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How does co-creation influence healthcare regulations? An analysis of co-creation in social innovation

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Social innovations are discussed as solutions to societal challenges, such as ensuring quality healthcare provision. Co-creation (i.e. the collaboration of actors who share their knowledge and skills), a primary feature of social innovation, can play a central role in changing formal institutions such as regulations, which is crucial to solving challenges in highly regulated sectors such as healthcare. However, research investigating how co-creation in social innovation can influence regulations is lacking. We investigate how co-creation can affect the ways social innovation actors influence healthcare regulations by analysing three social innovations in the Bernese Oberland, a Swiss mountain region facing the challenge of maintaining quality healthcare provision. Applying innovation biographies and semi-structured interviews, we find that two co-creating actor types were involved in influencing regulations: social innovation leaders and actors who fulfil central social innovation tasks. They influenced regulations by suggesting changes and inducing others to implement them, and they learned knowledge and skills in co-creation that helped them perform these activities. However, resources unrelated to co-creation also helped them influence regulations, such as actor networks and skills in persuading others. Co-creation in social innovation can thus support institutional change but is not a guarantee for it.

Keywords: Co-creation; institutional change; regulation; healthcare; social innovation

Introduction

Ensuring high-quality and cost-efficient healthcare provision is one of the most pressing challenges in high-income countries, mainly due to rising costs and demographic change (Berkers 2017). In recent years, social innovations – novel solutions to social challenges involving new or established forms of cooperation between individuals and/or organisations (Ayob, Teasdale, and Fagan 2016; Moulaert, MacCallum, and Hiller 2013) – have been discussed as novel ways to address such 'grand challenges' (Coenen, Hansen, and Rekers 2015). Particularly interesting is that social innovations are said to transform institutional contexts and provoke change (van Wijk et al. 2019). To support such transformations, collaboration is especially important (Lawrence, Hardy, and Phillips 2002). In this context, collaboration usually manifests as co-creation, one of the main features and

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success factors of social innovation (Eckhardt et al. 2021; Kumari et al. 2020). Defined as actors sharing their knowledge and skills with the aim of creating an innovative solution, co-creation can influence the activities of a wide range of social innovation actors – from leaders to occasional helpers – to induce institutional transformation and change.

Institutional transformation and change are crucial in sectors that are resistant to change, of which healthcare is a prime example; it faces high levels of regulations and rigid institutionalised practices (Lockett et al. 2012; De Pietro et al. 2015; Wendt 2015; Lakomaa and Sanandaji 2021). However, although social innovations in healthcare have the potential to induce institutional change (van Niekerk, Manderson, and Balabanova 2021), research investigating how co-creation inside social innovation processes can induce actors to influence institutions is scarce.

In this study, we address this gap by focusing on regulations as a significant formal institution in healthcare. Healthcare regulations are intentional interventions in the activities of healthcare actors exercised by public-sector actors that involve a set of authoritative rules (Jordana and Levi-Faur 2004; Koop and Lodge 2017). How regulations are changed is particularly interesting to study in healthcare for several reasons, firstly because they prescribe many healthcare processes and shape organisational issues to a very detailed degree (van Raak and de Haan 2017). Regulatory compliance is required and closely monitored by authorities, such that healthcare actors have strong incentives to follow the rules (Breaux, Vail, and Anton 2006; Kwon and Johnson 2013). As such, little room exists for deviating from regulatory prescriptions or establishing new rules (or institutions). As such, regulatory changes may exert a relatively immediate impact on actors' behaviour and organisational structures (Abraham and Lewis 2014; Price et al. 2020). Conversely, due to these same circumstances, healthcare is less innovative than other sectors (Herzlinger 2006), such that novel, co-creative practices that could trigger regulatory changes may be limited. However, as a defining feature of social innovation, such practices may help actors change regulations in this sector. As healthcare regulations are altered or newly created through political processes, social innovation actors are likely to engage in institutional work aimed at influencing politicians or other policymakers, which co-creation in social innovation processes can support. For instance, social innovation actors can co-create with public (healthcare) actors, or they can co-create knowledge and skills that they can then use in their activities to influence regulations. However, how co-creation can affect how these actors influence regulations remains unexplored. We address this gap with the following research question: In what ways does co-creation affect the activities of social innovation actors to influence healthcare regulations?

We analysed social innovations in the Bernese Oberland, a Swiss mountain region facing the challenge of maintaining high-quality healthcare provision due to ever-rising healthcare costs, state withdrawal, and demographic change (Cerny et al. 2016; Tschumi and Mayer 2020; Stierli et al. 2021). We used the method of innovation biographies (Butzin and Widmaier 2016; Kleverbeck and Terstriep 2018), which are particularly appropriate to study co-creation in social innovation because they allow for a detailed analysis of sequential events during the innovation process. After writing the biographies and completing the analysis of the co-creation events, we conducted additional semi-structured interviews with actors involved in the social innovations to obtain data on the ways co-creation affects the activities of these actors to influence healthcare regulations.

The following section discusses the commonalities among the various definitions of social innovation, before reviewing the connections between co-creation and social innovation and discussing the types of activities social innovation actors may perform to influence regulations, as well as how co-creation can support such activities. This is followed

by a description of the three social innovations we analyse and our methodological steps. In the results section, we present the regulation types that the five actor types we categorise had to address, along with a description of each actor type. We then present the ways co-creation affected the social innovation actors' activities to influence healthcare regulations. The paper concludes with a discussion of contributions to the literature on co-creation in social innovation.

