjects; Consano; Cure Cancer Starter; Experiment; RocketHub; StartACure; WhenYouWish; Cancer Research UK; Give To Cure |
| Commercial health innovation | Crowdfunded for-profit health ventures that need additional capital to get off the ground. | Investment-based | Drug development, therapy innovations, and complimentary & alternative medical treatments | Crowdcube; ShareIn; MedStartr; Healthios Xchange; Wiseed; Venture Health; Homestrings |

The second type are not-for-profit health initiatives that include fundraising for medical institutions or charitable organizations, patient education programs, disease awareness campaigns, and global health missions. Contributions to these crowdfunded campaigns are typically incentivized through donations or offering rewards. A particularly well-known instance of a crowdfunded health initiative is the 2014 Ice Bucket Challenge, which supported patients with amyotrophic lateral sclerosis. The project raised over $115 million towards the ALS Association and Motor Neuron Disease Association (Chakradhar, 2015).

The third classification is health research. There is an emerging trend for health scientists to directly crowdfund donations for their not-for-profit research work (P. P. Cameron, 2013; Kaplan, 2013; Özedmir et al., 2015; Otero, 2015; Perlstein, 2013; Philippidis, 2013; Vachelard et al., 2016; Wheat et al., 2013). Crowdfunding, alongside crowdsourcing, has supported valuable scientific breakthroughs in understanding human metagenomics and microbiome dynamics (Debelius et al., 2016). Oncology research has been another major focus for crowdfunding efforts with a number of platforms dedicated to cancer-specific crowdfunding (Dragojlovic and Lynd, 2014).

Finally, innovative health care ventures that have commercial potential could access capital through investment-based, typically equity, crowdfunding. Pharmaceutical and biotech SMEs as well as spin-off companies from university research groups are using platforms such as Crowdcube and ShareIn to sell equity stakes in their company in return for capital (Fiminska, 2015). This money may be used to accelerate clinical testing and development of a novel therapy, expand health service offerings, or scale-up production and operations for a medical product.

### 4.2. Economic benefits of health-related crowdfunding

We identified four major economic benefits of health-related crowdfunding: expanding market participation, increasing funding access for individuals and SMEs, drawing awareness and funding to neglected issues, and improving social engagement. Table 2 summarizes these benefits across the four types of health-related crowdfunding.

#### 4.2.1. Expands funder participation in the health market

Crowdfunding appears to support and magnify systems of economic sharing on local, national, and global stages by breaking down institutional barriers and encouraging active participation (Share the World's Resources, 2014). Light and Briggs argue (2017) that “crowdfunding platforms collectively change the economic landscape and enfranchise new pockets of society to contribute and see their choices enacted.” Therefore, rather than redirecting funds through a different financing avenue, health crowdfunding may leverage globalization and capture new funding that would not have existed. Snyder et al. (2016) suggests that “compared to the experience people have when giving or considering donations to a large charitable organization, an individual's medical crowdfunding initiative can feel much more personal and compelling, leading to giving that would not have occurred otherwise.” In addition, more inclusive regulations for investment-based crowdfunding are increasingly permitting non-accredited investors to participate in the private equity market for biotech companies (Moran, 2017). A 2015 Biocom report estimates that there are over 100 million non-accredited US investors who could potentially participate in this venture capital market (Cameron et al., 2015).

#### 4.2.2. Improves individual and SME access to financial support

Crowdfunding may improve general access to financial support for SMEs and individuals (Valančienė and Jegelevičiūtė, 2013). A 2014 UK industry report found that 64% of those who raised money through a donation-based campaign indicated that it was ‘unlikely’ or ‘very unlikely’ they would have been able to access funds if alternative financing was not available (Baeck et al., 2014). Similarly, 53% of those using reward-based campaigns thought obtaining financing through traditional methods would have been ‘unlikely’ or ‘very unlikely’. The benefit of improved access to funding is evident in the health sector. In the US, medical expenses were the leading cause of bankruptcy in 2014 (Himmelstein et al., 2009). Crowdfunding now averts between an estimated 114 and 136 bankruptcies per quarter in the US, representing 3.9% of total bankruptcies caused by medical expenses (Burtch and Chan, 2015). A higher proportion of these US medical expense campaigns are hosted by patients located in states without the Affordable Care Act Medicaid expansion (Berliner and Kenworthy, 2017). Moreover, according to the 2015 Biocom analysis of life science crowdfunding, biotech companies are increasingly relying on investment-based crowdfunding as a means of raising capital (Wirsching et al., 2015). Between 2010 and 2015, a total of 42 European biotech companies raised €23 million through crowdfunding. The average amount raised by these companies was €550,000 and multiple companies raised over €1 million. This is a significant trend upwards from 2010 when the average equity-based life science campaign raised €127,000. Some of these SMEs state that they would not have been able to raise this capital and start their company without access crowdfunding.

