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# Online Innovation Intermediaries as a Critical Bridge between Patients and Healthcare Organizations

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**Abstract.** In healthcare, a promising direction for innovation lies in harnessing the innovation potential of patients. Web-based platforms have created a new and powerful route to open innovation in healthcare. In a sector where knowledge resources within organizational boundaries are limited, this study is focused on understanding how online innovation intermediaries (OIs) in healthcare help to transfer relevant knowledge towards innovating healthcare organizations. Through a qualitative design, we collected data through 23 interviews with CEOs/founders from OI organizations across eight countries. This paper uncovers what OIs in healthcare actually do when they engage in co-creation activities with the ecosystem of stakeholders. We suggest there are four distinct types of OI in healthcare. OIs can help healthcare organizations to adopt appropriate strategies and practices to embrace consumers as partners in the development and delivery of innovative healthcare products and services.

**Keywords:** Open Innovation, Co-Creation, Intermediaries, Healthcare, Information Systems

## 1 Introduction

Healthcare is perhaps one of the most significant social and economic issues facing societies across the globe. Not only does it account for a substantial proportion of national expenditure in many nations [1], it is a domain that affects the lives of every individual in a society. To the degree that healthcare systems are struggling with a multitude of challenges ranging from rising costs, to questionable quality, to an increasing number of medication resistant pathogens, to pandemics arising in part by globalization, it is not surprising that innovation is an activity of central and crucial importance in this sector.

While innovation has traditionally been acknowledged as a collaborative, multi-player activity, in today's knowledge rich environment even the largest healthcare organizations (HCOs), such as pharmaceutical or medical technology companies, experience a bottleneck of internal knowledge resources, fueling the search to engage and employ a wide range of additional players. The ideas behind "open innovation" essentially involve finding ways to cast a wide net for sourcing knowledge by mobilizing the experience and creativity of a wider range of players in what was traditionally regarded as an "internal

to the company” innovation process. Through engagement with the new players, companies are able to expand their search for novel and sustainable solutions [2, 3].

In the context of healthcare, a promising direction for innovation lies in harnessing the innovation potential of individual patients and their care-providers [4–6]. There are many examples where patients have played a key role in developing solutions to their healthcare challenges – and there is evidence that this process is accelerating [7–9]. Today, web 2.0 technology and interactive online platforms have created a new and powerful route to open innovation in healthcare. In the past decade we observe an increasing number of health-related online platforms that, in addition to traditional resources such as health professionals and books, help sick and well people to gather additional information on medical conditions, share their medical experience, and discuss questions and concerns [10, 11]. Based on prior research [12–14], some of these online health platforms can support and contribute to innovation activities in modern healthcare systems. The vast majority of the literature on health-related online platforms though emphasizes the impact on easier information retrieval, sharing, and creation [13–16]. A dedicated link towards innovation outcomes, i.e. developing new ideas with healthcare consumers and exploiting those ideas through healthcare organizations, is widely neglected.

By contrast, in other sectors quite distant from healthcare, there is evidence in academic literature that manufacturing firms work together with consumers through third-party online platforms for innovation purposes [17–19]. When we compare those sectors, we find that the healthcare sector works in a structurally different and very complex set-up. For example, organizations have to deal with a much higher degree of regulatory requirements and patients are involuntarily forced to be end consumers of healthcare products and services once an illness occurs. We argue that this has implications for the design and management of health-related online platforms. Such platforms fundamentally serve as intermediaries between healthcare consumers, e.g. patients, and seeking healthcare organizations, e.g. medical manufacturing firms. Intermediaries can support the generation, aggregation and transmission of patients’ knowledge and ideas towards innovating firms, providing critical tacit knowledge and experiences. Yet extant knowledge about the nature, functioning, and effects of these intermediaries and how they accommodate the distinctive healthcare set-up is limited. To the degree that innovation intermediaries will become increasingly significant in a sector where knowledge resources within organizational boundaries are limited, this study focuses on understanding how online innovation intermediaries (OII) in healthcare help to bridge and transfer relevant knowledge towards innovating healthcare organizations. Therefore, we address the following research question: What are the key activities of OII in healthcare, and how do these activities conceptually bundle together across different OII?