Literature review

Social innovation

Efforts to conceptualise social innovation have increased substantially since the beginning of the twenty-first century (van der Have and Rubalcaba 2016; Ayob, Teasdale, and Fagan 2016). However, to date, an agreed-upon definition of the concept is lacking. Bibliometric analyses of social innovation research articles and other publications find that the most significant conceptualisations perceive social innovations as solutions to (local) social challenges (van der Have and Rubalcaba 2016) and that a general feature of definitions of social innovation is the notion that it can induce social change and institutional transformation (Ayob, Teasdale, and Fagan 2016). Several more recent publications also point to the transformative power of social innovation, emphasising the agentic and collaborative processes of social innovation actors, which can lead to institutional change (van Wijk et al. 2019; Pel et al. 2020); such innovations typically involve many actors with varying sectoral and professional backgrounds (Nicholls, Simon, and Gabriel 2016; Domanski, Howaldt, and Kaletka 2020; Moulaert, MacCallum, and Hiller 2013). This is especially true in healthcare-related social innovations, which involve healthcare professionals, public actors, local citizens, and volunteers alike (Farmer and Nimegeer 2014; Kenny et al. 2015; Roberts et al. 2014; Farmer et al. 2018), and is reflected in one of the key common features of social innovations: they comprise 'new forms of collaboration, whether at an individual or organisational level' (Ayob, Teasdale, and Fagan 2016, 648), which lead to new ideas (innovations). Based on these considerations, we define social innovations as novel solutions to social challenges involving new or established forms of cooperation between individuals and/or organisations that can lead to institutional change. As we discuss in the next section, such cooperation is crucial to co-creation. However, authors from various disciplines have only recently begun to conceptualise connections between co-creation and social innovation.

Co-creation and social innovation

The concept of co-creation originates from the marketing literature (Leclercq, Hammedi, and Poncin 2016), where it describes the interactions of consumers and firms in the development and production processes of products and services to jointly generate product value (Prahalad and Ramaswamy 2004). The perspective of value co-creation has also become popular in the public administration literature (Brandsen, Steen, and Verschuere 2018). There, it is often interchangeably termed 'co-production' and defined as the joint development and/or provision of public services by public actors and citizens (Brandsen and Honingh 2018). Connections between social innovation and co-creation are predominantly made by this literature strand. Co-creation is seen as 'important social innovation in public services […], since it promotes a partnership that governments form with citizens and civil society organizations in order to innovate and deliver improved public service

outcomes' (Pestoff 2015, 6). Some authors also discuss co-creation (by public actors and citizens) as an important condition for actually creating social innovations (Nyseth, Ringholm, and Agger 2019; Voorberg, Bekkers, and Tummers 2015; Bekkers et al. 2014). These authors posit that policymakers and politicians should actively seek co-creation with citizens to meet their needs and tackle social challenges.

Co-creation in public services need not be confined to collaboration between public actors and citizens. More recently, Ansell and Torfing (2021) and Torfing, Sørensen, and Røiseland (2019) have conceptualised co-creation in the public sector as involving various types of private actors, ranging from service users to voluntary citizen groups to social enterprises and private corporations. They do not view co-creation as the mere joint production of public services between citizens and public actors (Torfing, Sørensen, and Røiseland 2019, 8) – as co-*production* is usually defined – but instead emphasise that co-creation goes much further: it involves solving a shared challenge and encompasses innovation in the development of public services. To this end, co-creation includes many different actors who contribute innovation resources, such as knowledge and skills, that are distributed among the various actors (Ansell and Torfing 2021). In this way, co-creation pro-actively mobilises the 'otherwise untapped [innovation resources] for the purposes of social innovation' (Ansell and Torfing 2021, 219).

Another group of authors widens the service spectrum to include various types of services – not just public ones – where co-creation is key to developing and implementing social innovations. These authors bridge social and service innovation (Windrum et al. 2016; Gallouj et al. 2018; Windrum, Schartinger, and Waring 2018). Drawing on the notion that 'social innovation is often an innovation in services and a service innovation' (Windrum et al. 2016, 153), they argue that co-creation is a key aspect in both service and social innovation processes and introduce the concept of multi-agent co-creation, in which various types of actors are involved in the development, implementation, and sustaining of social innovations (Windrum et al. 2016). This is similar to more recent publications, which focus on co-creation in (social) innovation ecosystems, where collaboration (co-creation) among different types of actors, such as citizens, enterprises, or higher educational institutions, is facilitated or fostered for social innovation in general, not only in services or in the public sector (Eckhardt et al. 2021; Kumari et al. 2020; Terstriep, Rehfeld, and Kleverbeck 2020). Based on these literature strands, we define co-creation as the collaboration of two or more public and/or private actors who deliberately apply and share their knowledge and skills. In the context of social innovation, the actors do so with the aim of creating (part of) an innovative solution to a societal problem or challenge.

Influence of co-creation in social innovation on regulations

Although co-creation is a primary feature and success factor of social innovation, little research exists on how co-creation in social innovation can impact institutions, such as regulations, in highly regulated sectors such as healthcare. This is rather surprising, since social innovations are often viewed as being transformative, inducing institutional change in both informal and formal institutions (Parés, Ospina, and Subirats 2017). Drawing from a review of articles about the application of social innovation in healthcare, van Niekerk, Manderson, and Balabanova (2021, 1) conclude that '[b]ased on theoretical literature, social innovation has the potential to mobilise institutional and systems change, yet research in health has not yet fully explored this dimension'. Such transformative potential can be referred to as the 'inherent and/or intended qualities to challenge, alter

and/or replace dominant institutions in a specific context' (Haxeltine et al. 2017, 18). Co-creation may increase this potential by supporting the activities of social innovation actors aimed at changing or adjusting regulations, which, as a concept, are usually not explicitly defined (Koop and Lodge 2017). In this study, we draw on definitions that are valid in many social-science disciplines (Jordana and Levi-Faur 2004; Koop and Lodge 2017) and adapt them to the healthcare context. We define healthcare regulations as intentional interventions exercised by public-sector actors in the activities of healthcare actors that involve a set of authoritative rules accompanied by some administrative agency for monitoring, enforcing compliance, and sanctioning.