#### 4.2.3. Draws awareness and funding to neglected health issues

In the health sector, rare diseases can sometimes be neglected by traditional financing sources. Crowdfunding may help pull money into these unique funding gaps. A 2016 Pew Research Centre

**Table 2**
Key economic benefits and concerns across the types of crowdfunded health projects.

| Project type | Benefits | Risks |
|---|---|---|
| Health expenses (Donation-based) | • Expands the pool of potential donors<br>• Draws money and attention to neglected and under-supported medical conditions<br>• Partially fills gap in medical care coverage for patients in need<br>• Backers can provide support community for the patient | • Asymmetrical information and poor project transparency makes it difficult for backers to ensure project accountability<br>• Risk of fraud and money laundering<br>• High transaction fees charged by platform may make crowdfunding an inefficient method of financing |
| Health initiatives (Donation-based; Reward-based) | • Expands the pool of potential donors<br>• Draws money and attention to neglected and under-supported health care issues<br>• Partially fills gap in access to financing for SMEs and individuals<br>• Backers can hold project initiators accountable & be engaged in initiative progress | • Asymmetrical information and poor project transparency can make it difficult for backers to ensure project accountability<br>• Risk of fraud and money laundering<br>• High transaction fees charged by platform may make crowdfunding an inefficient method of financing |
| Health research (Donation-based) | • Expands the pool of potential donors<br>• Draws money and attention to neglected and under-supported health research<br>• Partially fills gap in public and private funding of health research<br>• Backers can hold researchers accountable and be engaged in research progress | • Community unlikely able to efficiently select high-priority projects from a public health perspective<br>• Research projects may not be funded based on scientific merit<br>• Ethical dilemma created when patients can fund and participate in research pertinent to their own treatment<br>• Backer short-term goals can supersede more important long-term research goals<br>• Asymmetrical information and poor project transparency can make it difficult for backers to ensure project accountability<br>• Risk of fraud and money laundering<br>• High transaction fees charged by platform may make crowdfunding an inefficient method of financing |
| Commercial health innovation (Investment-based) | • Allows non-accredited investors to access the private equity market<br>• Draws money and attention to neglected and under-supported health innovation<br>• Partially fills gap in access to financing for SMEs<br>• Backers can hold SMEs accountable and be engaged in development progress<br>• Backers can offer additional expertise, resources, and support for SMEs | • Backers may not have expertise to efficiently select profitable projects<br>• Community unlikely able to efficiently select high-priority projects from a public health perspective<br>• High risk of project failure and backers losing their financial investment<br>• Asymmetrical information and poor project transparency can make it difficult for backers to ensure project accountability<br>• Laws and regulation of equity-based crowdfunding is limited in many countries<br>• Concerns of intellectual property rights protection limit the applicability of crowdfunding innovative ideas<br>• Risk of fraud and money laundering<br>• High transaction fees charged by platforms may make crowdfunding a relatively inefficient method of financing compared to traditional financing avenues |

survey found that 84% of donors believe that crowdfunding "highlights causes or businesses that might not get much attention otherwise " (Smith, 2016). For instance, GoFundMe's largest campaign to date raised more than USD $2 million from over 37,000 donors around the world to support a young girl with a very rare neurological condition, Sanfilippo Syndrome Type A (Young and Scheinberg, 2017). Additionally, crowdfunding may fill holes in health research agendas by funding niche or high-risk health science fields. There is building evidence to suggest that crowdfunding may be an effective method for bringing scientists and donors together to finance early stage clinical trials targeting rare and neglected diseases (Dragojlovic and Lynd, 2014; Hawkes and Thomson, 2015; Sharma et al., 2015). Crowdfunding proof-of-concept research and initial clinical trials could allow scientists to attain more substantial grant funding or entice private investment (Dragojlovic and Lynd, 2014; Orelli, 2012).

#### 4.2.4. Improved social engagement

In the article "A guide to scientific crowdfunding", Vachelard et al. (2016) recommend that engaging the public and their contributors is critical to a campaign's success. The most effective initiators tend to provide frequent project updates, reply to funder inquiries, and harness the power of social media (Belleflamme et al., 2013; Vachelard et al., 2016). On the other side, funders can see how the project is progressing, provide input where possible, and monitor the project's practices. Social networks of funders create a community around various projects that can quickly spread awareness and signal legitimacy to new contributors (Belleflamme et al., 2015; Lehner and Nicholls, 2014). Moreover, funder feedback delivers early-stage market testing for those projects that have a product or service output (Belleflamme et al., 2015). In the health sector, transparency and social engagement are particularly powerful because funders often have a personal connection with the individual, issue or business being financed (Smith, 2016). This intrinsic connection fosters openness and accountability in the crowdfunding relationship (Perlstein, 2013).