In the next section, we present a brief theoretical background on the role of intermediaries and review prior research on OII in healthcare. Section three describes the qualitative research design as well as how the data analysis was performed. Findings based on interviews are presented in section four, including rich empirical evidence. The paper concludes with a discussion of findings as well as implications for research and practice.

## **2 Theoretical Background and Prior Research**

### **2.1 The role of intermediaries in the innovation process**

Different strands of research elaborate on the importance of external sources of knowledge for enhancing firms' capability to innovate, e.g. research on technological change [20], collective invention [21], user innovation [22], and open innovation [2]. To facilitate these knowledge inflows, a large number of players have emerged in the last decade that serve as intermediaries in an open innovation process, i.e. that bring into the innovation process of established organizations a wider range of external players including their expertise. Howells (2006:720) defines an innovation intermediary as follows: "An organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties. Such intermediary activities include: helping to provide information about potential collaborators; brokering a transaction between two or more parties; acting as a mediator, or go-between, bodies or organizations that are already collaborating; and helping find advice, funding and support for the innovation outcomes of such collaborations".

In the virtual world, a number of OIIs have emerged who leverage the Internet to support the innovation capacity of manufacturing firms. In contrast to innovation intermediaries in the physical world, those who operate in virtual environments are able to offer significantly richer capabilities with regard to network access, knowledge absorption, knowledge integration, and knowledge implementation [24]. Health-related online platforms can also act as OIIs when bridging the gap between the online crowd of healthcare consumers and healthcare organizations seeking to innovate. Such HCOs can greatly benefit from OIIs for two reasons [24]. First, they help to augment the network access by enhancing the reach in engaging with customers. And second, firms can gain richness through bidirectional interactions and higher quality content.

Conceptually, there are three main players involved in the intermediation process in healthcare: the healthcare consumers, the health-related online platforms, and healthcare organizations/firms. A central role is assumed by health-related online platforms, such as virtual patient communities. They attract and pool healthcare consumers as users according to the platform's leading theme, i.e. medical focus. The consumers are interested in gathering information on specific medical conditions, or may want to exchange with peers on a particular topic through discussion boards, chats or social networking. The intermediary platform may collect users' knowledge over time, and exploit it in a variety of ways. For example, one possible way is that the data could be analyzed and aggregated into some new form by the intermediary himself. From the perspective of the innovation process, however, it is important that the newly gathered knowledge is being transferred to a HCO which can exploit it for the purpose of research and development of new products, for example. The term "healthcare organization" (HCO) comprises different types of commercial or non-commercial organizations in the health sector that search to engage external sources of knowledge to nourish the corporate innovation capacity, such as pharmaceutical companies and medical technology companies, or hospitals and nursing homes.

## 2.2 Empirical evidence of OIIs in the literature

Despite a modest literature on the topic of online innovation intermediaries in the health sector, there is limited scholarly analysis of their and their contribution to innovation outcomes. A summary of OIIs discussed in prior research is presented below.

- Patient-reported outcomes have been used to evaluate off-label uses of drugs on *PatientsLikeMe.com*, an online patient network and research platform [15, 25]. It thus helps to understand efficacy and safety of some treatments and provides evidence for secondary drug uses. Further, it allows evaluation over a longer time period than feasible through traditional clinical trials. In a similar vein, Armstrong et al. evaluate the efficacy of acne treatments in real-world patient population via *CureTogether.com*, a crowdsourcing platform for high-volume patient data and experience [26]. They note that, in traditional trials of acne treatments, predefined inclusion and exclusion criteria select for a homogenous population of study subjects that may not be representative of the real-world patient population. Such OIIs contribute to innovation by identifying potential targets for treatments to be studied systematically in traditional research settings.
- On other types of platforms, so-called “share-your-experience” websites, patients can review their personal health experiences, e.g., from the last hospital or doctor’s visit, and read reviews posted by others. Adams (2011) acknowledges the role of such sites as mediators between patients and other stakeholders and sees the potential of repackaging solicited feedbacks by the platform operator in order to link it back to hospitals, insurance companies, policy makers, or others [16]. Nevertheless at the point of research the analyzed websites simply did not have enough information to address further institutional or policy consequences. In a different study, Gao et al. [27] found that online doctor ratings are correlated with patient population opinions in the offline world, yet the online ratings tend to be exaggerated at the ends of the quality spectrum. Three of the four websites under study by Adams are shut down by today, the remaining one is UK-based *PatientOpinion.co.uk*.
- Evidence for the suitability of open innovation practices to integrate healthcare consumers is given by studies about two publicly funded online platforms in Germany. Bullinger et al. [13] study the adoption of *GemeinsamSelten.de*, an open health platform for rare diseases, through analyzing attraction of platform users and intensity of peer communication. Hartmann et al. [14] developed *DGM Ideenschmiede.de*, an online platform for systematic ideation, which is part of a virtual community for ALS patients. Both platforms enable a collaborative and systematic process of idea development between platform users and are expected to generate higher quality information and insight than in settings without systematic facilitation.