The ways in which co-creation in social innovation processes can induce actors to change or adjust healthcare regulations may vary. Actors may be involved in some type of institutional work, defined as 'the purposive action of individuals and organizations aimed at creating, maintaining and disrupting institutions' (Lawrence and Suddaby 2006, 215). In their study on how innovating actors in companies shape institutions throughout social innovation processes, Purtik and Arenas (2019, 966), drawing on Hargrave and Van De Ven (2006), find that '[i]nnovation literature has identified four different processes that are key to inducing change in the institutional environment when bringing new products and services to the market'. Of these four processes, one seems particularly relevant for influencing regulations. That is, innovating actors engage in political activities to influence politicians or other policymakers (Hargrave and Van De Ven 2006), since healthcare regulations are altered or newly created through political processes (Jordana and Levi-Faur 2004). For instance, social innovation actors may engage in lobbying, participate in sessions with important healthcare politicians, or persuade persons with formal authority to support a regulatory change.

Co-creation in social innovation processes can support such political activities. One way is through co-creation between public and social innovation actors, which is likely because social innovation actors in healthcare may need support from public actors to facilitate successful implementation (Farmer et al. 2018). In this way, public actors, such as authorities, can be made aware of necessary regulatory changes. Another way in which co-creation can support political activities is by supporting social innovation actors in elaborating documents to persuade others of regulatory changes. As many forms of knowledge and skills are shared in co-creation activities (Torfing, Sørensen, and Røiseland 2019), those who engage in influencing regulatory changes can acquire some of this knowledge and these skills and use them to develop documents. For example, they may acquire knowledge on regulatory processes to spur parliamentary initiatives or write position papers. In other instances, they may acquire scientific skills while collecting data or conducting desk research. Such knowledge is crucial for underlining one's expertise to persuade others with solid arguments (Kristof 2017). Despite these indications on how co-creation may impact the activities of social innovation actors to influence regulations, empirical research investigating this relationship is lacking.

Concerning the characteristics of social innovation actors who engage in influencing regulations, the literature is not very revealing. The literature about co-creation and social innovation emphasises that actors with a variety of sectoral and professional backgrounds are involved in co-creation (Voorberg, Bekkers, and Tummers 2015; Torfing, Sørensen, and Røiseland 2019; Eckhardt et al. 2021). However, it does not discuss the roles of these actors in social innovation or the extent to which they are involved. The actor's role (for example, social innovation leader or external actor) and the level of involvement that comes with it can hint at their success in influencing regulations. The more involved

an actor is in social innovation, the more motivated it may become to engage in activities to influence regulations, perhaps due to interest in regulatory changes that facilitate the operation and spreading of social innovation. This aligns with the literature about institutional entrepreneurs, who are particularly successful in inducing institutional changes because they are driven by (among other factors) a personal motivation to change institutions (Battilana, Leca, and Boxenbaum 2009). However, whether this is also the case for social innovation actors who are part of the co-creation of social innovations remains an open question. Therefore, we also investigate the role of the co-creating actors engaged in influencing health regulations according to the extent to which they are involved in social innovations.

Methods

To analyse co-creation in social innovation, we opted for the method of innovation biographies because this method allowed us to analyse the collaborations of actors throughout sequential events in the social innovation process. We developed social innovation biographies for three social innovations to analyse the extent to which the co-creating actors were involved in them and to gain data on co-creation during the social-innovation process. We subsequently conducted semi-structured interviews to obtain data on the ways co-creation affects the activities of social innovation actors to influence healthcare regulations. An overview of the methodological steps and their outputs is presented in Table 1. Details of the data used and analysed in each step are included in the appendix.

The analysis of co-creation in social innovation required data on the social innovation actors' roles and involvement, as well as how they collaborated with other actors. Throughout a social innovation process, various actors with different roles and involvements collaborate in several co-creation events; to gain data on these co-creation events

Table 1. Methodological steps.

Methodological step	Output
1. Narrative interviews with persons who have been strongly involved in the social innovation for a long time (one per social innovation).	Still incomplete data on actors involved throughout the social innovation process and their relationships with other actors.
2. Comprehensive desk research of newspaper articles, websites, annual reports, and other documents.	Comprehensive data on actors involved throughout the social innovation process and their relationships with other actors.
3. Nineteen semi-structured interviews with actors active in the social innovations (four to eight per social innovation).	Data on the extent to which the social innovation actors were involved, the actors' roles, and the knowledge and skills they contributed. Thirty-eight co-creation events in the social innovation process (eight to 15 per social innovation).
4. Nine semi-structured interviews with social innovation actors who were knowledgeable about regulatory issues and active in communicating the concerns of the social innovation to the outside world (three per social innovation).	Twenty-three co-creation events (six to 11 per social innovation), in which the social innovation actors had to cope with healthcare regulations. Data on the activities of social innovation actors to influence regulations and on the knowledge and skills they used for these activities.

and the actors involved in them, we applied the above-mentioned method of social innovation biographies, a relatively novel approach that analyses social innovation processes from a micro-level, actor-oriented perspective (Kleverbeck and Terstriep 2018; Jungsberg et al. 2020). The method is well suited for the analysis of co-creation events in a social innovation process, as its idea is to create innovation biographies (in the form of a narrative text or a keyword-like listing, sometimes enriched with figures and illustrations) by delineating a dense sequence of the social innovation's events 'from [its] first idea until its implementation' (Butzin and Widmaier 2016, 221) to identify the roles of the actors involved in the social innovation process, the networks and collaborations among the actors, and the knowledge and skills the actors contributed throughout the social innovation process.

We developed social innovation biographies for three healthcare-related social innovations in the Bernese Oberland (see Table 2 for descriptions) that emerged in response to challenges in maintaining high-quality healthcare provision (such as an ageing population and decreasing public budgets). The first is a birth centre in the mountain village of Zweisimmen established in response to the closure of the regional hospital's maternity ward, to prevent women from needing to travel long distances to get birth services. The

Table 2. Short descriptions of the analysed social innovations.