### 4.3. Economic risks of health-related crowdfunding

Based on our review, we have highlighted five economic risks related to crowdfunding health projects: inefficient priority setting, financial risks, unclear regulatory frameworks, issues of accountability, transparency, and due diligence, and risk of fraud and money laundering. Table 2 summarizes these concerns across the four types of health-related crowdfunding.

#### 4.3.1. Inefficient health priority setting

Crowdfunding may be an inefficient method of health priority setting and allocation of financing because decisions may be determined by funder sentiment and swayed by behavioural economic principles such as signalling and herding (Agrawal et al., 2014; Belleflamme et al., 2015). An increasing number of life science researchers and patients are turning to social media to solicit donations and attention for their campaign (Berliner and Kenworthy, 2017; Vachelard et al., 2016). The success of a research project or medical expense campaign is often largely based on an initiators ability to tap social networks (Barclay, 2012; Byrnes et al., 2014). There is concern that this may come at the cost

of determining health research financing based on scientific merit or health care funding based on clinical need (Del Savio, 2017; Snyder, 2016). Moreover, allowing patients to crowdfund or pay to participate in clinical trials poses an especially difficult ethical and economic dilemma. Patients may tend to support the short-term goals of a new intervention at the potential expense of longer-term medical evidence production (Wenner et al., 2015). In addition, crowdfunded clinical trials may not go through the same rigorous peer-review process as publicly funded trials to validate preclinical evidence (Wenner et al., 2015).

#### 4.3.2. Financial risks

An increasing number of countries are amending regulations to allow non-accredited investors to participate in investment-based crowdfunding (Cusmano, 2015; Hemmadi, 2015). However, introducing non-accredited investors to private equity investing and lending may expose inexperienced retail investors to more financial risk than they are aware (Kirby and Worner, 2014; Pazowski & Czudec, 2014). Start-up businesses seeking equity investment often have failure rates between 75% and 90% in the first five years (Hemmadi, 2015). Crowdfunded loans are often unsecured and there is minimal liquidity in the investment-based crowdfunding market, which has no secondary market (Hemmadi, 2015).

Financial risks also apply to donation- and reward-based crowdfunding campaigns where there is the possibility that a backed project does not produce its projected goal. Kickstarter, a reward-based platform, noted that 25% of start-up projects failed in the first year, 55% failed by year 5, and 71% failed by year 10 (Fronda, 2015). In cases where reward-based projects do not actually fail, the majority of campaigns do not deliver their reward on time. A 2014 study of 48,500 crowdfunded projects found that over 75% delivered their products later than originally promised (Mollick, 2014).

Another financial concern is that transaction fees levied by platform providers may be a source of economic inefficiency. Investment-based crowdfunding platforms typically charge around 5% on funds raised, which is in line with what major banks charge on initial public offerings (5–7%) (Belleflamme et al., 2015; PricewaterhouseCoopers, 2012). However, some donation-based and reward-based crowdfunding platforms seem to charge higher transaction fees on funds raised. For example, GoFundMe has a 5% participation fee, a 2.9% processing fee, and a flat 30 cent charge on all donations (Belleflamme et al., 2015). An average $10 donation with GoFundMe would incur a 10.9% charge. Kisskissbankbank, a popular French platform, charges a 5% commission plus a 3% bank fee, creating a total transaction fee of 8% (Belleflamme et al., 2015).

#### 4.3.3. Unclear regulatory framework

Existing regulatory definitions of crowdfunding appear to be ill-defined and there is little consensus among policy-makers regarding what should fall under existing and future crowdfunding regulation (INT-2, INT-3) (Cusmano, 2015). All the interviewed experts could not specify a country that employed a particularly enabling policy environment for crowdfunding that could guide future regulation development (INT-1, INT-2, INT-3, INT-4, INT-5). Regulators may be operating with limited knowledge and experience (INT-2, INT-3) and risk applying the wrong policy frameworks to differing crowdfunding models. This confusion is particularly evident with regards to peer-to-peer lending and crowdfunding securities, which often fall under the same regulations (European Crowdfunding Network, 2014).

Determining appropriate regulations for equity-based crowdfunding appears to be particularly challenging given its potential for economic impact (INT-1, INT-5). Important regulatory considerations include the size of equity offerings, capital requirements, registration with the national licensing authority, the number of investors per offer, restrictions on who can invest, and controls on how much they can invest (Kirby and Worner, 2014). Moreover, a common set of legal frameworks has not been established across borders (European Crowdfunding Network, 2014; Gabison, 2015). Countries frequently have divergent taxation and tax incentivization schemes for international platforms (European Commission, 2014). Finally, it is unclear the degree of liability international platform providers hold for screening risky, incompetent, unethical, or illegal projects (INT-2, INT-3).