In other sectors [e.g. chemicals [17]; machinery [18]; science problems [19]] there is growing evidence in academic literature that manufacturing firms work together with web-based innovation intermediaries. To illustrate, *InnoCentive.com*, an online innovation intermediary, is often described as a prominent example and has received significant attention in scientific literature [24, 28–30].

Within the health sector, some studies suggest that ideas from user innovators have been (directly) absorbed by manufacturing firms, e.g., for advancing drug therapies or medical equipment technology [8, 31–33]. However, the innovators involved generated

their contribution from their direct work environment in the role as clinicians or surgeons. They can be considered as professional user innovators as opposed to lay user innovators such as healthcare consumers.

Our review of the literature reveals that while studies emphasize the impact of intermediaries on easier knowledge retrieval, sharing, and creation, a distinct link towards innovation, i.e., co-development of ideas with healthcare consumers and exploiting those ideas through healthcare organizations, is neglected. Existing studies focus on professional user innovators while the innovation potential of lay consumers has attracted limited research attention. In this paper we address this gap in understanding by focusing on online intermediaries that leverage lay consumers to advance innovation in healthcare.

### 3 Method

To study this emerging phenomenon of OII in healthcare about which limited understanding exists, we utilized a qualitative research design that supports rich, contextualized insights in nascent domains. We collected data through interviews with key informants; one of the most commonly used methods of data collection in qualitative research [34].

The process of data collection started with the selection of appropriate cases. We build on a shortlist of 30 cases from across the globe that is one of the results of a previously published study [12]. Among those are, for example, platforms like CreateHealth.io, HealthUnlocked.com, PatientsLikeMe.com, InnovationByYou.com. This empirical context is special as these cases all have a dedicated focus on healthcare and perfectly fulfill the role of an intermediary that is under investigation. We contacted them through email or social networks expressing our request for an expert interview. Interviews were conducted using a semi-structured guide with five broad questions, each of which leads the respondent into addressing a variety of related subthemes. The interview guide was validated and re-adjusted with researchers from other universities in an iterative, multistage process. 23 of 30 experts agreed to participate, from OIIs across eight nations, including the United States, the United Kingdom, Germany and other countries. Respondents were predominantly CEOs and/or founders. The interviews were conducted by telephone during September 2013 and lasted an average of 60 minutes. With the consent of the interviewees, all interviews were audio-recorded and subsequently transcribed verbatim. The interviewees prefer to stay anonymous; therefore the source of quotes will be indicated by acronyms in this study.

In total, the transcription of the 23 semi-structured interviews resulted in 447 pages of text. The data was analyzed using MaxQDA version 11. Data analysis followed the standards for qualitative research as reported by Miles & Hubermann [35]. The analysis process is broken down into a series of stages, with multiple steps within stages. While we adopted the step-by-step-approach by King & Horrocks [34], we note that the analysis was not conducted sequentially. Rather, as is generally the case in qualitative data analysis, we frequently iterated between stages. At the first stage of analysis, the goal is to identify those parts of the data (transcripts) that are likely to be helpful in answering the research questions. We read each transcript and highlighted relevant material to focus on participant's views and experiences. The next step is to use the highlighted pas-

sages in the text to define descriptive codes. Labelling the descriptive codes stays close to the text and with single words or short phrases. We checked reliability by coding the data by two independent coders.