Maternité Alpine birth centre	This birth centre was established because a regional hospital closed its maternity ward in 2015. A group of local women began to consider alternatives and acquire allies to create a birth centre. They were supported by a local gynaecologist, a retired head doctor of the local hospital, a locally well-embedded midwife, a local politician, and a range of other engaged people. In 2017, the centre was opened. Efforts to integrate the centre into the local hospital were made by the involved actors, which had not occurred at the time of data collection. However, as the integration was not successful, they implemented a service that gave women who gave birth by caesarean section the opportunity to stay in the birth centre during the postpartum period. At the time of data collection, the actors were still willing to integrate the centre into the hospital.
Integrated healthcare network	The network was established because a regional hospital had been running at a deficit for several years and a need thus existed to find alternative ways of maintaining regional healthcare provision. During several workshops in 2018 and 2019, various types of actors – hospital providers, civil actors, practitioners, healthcare experts, authorities, and others – developed a design plan of a healthcare network to integrate various regional healthcare services into one area with the regional hospital as its centre. In 2019, a public limited company was founded to implement the plan. At the time of data collection, the funding of the network was secured, and some aspects of the plan were already implemented.
First-responder system	The first-responder system alarms lay paramedics who are in close proximity to patients suffering from sudden potential cardiovascular arrest. It was introduced in 2010 by the head of a regional emergency corps and professional paramedics to quicken the reanimation of patients. Some areas in the Bernese Oberland are hard to reach by ambulance, which was one of the main motivations to introduce the system. In 2016, an association was founded to professionalise the system and to spread it to other regions in the canton of Berne.

second is an integrated healthcare network in the mountain valleys of Simmental and Saanenland. As the regional hospital had been running at a deficit for over 10 years, local mayors and municipality authorities searched for solutions together with the healthcare minister of the canton (political department in Switzerland). This became the starting point for planning the healthcare network, which aims improve the cooperation and efficacy of local healthcare providers by integrating them around a newly conceptualised regional hospital. Finally, the third social innovation is the cantonal first-responder system, through which lay paramedics close to suddenly collapsed people are alarmed for quick help. Originally introduced in the Bernese Oberland to reduce reanimation time in this area that is hard to reach for ambulances, the system has since spread to the entire canton of Berne. We chose these three social innovations for a number of reasons. First, they comprise novel solutions in the field of healthcare, and as a result, they were confronted with healthcare regulations during implementation. Second, they involve many collaborating actors from diverse professional and sectoral backgrounds. From desk research, we know of other healthcare-related projects in the Bernese Oberland that involve collaboration among diverse actors and address challenges. However, only the three social innovations we analysed involve a large number of actors (at least 12), which allowed us to analyse co-creation events with differing actor constellations. Furthermore, due to their relatively recent development (at time of data collection), the actors could reliably report on past (co-creation) events.

The method of social innovation biographies involves several steps, which include interviews and desk research (Butzin and Widmaier 2016). First, for each social innovation, we conducted a narrative interview with a person who has long been strongly involved in the social innovation. With the interview data, we created draft versions of the biographies. We could also identify the actors involved in the social innovations and their relationships with other actors. We subsequently filled any gaps in the biographies or actor networks with comprehensive desk research of newspaper articles, websites, annual reports, and other documents. To collect data on the actors' roles and the knowledge and skills they contributed, we conducted 19 semi-structured interviews with actors active in the social innovations (four to eight per social innovation). The interviewees ranged from very active actors who took on recurrent tasks to less active actors who only sporadically worked with social innovation. Based on the data from these interviews and the biographies, we isolated 38 co-creation events (eight to 15 per social innovation) that had occurred throughout the social innovation process. We defined a co-creation event as the collaboration of two or more actors pursuing an overarching goal during a specific period to create (part of) an outcome that promotes social innovation. Although some events lasted only several hours to a day, most were divided into chunks over several weeks or even months. Therefore, two or more events in one social innovation could run in parallel. In most of the birth-centre and first-responder cases, users of these social innovations' services were not present, presumably because they comprised issues that particularly required knowledge that only social innovation insiders had. However, in the four assessment events of the healthcare network (co-creation events 14–17), many service-user representatives were present (e.g. hospital or elderly home representatives). We – the authors – were not part of any of the events, since the data were collected ex post. As we had data on every actor involved in every co-creation event, we knew their roles and the extent to which they were involved in social innovation, as well as the knowledge and skills they contributed.

The method of social innovation biographies allows for subsequent analyses using various methods once the biographies are created (Butzin and Widmaier 2016). In our

study, we wanted to isolate the co-creation events in which the social innovation actors had to cope with healthcare regulations, because we assumed that in these events, relevant knowledge and skills for influencing regulations were shared and learned. We also wanted to gain data on the types of regulations the actors encountered during the social innovation process, the ways the actors were active in inducing regulatory changes or adjustments, and the types of knowledge and skills necessary for such changes or adjustments. As a result, we needed to acquire data by interviewing people who were knowledgeable about the regulatory issues concerning the social innovations, and who were involved both in several co-creation events and in disseminating concerns about social innovation to the outside world. The latter was an important criterion because successful regulatory changes need interaction with external actors (Lawrence, Hardy, and Phillips 2002; Battilana, Leca, and Boxenbaum 2009). Therefore, we conducted nine additional semi-structured interviews with social innovation actors who fulfilled these criteria according to our previous analysis (three interviews per social innovation). From all the co-creation events isolated in the previous analysis, we identified 23 in which social innovation actors had to cope with regulations (six to 11 per social innovation). To verify the reported regulatory changes and adjustments, we searched for them in reports of organisations, cantonal authorities, and the media. All changes and adjustments could be verified.