These challenging questions are being discussed by government agencies like the European Commission, US Securities and Exchange Commission, UK Financial Conduct Authority, the Ontario Securities Commission, and the Australian Corporations and Markets Advisory Committee (Cusmano, 2015; Wirsching et al., 2015). There does not appear to be a practical role for a global crowdfunding regulator, but it seems that there is a trend towards international harmonization of crowdfunding regulation (INT-1, INT-2, INT-3). Large multinational banks, who perceive the crowdfunding market to have an unfair advantage over traditional capital markets, are responsible for increasing pressure and lobbying of regulators to further limit crowdfunding (INT-2, INT-3). Despite this, large banks are entering the crowdfunding space, which has benefited from years of low regulation.

The increasing regulation of the equity crowdfunding market is spilling into the non-investment markets. In the US, there are currently no specific policies or laws that govern donation- and reward-based crowdfunding (INT-1). But, the Federal Trade Commission and Association of United States Attorneys is now exploring ways to respond to the growing incidence of fraud on donation- and reward-based platforms (INT-1).

#### 4.3.4. Issues of accountability, transparency, and due diligence

The anonymity, geographic distance, and information asymmetry between funders and project initiators makes it challenging to ensure accountability, transparency, and due diligence across all projects (Agrawal et al., 2014; Kirby and Worner, 2014). Much of this responsibility falls on project initiators to provide necessary information to contributors and to fulfil the project's stated objectives (Agrawal et al., 2014). However, project initiators can avoid their responsibilities and there is a risk that contributors could lose their capacity to hold initiators accountable. Even when project information is made readily available, project goals can be vague or have unclear metrics on which contributors can gauge project progress or success. In addition, the average contribution is often small thereby reducing individual contributors' incentive to hold initiators accountable (Agrawal et al., 2014). Platform providers are increasingly expected to provide some screening, rule setting, and information to protect contributors from incompetent project initiators and to help contributors make informed decisions (Belleflamme et al., 2015).

An important issue related to transparency is intellectual property rights. Crowdfunded health and biotechnology start-ups are at risk for having their intellectual property stolen or plagiarized by others on the Web (European Commission, 2014). In the US, Title III of the JOBS Act requires equity-based crowdfunded projects to disclose detailed reports of company operations and finances to its investors (112 th US Congress, 2012). The project initiator must therefore balance their responsibilities of disclosure with the dangers of divulging proprietary information or company details to market competitors (Adams and Constantine, 2015). There is concern that disclosure of any proprietary information to funders may constitute as prior art, thus barring the initiator from claiming patent rights in the future (Adams and Constantine, 2015). While there are exemptions in the US that would allow project initiators to patent their invention post-crowdfundraising, many

foreign patent systems do not have the same leniencies (INT-2). Finally, it is important to recognize the expansive trademark and copyright entitlements platform providers attain through hosting a campaign (Adams and Constantine, 2015).

#### 4.3.5. Risk of fraud and money laundering

Online crowdfunding leaves contributors susceptible to fraud because traditional legal and reputation security measures may not work (Gabison, 2015). There have been several legal cases against crowdfunders whom fraudulently collected donations for a medical condition they did not have (Snyder, 2016). The relatively small average contribution and anonymity of the project initiator disincentivizes legal action in the event of fraudulent behaviour (Agrawal et al., 2014). Also, initiators often do not have the same traditional motivation to protect their reputation and goodwill because they are anonymous and frequently one-off participants. There appears to be some risk for money laundering, which could support narcotics deals, terrorism, and other illegal activities (Robock, 2014). Both fraud and money laundering seem to be rare and do not significantly discourage people from participating in crowdfunding (European Commission, 2014). Nonetheless, states are working to further develop anti-fraud and anti-money laundering safeguards (INT-1) (European Commission, 2014).

## 5. Discussion

Health policy makers need to be aware of and understand the growing economic impact of health-related crowdfunding. Countries will likely continue to embrace health-related crowdfunding because it expands health market participation, improves individual and SME access to funding, pulls funding to neglected health issues, and encourages project accountability and community engagement. Regulators in North America and Europe are working to delineate regulatory systems that integrate crowdfunding into their existing financial markets (European Crowdfunding Network, 2014). However, policy makers are faced with market risks that could impact the health sector such as inefficient priority setting, heightened financial risk, inconsistent regulatory policies, intellectual property rights concerns, and fraud. Self-regulation within the crowdfunding community may serve to compliment formal policy. Professional accreditation (e.g. Crowdfunding Accreditation for Platform Standards) and systems for tracking fraudulent campaigns exist (e.g. www.gofraudme.org), however these programs do not seem widely recognized or utilized.