At the second stage, beyond mere description, a new level of codes is defined which focuses more on the interpretation of the meaning of the descriptive codes. Essentially it is about grouping together descriptive codes that share some common meaning and creating an interpretative code that captures it. At the third stage, overarching themes are identified. This stage builds on grouping interpretative codes, i.e. being on a higher level of abstraction. The overarching themes characterize key concepts in the analysis that are rooted in theoretical ideas or practical concerns. For example, two descriptive codes were “sentiment mining” and “keyword search”; they were grouped under the interpretative code “analyzing group discussions” which eventually wraps up in “sense-making” as the overarching theme.

## 4 Findings

### 4.1 Key activities of OIIs in healthcare

In the research question we sought to identify the unique activities and types of OIIs in healthcare. Analysis of the interview data yielded four distinct key activities of OIIs that are mutually exclusive and collectively exhaustive with respect to this sample. We label these as facilitation, support, incubation, and sense-making. We explain the essence of these activities and illustrate them with quotes from the interview data below.

**Facilitation.** The facilitation of connections between complementing stakeholders, e.g. innovation seekers and providers, is a key activity of OIIs. They build bridges between healthcare firms and patients, research institutions and patients, but also patients and patients by using the reach of the intermediary’s network. As noted by the interviewees:

- ❖ *Our job is to try to bring the two together. (HT, paragraph 38)*
- ❖ *We are a broker bringing together people who otherwise wouldn’t get together. (HH, paragraph 45)*

The above quotes illustrate the fact that the OII constitutes a crucial link between independent stakeholders. Without that “connecting link” it would be difficult, and perhaps even infeasible, for the stakeholders involved to get into contact. The value is that the OII is able to engage with focused patient populations in a way that would be difficult by other means. Apart from linking stakeholders, the facilitation activity includes an aspect of selecting and matching the right people. In essence, the OII becomes a gatekeeper who filters the reach of his network by a set of criteria determined through the actual project. A positive match is more likely through applying selection criteria. Therefore, the OII may gather detailed information about their users and their professional partners to support the selection procedure. It is exemplified by the following quotes:

- ❖ *So we collect very detailed profiles of members, so that we can match information from third parties and just show it to the right members. (DU, paragraph 33)*
- ❖ *We are helping to recruit people for clinical trials. (PL, paragraph 83)*

**Support.** A second key activity of the OII that was evident in our data was one of active support during joint innovation projects. In contrast to facilitation, in the support role, the OII engages at an operational level. We found recurring activities that OIIs perform to ensure that projects run successfully, including (i) moderating conversations, (ii) guiding discussion threads, (iii) reviewing contributions, and (iv) administrative-technical support. However, we also discovered variation across OIIs in regard to the different aspects of active support they emphasize.

Depending of the activity levels in a community, moderating conversations is important to construct a virtual environment in which users feel engaged and motivated to contribute. Especially for communities of smaller size, a moderator who is part of the OII organization can act as a catalyst for stimulating participation in conversations without being directly involved in the topic-related discussion. This can occur through actions such as writing welcome messages to new users, writing thank you messages for contribution made by users, sending invitations to participate, or writing synopses of what has been discussed so far. The following quotes from the interview data give evidence for moderating community conversations:

- ❖ *I think we felt the patients were underserved by many of the existing communities. We felt many of those communities were not properly moderated. So our communities are moderated by life humans. (IN, paragraph 13)*
- ❖ *The groups usually have less than 100 participants. So with such small groups it is necessary to actively moderate in order to keep the conversations going. (CO, paragraph 82)*

Enhancing the moderation of conversations, moderators can also actively determine the topical focus of community conversations. As such, the users are guided towards specific topics. This helps motivate the users to explicate their knowledge and experience regarding a certain topic. Often, if the OII is running a project in collaboration with a healthcare organization, the overall themes of discussion are well aligned with the OII's clients:

- ❖ *Typically the client is not involved day to day. The client has questions they want to answer and we help answer those questions. (IN, paragraph 65)*