In the previous analysis, we acquired data on the involvement of and knowledge and skills contributed by every actor involved in every co-creation event. From the nine subsequent interviews, we gained additional data on the types of knowledge and skills that these actors contributed to the 23 identified co-creation events. These types of knowledge and skills were those that were presumably shared in co-creation and could be used in activities to influence regulations. We compared these types of knowledge and skills with those actually used for such activities (as reported in the nine interviews), which allowed us to derive the types of knowledge and skills that could have been acquired in co-creation events to influence regulations, as well as the types of knowledge and skills actors possessed independently of co-creation.

In Switzerland, the cantons have the largest health-related regulatory responsibility (De Pietro et al. 2015; Oggier 2015). However, the federal level also has responsibilities in almost every area of healthcare. Municipalities have relatively few responsibilities, but this varies. In terms of the regulation of third-party payers, the Federal Health Insurance Law, which determines the rules of mandatory health insurance, outlines the types of providers allowed to provide services reimbursable by mandatory health insurance. Cantons licence ambulatory providers and determine which of these providers are allowed to provide such services. Human resources are regulated differently according to groups of medical professionals. University professionals (physicians, pharmacists, etc.) and psychological professionals are regulated by their own laws determining education, training, licencing, and registration. Non-university professionals (nurses, midwives, etc.) are regulated like any other professional education by the State Secretariat for Education, Research, and Innovation. Pharmaceutical licencing and marketing is regulated by the Swiss Agency for Therapeutic Products (Swissmedic), affiliated with the Federal Department of Home Affairs.

Of the regulations considered for our analysis, some could be successfully changed or adjusted, and some were in the process of being changed at the time of data collection. Although whether the latter group can be successfully altered in the future is uncertain, we included them in our analysis because the changing and adjusting process had sufficiently progressed and the efforts of the social innovation actors in the process were large enough for proper results.

Results

This section is structured around Table 3, which provides information about all 23 analysed co-creation events. We first present the actors and regulatory types involved in these events, followed by the results on the ways co-creation contributes to influencing regulations.

Actor and regulation types in co-creation

Highly diverse actors were involved in the investigated social innovations, which we categorised into five types (see Table 4) describing their roles according to their level of involvement in the social innovation process. We applied two criteria: first, we evaluated whether the actors took on tasks that were essential for the success of social innovation; second, we evaluated whether they were part of the social innovation's in-group. They were considered part of the in-group if they were well connected to other social innovation actors and took on recurring tasks during the social innovation process. In addition to the four actor types resulting from the combination of these two criteria, we identified a fifth actor type: actors who were part of the in-group, took on essential tasks, *and* had a leadership function. These actors additionally took over leadership and management duties, such as coordinating tasks and distributing responsibilities.

The actors most involved in the analysed co-creation events were leaders, external helpers, and central internal actors (Table 3; see appendix for more details). Internal helpers were less common, and central external actors were almost never involved. Thus, co-creation events in which regulation issues were present required leaders and central internal actors to participate. Considering the high importance of leaders and central internal actors for the success of the social innovations, this finding implies that these co-creation events were particularly important for this success.

Regulations were an important and persistent issue in the social innovations, as central social innovation actors participated in the co-creation events throughout the entire social innovation trajectory. Regulations had to be addressed to clarify certain aspects or to achieve tasks that served the goal of the respective co-creation event. In the first-responder case, for instance, two events occurred regarding discussing and elaborating on a smartphone application for alarming the lay helpers (co-creation events 18 and 19). There, the issue of data protection needed to be clarified to achieve the goal of a legally compliant application.

The actors involved in co-creation had to address regulations from three fields (Table 3; see appendix for more details on the regulations): finance, primarily in terms of regulations concerning the financing of healthcare services, such as the reimbursement of the services by healthcare insurers; service safety, typically in terms of requirements to ensure the safe implementation of healthcare services (e.g. obligations to provide adequate medical aid in case of emergency while implementing services such as birth assistance); and lastly, data protection, specifically in terms of patient data. Financial regulations were the most frequent type. In many co-creation events in which the actors had to address financial regulations, they also had to address safety and data-protection regulations.

All regulations applied to a specific type of healthcare service and/or were regionally restricted to the canton level. The latter reflects the nature of the Swiss healthcare system, where the cantons have the largest decision-making power of all political institutions. Thus, the social innovation actors only influenced relatively detailed (rather than broad) healthcare regulations. For instance, the actors in the healthcare network achieved the inclusion of financial contributions for healthcare networks for primary care and for

Table 3. Specificities of co-creation events in which social innovation actors had to cope with healthcare regulations.

Co-creation event	Primary actor types involved in co-creation event	Primary regulation types the actors had to cope with in the event	Overarching goal pursued by co-creating actors	Primary knowledge & skills used in the co-creation event that were applied to influence regulations (excluding knowledge about regulations)	Timing of the event
Birth centre					
1 – Talks/negotiations with heads of the regional hospital.	Leaders	Finance	Integrating the birth centre into the regional hospital (failed).	Healthcare processes and medical procedures	Several meetings over several weeks
2 – Visit to a birth centre in an urban area.	Leaders & external helpers	Service safety	Learn from already operating birth centre.	Healthcare processes and medical procedures	Several full days over several weeks
3 – Preparing and furnishing the rooms of the birth centre.	Central internal actors & external helpers	Service safety	Prepare adequate rooms for operating the birth centre.	Healthcare processes and medical procedures	Several days over several weeks
4 – Writing the operating approval for the birth centre.	Leaders	Finance & service safety	Put the birth centre into operation.	Analytical/scientific	Several days over several weeks
5 – Writing approval for the birth centre to be recognised as an official healthcare provider.	Leaders	Finance	Authorisation to reimburse services by healthcare insurers.	Analytical/scientific	Several days over several weeks
6 – Writing (first) application to integrate the birth centre into the regional hospital.	Leaders & internal helpers	Finance	Integrating the birth centre into the regional hospital (failed).	Healthcare processes and medical procedures	Several days over several weeks

(*Continued*)

Table 3. Continued.