Crowdfunding theory and the principle-agent relationship are useful tools for understanding crowdfunding in the health sector. Theorized crowdfunding behaviours such as signalling and herding are likely present in the market for crowdfunding health. In addition, broader threats of market failure stemming from adverse selection and moral hazard may also apply. Consequently, many of the discussed benefits and risks of crowdfunding health campaigns are shared more broadly with those of crowdfunding projects in other sectors. Equity-based projects seem particularly prone to market failures due to the financial sensitivity of their investors and the greater size of the potential market compared to those of reward- or donation-based campaigns. Therefore, the outlined economic risks in this paper may apply more significantly to equity-based projects in health care.

Where crowdfunding in health appears to diverge from generalized crowdfunding theory is the negative externality inefficient priority setting may have towards achieving broader public health goals. Where most of the highlighted benefits and risks focus on crowdfunding participants, the issue of inefficient priority setting could affect the health of people beyond the crowdfunding market. Scientific research, social initiatives, and innovation in health care have a uniquely direct impact on individuals suffering from medical conditions. Therefore, this new market for health cannot just be economically stable; it must also be designed to optimally and equitably improve public health.

Policy makers in countries with insurance gaps and inadequate universal health care coverage must realize that health-related crowdfunding is often a symptom of gaps in health policy. Individuals crowdfund their medical expenses because health insurance coverage in their country is incomplete (Snyder, 2016); scientists turn to crowdfunding as public grant funding declines and pharmaceutical companies de-risk their R&D portfolios (Dragojlovic and Lynd, 2014); start-up entrepreneurs solicit the 'crowd' because they are unable to access capital through conventional avenues (Wirsching et al., 2015). It seems impractical to patch all these gaps in access to financing using crowdfunding. It is our opinion that crowdfunding is a complimentary financing tool in health care that can offer interim financial relief while improved policies are designed and implemented. Particularly troublesome is the inordinate number of crowdfunding projects for covering medical expenses, highlighting the need for improved health insurance coverage around the world. While altruistic crowdfunding partially fills this medical insurance gap, it should not be thought of as a practical method for mitigating user charges and attaining universal health coverage in any country, particularly developing countries.

Crowdfunding could play a more valuable role in health science research, non-profit health initiatives, and commercial innovation. Crowdfunding offers the possibility of much needed access to funding for scientists that can make important contributions to often-neglected medical research. Valuable non-profit health programs are additionally benefiting from new financing driven by crowdfunding. We believe this opportunity to expand funding for non-profit health ventures should be better guided by sound evidence and health priority setting, which are often lacking in the current system. Crowdfunding for-profit health ventures also seems promising and allows SMEs to more effectively compete in the health sector. At present, the scalability of health care crowdfunding appears generally capped at projects under €1 million (Moran, 2017). However, crowdfunding may allow health researchers and SMEs to validate the worthiness or profitability of their venture to larger companies and major private investors thereby opening access to additional financing. Regulators look to be moving in the right direction by trying to improve the market's stability, but it appears there is a need for greater legal and regulatory harmonization across borders. Additionally, the risk of illegal activity could threaten needed confidence in the fledgling crowdfunding market and, thus policy makers must approach this issue seriously.

Many of the economic risks stem, at least in part, from the principal-agent relationship and the associated information asymmetry. Thus, there could be an important role for targeted regulation that minimizes steep information asymmetry gradients between initiators and funders. For instance, it may be valuable to have a credentialing body endorsed by relevant scientific associations that could certify a crowdfunding project's credibility and rate the project's health care value. In parallel, a financial regulatory agency specific to crowdfunding could assess project financial riskiness, impose solvency requirements on funders and initiators, monitor illegal activity, regulate transaction charges levied by platforms, and ensure platform transparency. In this way, public health objectives could be fostered and the market's economic stability could be strengthened.

There are a couple limitations to this review. First, the simple sampling strategy used to solicit interviews does not capture the full range of stakeholders in the crowdfunding market. This

sampling technique was only used to validate and compliment the main results from our rapid evidence review. It is our hope that a comprehensive primary research project employing a rigorous interviewing protocol will build on this introductory review. Second, this review solely focuses on the economic issues of crowdfunding health care; there are a variety of important ethical and social issues, discussed in other articles, that we do not broach such as equity, access, autonomy, and privacy (Berliner and Kenworthy, 2017; Shaw et al., 2016; Snyder, 2016; Snyder et al., 2016). Understanding the role of these other aspects in conjunction with the economic issues we raise is critical to understanding the complete set of benefits and risks of crowdfunding health care, especially crowdfunding medical expenses.