As has been extensively documented, in healthcare, the privacy and confidentiality of information is a focal concern among participants in digitally mediated environments [36]. With all the contributions in the community, it may become important to review the quality of user posts before the information is fully disclosed online. Reviewing includes activities such as sanitizing private or confidential information. It can protect the user of being identified in public. Altogether, it is a mechanism for ensuring quality control:

- ❖ *People put their stories on and then we moderate them. That means nothing is public until we have read it. We may make a small audit, sometimes we have to remove names or dates because the aims of moderation are to reduce the risk of identifying the patient and to reduce the risk of public criticism of names, health service staff, which could result in legal actions. (PO, paragraph 17)*

We present these support activities as illustrative to the extent of evidence provided by the interview data, while fully recognizing that there may be other support activities that did not surface among the sample of respondents.

**Incubation.** Incubation is a third block of activities that OIIs perform. Some OIIs offer consultancy services to help healthcare organizations to start new co-creation projects. If healthcare organizations do not have much experience in running co-creation projects, OIIs with incubation activities act as enablers. Such OIIs have wider responsibilities in (i) conceiving, (ii) preparing and (iii) executing co-creation projects. The intensity of the agent's support depends on the earlier work done by the commissioning organization – our findings suggest that it can range from refining existing projects plans to conceiving a new co-creation project from scratch.

For conceiving new projects, the healthcare organization approaches the OII with a high-level business challenge for which they think co-creation can be a viable method. Then, the OII proposes a project about how to get the best output from the users within the given context. Often new data needs to be collected and methods of data collection need to be adapted because the goals of the commissioning organizations vary. OIIs conceiving new projects are demonstrated by these quotes:

- ❖ *So they give us the high level, business pain point or the area that they are trying to tackle. We then go away and have a little brainstorm, think about the best way to work with the crowd/community to get the best output. (PC, paragraph 71)*
- ❖ *A lot of our job is persuading clients to simplify and reduce the complexity and break things down into its component part. (DO, paragraph 36)*

In addition to the conceptualization and design, executing the projects independently can be part of OII incubation. Executing projects may include building new virtual rooms as a platform for exchange, developing forms of how to canvass the users, e.g. by tailored questionnaires, leading the entire communication with users, and others. The following quotes demonstrate aspects of executing a co-creation project as part of OII incubation:

- ❖ *Any sponsor or company will literally, once have agreed on whatever we are working on, just sit back and enjoy the ride. And we do all the work for them. So, they can either observe or be proactive in it, it's up to them. (PC, paragraph 106)*
- ❖ *But largely I should be clear: our clients don't want to have direct access to the patient base, they never asked for it because of the regulatory concerns. (IN, paragraph 205)*

It is noteworthy that agents create an environment for users to support them in advancing their ideas. In this vein, agents are no different from incubators that provide a protective environment for innovative users in which they can develop their ideas under controlled conditions. One of our interview partners made a fine but important distinction: *"Our project approach is not to take ideas from people and run away - but to take ideas and support people to help develop and evolve them."* (PC, paragraph 19). The same interviewee highlighted that they want to create a fertile environment beyond ideation alone. This can be achieved by enabling users to also *"pilot and then scale"* their ideas through the OII's network, namely other users from the community and professional partners.

**Sense-making.** OIIs collect substantial amounts of qualitative and quantitative data through the OII platform. Hence, making sense of these data and extracting insight is one of their key activities. The value of the data collected can be increased by means of data

processing, data aggregation, and data interpretation. Quantitative data in this context foremost relates to questionnaire data, medical data manually entered by the users, geolocal data, sensor data from smartphones, and many other forms. At a base level, OIIs can perform the aggregation of quantitative data which enables statistical interpretations as exemplified by the following quotes:

- ❖ *We are really like the layer like select, analyze, process, interpret these data and then is the mechanism for interventions as you go forward. (GI, paragraph 106)*
- ❖ *We now get into a position that we have collected and validated enough data to run analysis on it. One of the analyses would be "hey where is this blind spot?" For instance in this city there is way too low number of AEDs to create a safe environment. (AD, paragraph 38)*