Co-creation event	Primary actor types involved in co-creation event	Primary regulation types the actors had to cope with in the event	Overarching goal pursued by co-creating actors	Primary knowledge & skills used in the co-creation event that were applied to influence regulations (excluding knowledge about regulations)	Timing of the event
7 – Talks/negotiations with heads of the regional hospital about the (first) application to integrate the birth centre into the regional hospital.	Leaders	Finance	Integrating the birth centre into the regional hospital (failed).	Healthcare processes and medical procedures	Several meetings over several weeks
8 – Writing (second) application to integrate the birth centre into the regional hospital.	Leaders & internal helpers	Finance	Integrating the birth centre into the regional hospital (failed).	Healthcare processes and medical procedures	Several days over several weeks
9 – Talks/negotiations with heads of the regional hospital about the (second) application to integrate the birth centre into the regional hospital.	Leaders	Finance	Integrating the birth centre into the regional hospital (failed).	Healthcare processes and medical procedures	Several meetings over several weeks
10 – Writing application to implement a service to give women who give birth by caesarean section the opportunity to stay in the birth centre during the postpartum period.	Leaders & central internal actors	Finance & service safety	Partial integrating of services of the birth centre into the regional hospital (succeeded).	Healthcare processes and medical procedures Local, contextual	Several days over several weeks
11 – Talks/negotiations with heads of the regional hospital about the application to implement a service to give women who give birth by caesarean section the opportunity to stay in the birth centre during the postpartum period.	Leaders & central internal actors	Finance & service safety	Partial integrating of services of the birth centre into the regional hospital (succeeded).	Healthcare processes and medical procedures Local, contextual	Several meetings over several weeks

Integrated healthcare network

12 – Conceptualise alternative regional healthcare supply models.	Leaders & central internal actors	Finance	Providing number of alternative regional healthcare supply models as a basis for further discussion.	Local, contextual Analytical/scientific	Several days over several weeks
13 – Review of the regional hospital's accounting.	Central internal actors	Finance	Find funding sources for alternative regional healthcare supply models.	[none]	Several days over several weeks
14 – Assessment of needs for healthcare in the region (during the phase when several models besides the healthcare network were still being discussed).	Central internal actors	Finance	Choosing alternative healthcare supply models that suit the regional population's needs.	Local, contextual	Several days over several weeks
15 – Assessment of needs for healthcare in the region (during the phase when the healthcare network was a decided matter and a concrete design plan was discussed for it).	Central internal actors	Finance	Choosing healthcare services for the healthcare network that suit the regional population's needs.	Local, contextual	Several days over several weeks
16 – Assessment of future developments of the regional hospital in terms of location and financing (during the phase when several models besides the healthcare network were still being discussed).	External helpers	Finance	Choosing the right development for the regional hospital.	Local, contextual	Several days over several weeks
17 – Assessment of future developments of the regional hospital in terms of location and financing (during the phase when the healthcare network was a decided matter and a concrete design plan was being discussed).	External helpers	Finance	Choosing the right development for the regional hospital.	Local, contextual	Several days over several weeks
First-responder system					

(*Continued*)

Table 3. Continued.

Co-creation event	Primary actor types involved in co-creation event	Primary regulation types the actors had to cope with in the event	Overarching goal pursued by co-creating actors	Primary knowledge & skills used in the co-creation event that were applied to influence regulations (excluding knowledge about regulations)	Timing of the event
18 – Conceptual work on a smartphone application to alert lay helpers.	Central internal actors & central external actors	Data protection	Effective alerting of lay helpers.	[none]	Several days over several weeks
19 – Implementation of the smartphone application to alert lay helpers.	Central internal actors & central external actors	Data protection	Effective alerting of lay helpers.	Analytical/scientific Local, contextual	Several days over several weeks
20 – Implementation of an add-on for the smartphone application for alerting professional paramedics who are off duty.	Leaders, central internal actors, & central external actors	Finance	Improving the emergency service quality in the first-responder system.	Analytical/scientific Local, contextual	Several days over several weeks
21 – Implementation of service to alert lay helpers when elderly people press an emergency button installed at home.	Leaders & central internal actors	Finance	Expand services of the first-responder system to help more vulnerable people.	Analytical/scientific	Several days over several weeks
22 – Implementation of a single health and legal protection insurance for lay helpers when they are on duty.	Central external actors & external helpers	Service safety	Reduce personal risk of lay helpers.	Analytical/scientific	Several days over several weeks
23 – Implementation of an indemnity insurance for public automated external defibrillators.	Central external actors & external helpers	Finance	Reduce financial risk of public providers of automated external defibrillators.	Analytical/scientific	Several days over several weeks

Table 4. Social innovation actor types.

	Takes on tasks essential for the success of the social innovation	Part of the social innovation's in-group	Takes on leadership and management tasks	Example from data
Leaders	Yes	Yes	Yes	Head of a regional emergency corps who coordinates who represents the first-responder system externally and is involved in the most important strategic decisions concerning, for instance, alerting lay paramedics.
Central internal actors	Yes	Yes	No	A representative of the cantonal health department who helped coordinating the workshops, in which the integrated healthcare network was conceptualised.
Central external actors	Yes	No	No	A retired head of a local hospital who supported the birth centre with his expert knowledge.
Internal helpers	No	Yes	No	A midwife working at the birth centre who sporadically helped organising events and meetings.
External helpers	No	No	No	Engineers from the cantonal office of geoinformatics who helped develop a digital map indicating the location of automated external defibrillators to support lay paramedics in the first-responder system.

emergency care in peripheral regions in the regulations for financing cantonal hospital supply and care. Another example from the first-responder case concerned reimbursement; the actors achieved the implementation of a rule that every deployment of a lay paramedic can officially be billed via the patients' health insurance – although only a rather small lump sum.