## 6. Conclusion

This review demonstrates that crowdfunding plays a unique and growing role in the global health sector. There appears to be four major types of crowdfunded health projects that present important economic benefits and risks. The limited scope of literature on this topic indicates that the importance of health-related crowdfunding may be underappreciated. Consequently, as crowdfunding seizes a larger role in health care, there will be a need for greater academic scrutiny and scholarship in this field. Research in health-related crowdfunding can support evidence-based policy frameworks that enhance the health sector and allow it to evolve with crowdfunding. A valuable first step would be a comprehensive mapping and quantification of health-related crowdfunding campaigns with the goal of identifying measures to mitigate the economic risks identified in this review.

## Acknowledgements

We would like to thank the following for taking the time to be interviewed: Richard Swart (Institute for Money, Technology, & Financial Inclusion, University of California, Irvine); Lucia Cusmano and Kris Boschmans (Centre for Entrepreneurship, SMEs, and Local Development, OECD); Oliver Gajda (European Crowdfunding Network); and Jason Pope (UK Financial Conduct Authority). The discussion and conclusions made in this paper are wholly the authors' and do not necessarily reflect those individuals that were interviewed.

## Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.socscimed.2017.08.035.

## References

112 th US Congress, 2012. Jumpstart Our Business Startups Act. Title III - Crowdfunding, 2nd Session.
Adams, L., Constantine, D., 2015. Crowdfunding and IP in health and biotech start-ups (Part 3): potential dangers. https://www.globalipmatters.com/2015/06/29/crowdfunding-and-ip-in-health-and-biotech-start-ups-part-3-potential-dangers (Accessed 23 May 2017).
Agrawal, A., Catalini, C., Goldfarb, A., 2014. Some simple economics of crowdfunding. Innov. Policy Econ. 14 (1), 63–97.
Agrawal, A., Catalini, C., Goldfarb, A., 2015. Crowdfunding: geography, social networks, and the timing of investment decisions. J. Econ. Manag. Strategy 24 (2), 253–274.
Baeck, P., Collins, L., Zhang, B., 2014. Understanding Alternative Finance. The UK alternative finance industry report 2014. Nesta. https://www.nesta.org.uk/sites/default/files/understanding-alternative-finance-2014.pdf (Accessed 23 May 2017).
Barclay, E., 2012. The Sick Turn to Crowd Funding to Pay Medical Bills. NPR Shots. http://www.npr.org/sections/health-shots/2012/10/23/163489063/the-sick-turn-to-crowdfunding-to-pay-medical-bills. (Accessed 18 August 2016).
Belleflamme, P., Lambert, T., 2014. Crowdfunding: some empirical findings and microeconomic underpinnings. Revue Banc. Financ. 4, 288–296.
Belleflamme, P., Lambert, T., Schwienbacher, A., 2013. Individual crowdfunding practices. Ventur. Cap. 15 (4), 313–333.
Belleflamme, P., Omrani, N., Peitz, M., 2015. The economics of crowdfunding platforms. Inf. Econ. Policy 33, 11–28.
Berliner, L.S., Kenworthy, N.J., 2017. Producing a worthy illness: personal crowdfunding amidst financial crisis. Soc. Sci. Med. 187, 233–242.
Boudreau, K.J., Jeppesen, L.B., Reichstein, T., Rullani, F., 2015. Crowdfunding as "donations": Theory & Evidence. Harvard Business School. Working Paper 16-038.
Burtch, G., Chan, J., 2015. Does Medical Crowdfunding Reduce Bankruptcy Rates in the United States? An Empirical Analysis. SSRN. https://ssrn.com/abstract=2676821.
Burtch, G., Ghose, A., Wattal, S., 2013. An empirical examination of the antecedents and consequences of contribution patterns in crowd-funded markets. Inf. Syst. Res. 24 (3), 499–519.
Byrnes, J.E.K., Ranganathan, J., Barbara, L.E., Faulkes, Z., 2014. To crowdfund research, scientists must build an audience for their work. PLoS One 9 (12), e 110329.
Cameron, P.P., 2013. Crowdfunding genomics and bioinformatics. Genome Biol. 14 (9), 134–134.