Qualitative data, in contrast to quantitative data, predominantly take the form of forum discussions, wiki-style contributions, submissions from idea contests, and live chats. For example, qualitative data contains experiential knowledge from users about living with a condition, going through prescribed medicines and treatments, and dealing with the challenges imposed. As we found in several instances, OIIs can analyze these types of qualitative data by consolidating forum discussions and combining it as a whole. There are several ways in which this is done, for example by selecting and observing certain communities of interest, or by searching the community discussions for particular key words. The OII then synthesizes the knowledge into a written report that is made available to the stakeholders involved, especially the healthcare organizations benefitting from this newly gained knowledge. These observations are substantiated by these interview quotes:

- ❖ *There are a couple of ways to get insights from our community. One is that, I would call that "fly on the wall", where we are just reading, we are just observing non-invasively in the support groups. (IN, paragraph 187)*
- ❖ *We typically write reports, we summarize it and synthesize it in ways that are digestible. We don't just give them raw data. Sometimes statistical work, sometimes sort of natural language processing, sometimes follow-on interviews with patients, you know, it depends on the project. (IN, paragraph 181)*

The degree to which the OII performs the interpretation activity depends very much on subsequent stakeholders and if they require raw data, pre-processed data, or fully analyzed data.

## **4.2 Emerging OII types**

Although the four activities are each independent and distinctive sets of tasks, the data reveal that the key activities are not exclusively associated with an entity. Rather, each OII can provide one or several of these activities. We found that the activities typically occur in bundles or configurations, and each exemplifies a distinctive interaction with the ecosystem of stakeholders, i.e. patients and firms. We also found one activity typically dominating and representing the central focus of the OII. Our iterative analysis yielded four such types in our sample: the proactive agent, the support provider, the community champion, and the bridge builder. We describe each of these types next; figure 1 gives a brief overview of the activity bundles that compose the four distinct OII types.

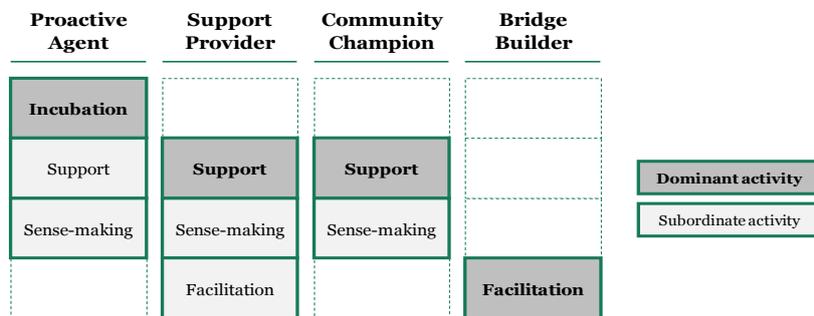


Fig. 1. Emerging OII types by activity bundles

**Proactive Agent.** The first typical bundle of OII activities is the proactive agent. It combines three out of four key activities which are: incubation, support, and sense-making. OIIs of this type assume a strong and proactive role in the ecosystem of stakeholders. That is also why HCOs and participating healthcare consumers do not interact directly with each other. In healthcare, the agent role is critical because some patients may be wary of engaging directly with HCOs [36]. The actual process of co-creation happens between the consumers and the OII. As an agent, the OII conceives co-creation projects on behalf of HCOs (incubation) and then manages the entire realization of the projects on a tactical and operative level (support). During and after the project, the OII collects large amounts of data from the users which are being analyzed and reported to the HCOs (sense-making). Typical examples of the agent type are OIIs such as *CreateHealth.io*, *Inspire.com*, or *PatientsLikeMe.com*.

**Support Provider.** The support provider bundles the activities support, sense-making, and facilitation. An OII of this type enables HCOs to interact directly with the consumers by enabling access to the user pool (facilitation). While the interaction takes place through the intermediary’s online platform, the OII supports the co-creation projects in an operational role, e.g. by supervising the day-to-day conversations and ensuring the technological functioning (support). Compared to the proactive agent, the HCO adopts a stronger and more salient role towards the consumers in terms of designing and leading the scope of the project. The OII, in return, can run various analyses on the gathered consumer data to gain insights for the benefit of the involved HCOs (sense-making). Typical examples of the support provider-type are OIIs such as *PatientOpinion.co.uk*, *HealthUnlocked.com*, or *HealthTechHatch.com*.