Co-creation and actors' influence on regulations

Actors involved in activities to influence regulations were mostly leaders, while some were central internal actors. All activities were concerned with inducing actors who had the power to change regulations (such as authorities) to start the process of making

regulatory changes or adjustments. Often, the actors also made propositions about concrete changes or adjustments. For all activities, they needed several types of knowledge and skills, which they partly acquired during co-creation events. This is how co-creation helped the actors influence regulations.

Of course, the social innovation actors required knowledge about regulations to influence them. However, they also needed other knowledge and skills (Table 3; see appendix for more details). Firstly, they needed knowledge about the operative processes in healthcare institutions, as well as about basic medical procedures such as surgeries. Understanding the implications of regulations and potential regulatory changes for healthcare institutions was thus critical. Such knowledge helped them argue in favour of such changes or adjustments because they could convincingly derive and present the favourable consequences. This was particularly crucial when the actors from the birth centre used knowledge about operative processes in hospitals, which they acquired during successful talks and negotiations, to create a pilot project through which women who gave birth by caesarean section could stay in the birth centre during the postpartum period (co-creation event 11). One birth-centre leader used this knowledge in parliamentary sessions to argue in favour of a regulatory change to loosen the preventive measures for birthing in hospitals in rural or peripheral regions (for instance, the permanent presence of at least one hospital midwife). As a member of the legislative council, she often had the opportunity to raise her concerns before authorities, and she was always up to date with the political debates and tried to adjust her concerns to the latest discussions.

Furthermore, the social innovation actors needed knowledge about the economic and social circumstances of the locality or region where the social innovation was established. The contextualisation of regulatory changes and adjustments was important to make the broader implications visible – beyond those for healthcare institutions and professionals. The actors could use the knowledge to clarify the favourable consequences of regulatory changes with concrete examples, thereby making their arguments more persuasive. They could not only present the implications for the people and organisations directly affiliated with the social innovation but also derive implications for the broader population and economy in the region or locality. For instance, one central internal actor active in the healthcare network and employed by the Bernese cantonal health department induced a change in the cantonal guidelines for the public financing of healthcare, because this involved reporting the potential consequences of such a change for the various regions of the canton of Berne. She learned the necessary local, contextual knowledge for the assessment of needs for regional healthcare (co-creation events 14 and 15). As she was directly subordinate to the department director, she could initiate regulatory changes or adjustments.

Lastly, the social innovation actors needed analytical and scientific knowledge and skills to collect, understand, and use empirical and statistical data, which could be used to show the quality and success of social innovation. The data provided arguments in favour of changing or adjusting regulations to foster similar social innovations, as well as to implement existing ones more straightforwardly. The data could also be used to identify deficits, which could be lifted via regulatory change or adjustment. For example, data about successful deployments of first-responder lay paramedics collected via a smartphone application (co-creation events 18 and 19) could be used by a central internal actor responsible for alarming first responders to raise the issue that alerting lay paramedics should be included in the official service mandate of the cantonal emergency call centre. The data could also be used by the leader, head of one of the cantonal

emergency corps, in his regular meetings with the cantonal healthcare authorities to convince them to expand the first-responder system.

Knowledge about operative processes in healthcare institutions and basic medical procedures, as well as local, contextual knowledge, was mainly contributed by central internal actors and internal helpers. These actors, often medical professionals such as doctors, midwives, or paramedics, were also often well embedded in the social innovation's locality. They knew a great deal about local social and economic conditions. As they were part of co-creation events, they likely shared their knowledge with those actors involved in influencing regulations. It is thus likely that the actors involved in influencing regulations learned the necessary medical and contextual knowledge to influence regulations in co-creation events. Notably, actors who contributed to influencing regulations were active in co-creation events throughout the entire social innovation trajectory and could thus learn knowledge and skills from others during the entire social innovation process. Analytical and scientific knowledge and skills were often brought into co-creation by the actors involved in influencing regulations (i.e. leaders and central internal actors). They may thus not have learned them during co-creation events.

The data further revealed circumstances related to the actors that were presumably independent of co-creation events but further facilitated regulatory changes or adjustments. Almost all actors involved in influencing regulations were in close contact with authorities that could initiate regulatory changes. Their networks also consisted of politicians who could initiate such changes through parliamentary means. In some cases, the social innovation actors even worked for authorities or were themselves politicians; all were experienced in talking to people with formal authority and knew how to act and express themselves persuasively. Whether these preconditions or circumstances were influenced by co-creation is thus unclear. Of course, the actors could have learned or improved some skills during co-creation events, but these are skills that are acquired in 'learning-by-doing' processes that require experience to master that are thus difficult to learn in short-term co-creation, even though the actors were active in multiple co-creation events throughout the entire social innovation trajectory.

In summary, regulations were a crucial and persistent issue in social innovation. Leaders, external helpers, and central internal actors were the most involved in co-creation, although only leaders and central internal actors were involved in influencing regulations. They implemented various activities – all concerned with inducing actors who had the power to change regulations to start the process – to adjust or change regulations. Often, they also made propositions about concrete changes or adjustments. Leaders and central internal actors acquired the necessary knowledge about regulations to influence regulations. However, they learned knowledge and skills in co-creation from other actors, which helped them influence regulations. In particular, they learned knowledge about operative processes in healthcare institutions and basic medical procedures, as well as local, contextual knowledge. Furthermore, the analysis revealed circumstances related to these actors that were independent of co-creation events but further facilitated regulation changes or adjustments. Namely, they had access to actors with formal authority and were skilled in persuading others. Before turning to the discussion and conclusion, we outline the study's conceptual contributions to co-creation in social innovation.