Cameron, M., Flach, E., MacDonald-Korth, D., Manaktala, N., Walker, T., 2015. Democratising Finance: Alternative Finance Demystified (Pp. 1–81) (DealIndex).
Chakradhar, S., 2015. In new crowdfunding trend, donors decide fate of clinical trials. Nat. Publ. Group 21 (2), 101–102.
Chen, D., Lin, Z., 2014. Rational or Irrational Herding in Online Microloan Markets: Evidence from China. SSRN. https://ssrn.com/abstract=2425047.
Cunha, D., 2015. Americans are Crowdfunding Health Care. They Shouldn't Have to. TIME. http://time.com/3831505/crowdfunding-health-care/.
Cusmano, L., 2015. Case study on crowdfunding. OECD. http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=CFE/SME(2013)7/ANN1/FINAL&docLanguage=En (Accessed 23 May 2017).
Debelius, J.W., Vazquez-Baeza, Y., McDonald, D., Xu, Z., Wolfe, E., Knight, R., 2016. Turning participatory microbiome research into usable data: lessons from the American gut project. J. Microbiol. Biol. Educ. 17 (1), 46–50.
Del Savio, L., 2017. The place of crowdfunding in the discovery of scientific and social value of medical research. Bioethics 31 (5), 384–392.
Dragojlovic, N., Lynd, L.D., 2014. Crowdfunding drug development: the state of play in oncology and rare diseases. Drug Discov. Today 19 (11), 1775–1780.
European Commission, 2014. Communication from the commission to the european parliment, the council, the european economic and social committee and the committee of the regions: unleashing the potential of crowdfunding in the european union, 2014, 1–12 (Brussels).
European Crowdfunding Network, 2014. Review of Crowdfunding Regulation: Interpretations of Existing Regulation Concerning Crowdfunding in Europe, North America and Israel, pp. 1–284.
Fiminska, Z., 2015. People power: can crowdfunding provide money for drug discovery? http://social.eyeforpharma.com/research-development/people-power-can-crowdfunding-provide-money-drug-discovery (Accessed 23 May 2017).
Freedman, S., Jin, G.Z., 2008. Do Social Networks Solve Information Problems for Peer-to-Peer Lending? Evidence from Prosper.com. SSRN. https://ssrn.com/abstract=1936057.
Fronda, A., 2015. Investors Navigate the Risks of Crowdfunding. World Finance. https://www.worldfinance.com/markets/investors-navigate-the-risks-of-crowdfunding. (Accessed 30 August 2017).
Gabison, G.A., 2015. Understanding Crowdfunding and its Regulations (pp. 1–40). European Commission. Joint Research Centre, Institute for Prospective Technological Studies.
Gerber, E.M., Hui, J., 2013. Crowdfunding: motivations and deterrents for participation. ACM Trans. Comput. Hum. Interact. 20 (6).
Hawkes, D., Thomson, M., 2015. Clinical trials: crowdfunded trials doubly scrutinized, 528 (7582), 333–333.
Hemmadi, M., 2015. Equity crowdfunding will soon be legal in Canada. Should you jump in? http://www.canadianbusiness.com/investing/equity-crowdfunding-for-canadians/ (Accessed 23 May 2017).
Himmelstein, D.U., Thorne, D., Warren, E., Woolhandler, S., 2009. Medical bankruptcy in the United States, 2007: results of a national study. Am. J. Med. 122 (8), 741–746.
infoDev, 2013. Crowdfunding's Potential for the Developing World (Pp. 1–103). World Bank, Washington, DC. http://www.infodev.org/infodev-files/wb_crowdfundingreport-v12.pdf (Accessed 23 May 2017).
Kaplan, K.K., 2013. Crowd-funding: cash on demand. Nat. Lond. 497 (7447), 147–147.
Kirby, E., Worner, S., 2014. Crowd-funding: an Infant Industry Growing Fast (Pp. 1–63). International Organization of Securities Commissions, Madrid, Spain. https://www.iosco.org/library/pubdocs/pdf/IOSCOPD459.pdf (Accessed 23 May 2017).
Kuti, M., 2014. Crowdfunding. Public Financ. Q. 59 (3), 355–366.
Lancet Oncology, 2017. Mind the gap: charity and crowdfunding in health care, 18 (3), 269.
Lee, E., Lee, B., 2012. Herding behavior in online P2P lending: an empirical investigation. Poverty, Technol. Microfinance 11 (5), 495–503.
Lehner, O.M., Nicholls, A., 2014. Social finance and crowdfunding for social enterprises: a public-private case study providing legitimacy and leverage. Ventur.