**Community Champion.** The third type, the community champion, integrates support and sense-making as key activities. This type is somewhat similar to the support provider, with the distinction that the OII does not facilitate between HCOs and consumers on the basis of specific projects. The reason behind it is the fact that there are HCOs that initiate and sponsor co-creation projects with consumers through OIIs, but they do not expect explicit outcomes for their own innovation capacity on the short-term. Their goal is to empower patients to exchange and develop solutions to their problems with each

other. So the co-creation process itself happens between consumers themselves, while enabled and closely supported by the OII (support). Certainly the HCO sets the overall direction, but it does not get involved in the actual process of co-creation. Any outcome of the process remains with the consumers. The OII, however, can again perform analysis on the process of social interaction or actual outcomes such as specific solutions or improvements on some products or services (sense-making). Typical examples of community champions are OIIs such as the *Patient-Innovation.com*, *Diabetes Mine Design Challenge*, or *Connecting-Nurses.com*.

**Bridge Builder.** The final type of OII revealed in our data, the bridge builder, provides a single activity of facilitation. It is the least complex of OII types. The bridge builder initiates relationships, e.g., by selecting and matching certain criteria, between HCOs and consumers pooled through the OII platform. Once these connections are made, the HCO and the consumers can interact directly, yet outside of the OII's platform, thereby allowing the co-creation process to continue to run beyond the OII's sphere of activity. Typical examples of the bridge builder-type are OIIs such as *CancerCommons.org*, *ArmyOfWomen.org*, or OIIs engaging in clinical trial recruitment, for instance.

To summarize, we have identified four key activities of OIIs in reply to the research question: facilitation, support, incubation, and sense-making. We also found that these activities typically occur in bundles. We labeled the four OII types: the proactive agent, the support provider, the community champion, and the bridge builder, to reflect their key.

## Discussion

Our analysis revealed four types of OIIs that consist of different key activities. We now discuss each of the emerging OII types and, in particular, highlight their structures in relation to desired innovation outcomes. We develop initial theoretical propositions based on the insights from our data to suggest the contingencies under which different OII types would be most useful for HCOs. Among all four types of OIIs, the proactive agent has clearly the most power to shape co-creation projects for HCOs. Due to the OII's incubation, support, and sense-making activities, the proactive agent positions itself as a strong middle man between HCOs and consumers. The proactive agent is ideal for HCOs who have not developed own capabilities to design and implement co-creation projects with healthcare consumers. Accordingly, we posit that:

**Proposition 1.** The “proactive agent” is an ideal partner for HCOs with limited in-house capabilities regarding innovation co-creation with healthcare consumers.

The support provider is the most common OII type in our sample. Support providers have often developed a distinct platform technology which enables them to offer specific tools and methods for co-creation through their platform. Their strength lies in activities on support, sense-making, and facilitation. HCOs with well-developed plans for co-creation projects may find an ideal partner in the support provider. We propose that:

**Proposition 2.** The “support provider” is an ideal partner for HCOs with advanced in-house capabilities.

The community champion operates co-creation projects for the benefit of the consumer community itself. HCOs assume a more passive role as they do not have an agenda for specific co-creation projects. HCOs partnering with community champions acknowledge the positive potential that lies in co-creation projects with healthcare consumers. We posit that:

**Proposition 3.** The “community champion” an ideal partner for HCOs with a passive innovation approach and lacking in-house capabilities.

The bridge builder is the least complex of OII types. Its capability lies in matchmaking HCO requests to relevant consumers from the OII user pool. HCOs using bridge builders are aware of their extensive network reach and acknowledge the innovation potential of healthcare consumers for their own co-creation projects that they may conduct detachedly from the intermediary’s online platform

**Proposition 4.** The “bridge builder” is an ideal partner for HCOs with advanced in-house capabilities.

Our proposed OII types go beyond Chesbrough’s [37] and Howells’ [23] seminal description of the role played by innovation intermediaries. Whereas Chesbrough discussed a type of intermediary facilitating the participation of external sources of ideas and Howells referred to industry and technology research associations, our analysis focuses on pure online innovation intermediaries that seek to leverage the innovation potential of consumers.

**Limitations and future research.** This study has three main limitations, which yield implications for future research. First, as is the case with qualitative research, we have a modest sample size of 23 OIIs. However, we note that our search process for appropriate OIIs was extensive. Future research that validates the above propositions could provide more insights on the relative impact of the four OII types on innovation outcomes. The emerging OII types should also be tested in other contexts than healthcare.

Second, the current state of OIIs that the interviewees conveyed is only a “snapshot” at a particular point in time. This field has a highly dynamic pattern of growth and development, so some existing OIIs may fail in the short-term or some new entrants may emerge. Continued research should be done to investigate the types of OIIs and their value generating potential because it remains an emerging and yet promising lever for healthcare innovation.

Third, when investigating the value generating potential of OIIs, the views of the HCOs as the actual beneficiaries should be taken into account; that was out of the scope for the current study. In a similar qualitative research design, key informants from HCOs should report on the value that they gained from collaboration with OIIs. Future research should also measure the specific impact of the OII phenomenon on the innovation process, ideally in a quantitative manner. In this respect, it would be important to compare the efficiency and effectiveness of the innovation process at HCOs that use OIIs and at HCOs that do not collaborate with OIIs.

## 5 Conclusion

Using a qualitative research design, this paper uncovers what online innovation intermediaries (OII) in healthcare actually do when they engage in co-creation projects with the ecosystem of stakeholders, i.e. healthcare organizations (HCOs) and healthcare consumers. The interview data suggest that there are four key activities that OII perform: facilitation, support, incubation, and sense-making. These activities can be grouped into archetypical bundles which give rise to four distinct types of OII in healthcare. We designated these types as the proactive agent, the support provider, the community champion, and the bridge builder.

Our study makes two important contributions to the research literature. First, it enhances the research stream on open innovation and innovation intermediaries. We add theoretical nuance towards a conceptual understanding of online innovation intermediaries in healthcare. Based on rich empirical evidence, we outline the activities of OII in greater detail. Compared to an analysis by Lopez-Vega et al. [38] who studied the activities of innovation intermediaries in general, we observe that activities of OII in healthcare partly overlap but are much more focused on a few core activities. All four key activities that we found contribute to create social relationships and an atmosphere of trust and confidentiality for patients being highly affected by their condition – aspects that are particularly important in the healthcare set-up. Moreover, we advocate for the crucial role of OII in healthcare, and extend the understanding of Nambisan and Nambisan [39] by suggesting that the assumption of a direct co-creation process between HCOs and consumers deserves revisiting. In many settings, this relationship is often mediated through OII platforms. For healthcare organizations, this can be a major advantage as some are restricted by regulatory requirements to step into direct contact with patients. Other organizations may just want to start interacting with patients on a more independent and neutral platform that is less influenced by a specific company brand. Further, our empirical data informs the understanding of individuals (here healthcare consumers) as external sources of innovation, responding to the call by West and Bogers [40] that this domain is under-researched.

Second, this paper enhances the research stream on online health communities. Existing studies have examined aspects such as the motivations and concerns of patients to participate, or social value creation in online health communities. We add a new perspective that is informed by open innovation as we suggest that some of these online health platforms can systematically support and contribute to innovation activities.

The managerial implications of our results suggest that innovation managers at HCOs need to consider OII as a valuable mechanism for improving their innovation outcomes. OII can help HCOs to adopt appropriate strategies and practices to embrace consumers as partners in the development and delivery of innovative healthcare products and services. Our findings also underscore the need for alignment in choice of OII types: an engagement with an OII should seek congruence with the in-house capabilities available, and the type of OII and its activities provided. Independent of the breadth and maturity of available OII as of today, a majority of the experts that we interviewed confirmed the widely untapped potential of healthcare consumers' knowledge pool and its increasing importance while HCOs seek new ways to enhance the quality and the value of their offerings.

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