Cap. 16 (3), 271–286.
Ley, A., Weaven, S., 2011. Exploring agency dynamics of crowd funding in start-up capital financing. Acad. Entrepreneursh. J. 17 (1), 85–110.
Light, A., Briggs, J., 2017. Crowdfunding Platforms and the Design of Paying Publics. In: CHI 2017. ACM, New York, pp. 797–809. ISBN 978-1-4503-4655-9.
Marshall, M.N., 1996. Sampling for qualitative research. Fam. Pract. 13 (6), 522–526.
Massolution, 2015. 2015CF: The Crowdfunding Industry Report. http://reports.crowdsourcing.org/index.php?route=product/product&product_id=54&tracking=5510b714cd9f5. (Accessed 29 August 2017).
Mollick, E., 2014. The dynamics of crowdfunding: an exploratory study. J. Bus. Ventur. 29 (1), 1–16.
Moran, N., 2017. Biotech startups woo increasing numbers of crowdfunders. Nat. Biotechnol. 35 (4), 299–300.
Orelli, B., 2012. Biotech crowdfunding paves way for angels. Nat. Biotechnol. 30 (11), 1020.
Otero, P., 2015. Crowdfunding. A new option for funding health projects. Arch. Argent. De. Pediatr. 113 (2), 154–157.
Özedmir, V., Faris, J., Srivastava, S., 2015. Crowdfunding 2.0: the next generation philanthropy. Sci. Soc. 16 (3), 267–271.
Pazowski, P., Czudec, W., 2014. Economic Prospects and Conditions of Crowdfunding (Pp. 1–10). Pororoz, Slovenia. http://www.toknowpress.net/ISBN/978-961-6914-09-3/papers/ML14-685.pdf (Accessed 23 May 2017).
Perlstein, E.O., 2013. Anatomy of the Crowd4Discovery crowdfunding campaign. SpringerPlus 2 (560), 1–3.
Philippidis, A., 2013. Crowdfunding touches down in biotech. Genet. Eng. Biotechnol. News 33 (10), 6–8.
PricewaterhouseCoopers, 2012. Considering an IPO? The costs of going and being public may surprise you. https://www.strategyand.pwc.com/media/file/Strategyand_Considering-an-IPO.pdf (Accessed 23 May 2017).
Robock, Z., 2014. The risk of money laundering rough crowdfunding: a funding portal's guide to compliance and crime fighting. Mich. Bus. Entrep. Law Rev. 4 (1), 1–19.
Schweinbacher, A., Larralde, B., 2012. Crowdfunding of small entrepreneurial ventures. In: Cumming, D. (Ed.), The Oxford Handbook of Entrepreneurial Finance.
Share the World's Resources, 2014. A primer on global economic sharing. http://www.sharing.org/information-centre/reports/primer-global-economic-sharing (Accessed 23 May 2017).
Sharma, A., Khan, J.S., Devereaux, P.J., 2015. Is crowdfunding a viable source of clinical trial research funding? Lancet 386 (9991), 338.
Shaw, D., de Wert, G., Dondorp, W., Townend, D., Bos, G., van Gelder, M., 2016. Permitting patients to pay for participation in clinical trials: the advent of the P4 trial. Med. Health Care, Philos. 20 (2), 219–227.
Sisler, J., 2012. Crowdfunding for medical expenses. Can. Med. Assoc. J. 184 (2), E123–E124.
Smith, A., 2016. Shared, Collaborative and on Demand: the New Digital Economy. Pew Research Centre. http://www.pewinternet.org/2016/05/19/the-new-digital-economy/ (Accessed 23 May 2017).
Snyder, J., 2016. Crowdfunding for medical care: ethical issues in an emerging health care funding practice. Hastings Cent. Rep. 46 (6), 36–42.
Snyder, J., Mathers, A., Crooks, V.A., 2016. Fund my treatment!: a call for ethics-focused social science research into the use of crowdfunding for medical care. Soc. Sci. Med. 169, 27–30.
Strausz, R., 2016. A Theory of Crowdfunding - A Mechanism Design Approach with Demand Uncertainty and Moral Hazard. SSRN. http://ssrn.com/abstract=2766550 (Accessed 23 May 2017).
Vachelard, J., Gambarra-Soares, T., Augustini, G., Riul, P., Maracaja-Coutinho, V., 2016. A guide to scientific crowdfunding. PLoS Biol. 14 (2), e1002373.
Valančienė, L., Jegelevičiūtė, S., 2013. Valuation of crowdfunding: benefits and drawbacks. Econ. Manag. 18 (1), 1–10.
Wenner, D.M., Kimmelman, J., London, A.J., 2015. Patient-funded trials: opportunity or liability? Stem Cell 17 (2), 135–137.
Wheat, R.E., Wang, Y., Byrnes, J.E., Ranganathan, J., 2013. Raising money for scientific research through crowdfunding. Trends Ecol. Evol. 28 (2), 71–72.
Wirsching, S., Laqua, M., Colthorpe, J., 2015. Analysis of crowd- based financing in european life sciences. BIOCOM AG (pp. 1–60). https://biocom.de/en/consulting-and-studies/analyses-and-research/analysis-of-crowd-based-financing-in-the-european-life-sciences/ (Accessed 23 May 2017).
Young, M.J., Scheinberg, E., 2017. The rise of crowdfunding for medical care: promises and perils. JAMA 317 (16), 1623–1624.
Zhang, J., Liu, P., 2012. Rational herding in microloan markets. Manag. Sci. 58 (5), 892–912.