Conceptual contributions to co-creation in social innovation

Our study contributes to existing conceptualisations of co-creation in social innovation by adding a detailed perspective on actors, considering social innovations explicitly as

processes, and attributing explanatory power to co-creation regarding the increase of the transformative potential of social innovations. Existing literature about co-creation and social innovation conceptualises co-creation in three ways: firstly, as the joint development of social innovations in public services by public actors and citizens (Nyseth, Ringholm, and Agger 2019; Voorberg, Bekkers, and Tummers 2015; Bekkers et al. 2014; Pestoff 2015), as well as by various types of private actors (Ansell and Torfing 2021; Torfing, Sørensen, and Røiseland 2019); secondly, as the involvement of various types of actors in the development, implementation, and sustaining of social innovation in various types of services (Windrum et al. 2016), where each of these actors can influence the characteristics of the services provided by the social innovation (Windrum et al. 2016); and lastly, as (social-)innovation ecosystems in which collaboration among different types of actors, such as citizens, enterprises, or higher educational institutions, is facilitated or fostered for all types of social innovation, not only in services (Kumari et al. 2020; Eckhardt et al. 2021).

Our study contributes to these conceptualisations in three ways. Firstly, we add depth to the consideration of social innovation actors in co-creation. While existing conceptualisations of co-creation emphasise the sectoral and professional variety of actors participating in co-creation for successful social innovation, they do not consider the role of the co-creating actors according to the extent to which these actors are involved in the process. The differentiation of actors according to the extent to which they are involved in the social innovations in our study allows us to deduce the actors' importance for successful development and implementation of social innovation. Such information can give hints about which combinations of certain co-creation actors are central to the social innovation's success throughout the process of development or implementation. This brings us to the second contribution: although it can implicitly be assumed that existing conceptualisations view social innovation as a process, they do not explicitly conceptualise co-creation as recurring throughout this process. Our study adds to these conceptualisations, as it perceives co-creation as events occurring throughout the social innovation process. This perspective accounts for the fact that social innovation always comprises a process with distinct stages (Neumeier 2012; Murray, Caulier-Grice, and Mulgan 2010), which may involve co-creation. The most important conceptual contribution of our study, however, is that an explanatory function is attributed to co-creation. This departs from extant conceptualisations of co-creation in social innovation, which remain largely descriptive (co-creation is basically seen as a characteristic of social innovation). Our study widens such conceptualisations by providing a perspective on the ways co-creation can increase the transformative potential of social innovations, that is, the 'inherent and/or intended qualities to challenge, alter and/or replace dominant institutions in a specific context' (Haxeltine et al. 2017, 18). We argue that co-creation increases such qualities by providing the social innovation actors with (part of) the necessary knowledge and skills to be able to influence regulations in the healthcare context. Our conceptualisation may be especially beneficial to social innovation research in healthcare, where changing regulations is crucial to solving healthcare challenges due to the highly regulated nature of the healthcare sector. However, other highly regulated sectors in which social innovations are emerging – for instance, transportation (Imhof 2021) – could equally benefit from our conceptualisation.

Discussion and conclusion

Regulations were an important and persistent issue in the analysed social innovations throughout the entire social innovation trajectory, both because many leaders and

central internal actors were involved in the examined co-creation events and because these actors contributed most of the knowledge and skills on regulations. Certainly, this reflects the highly regulated nature of the healthcare sector (De Pietro et al. 2015; van Raak and de Haan 2017; Lakomaa and Sanandaji 2021) and supports the notion that social innovations must always address and adjust to the regulatory context of the sector in which they attempt to evolve (Terstriep, Rehfeld, and Kleverbeck 2020).

Leaders and central internal actors were the most involved social innovation actors in co-creation, which is reflected in other social innovation studies, such as the SIMPACT project, which analysed 60 social innovations across Europe (Terstriep et al. 2015). The project shows that it is 'crucial and common practice' for so-called 'inner core' social innovation actors to collaborate not only with other actors but also with different types of actors (Terstriep et al. 2015, 41). Our findings add insights into how leaders and central internal actors gain knowledge and skills through such collaboration (co-creation), which helps them influence formal institutions such as regulations.

To influence regulations, the social innovation actors needed scientific expertise, system and process understanding, and contextual, object-specific knowledge. These types of knowledge and skills are among those that are important for change agents to possess when they enact institutional and social change (Kristof 2022; 2010). We show that the social innovation actors learned two of the three types of knowledge in co-creation, namely system and process understanding and contextual knowledge. Our results thus indicate that co-creation in social innovation can enhance social innovation actors' general competences to successfully induce institutional change in general, not just in the area of healthcare regulations. Factors beyond the knowledge and skills that the actors learned in co-creation can potentially enhance such competences. The actors already had some favourable competences and characteristics to influence regulations, which are well known from institutional entrepreneurs who actively seek to change institutions (Battilana, Leca, and Boxenbaum 2009). Firstly, they had networks of actors with formal authority that they tried to induce to enact changes in regulations. Furthermore, they were competent at persuading others rhetorically. As such, they could combine their favourable actor networks with their abilities to persuade others. As Lockett et al. (2012) show, these are good preconditions for institutional entrepreneurs aiming to reform healthcare.

Although our findings suggest that these preconditions are present independently of co-creation, it is possible that co-creation fosters them; our analysis was limited to co-creation events in which the social innovation actors had to address healthcare regulations, and these actors may have gained their networks and persuasion skills in other co-creation events. For example, in events where users of the social innovations' services participated Service users did not participate in the events in two social innovation cases. However, because service users often have diverse backgrounds and are less constrained by healthcare regulations (Demonaco et al. 2020), they may have useful knowledge that could be used to influence regulations. Similarly, the knowledge that social innovation actors used or shared with others to influence regulations could also have been acquired in other co-creation events. However, we can suggest that the examined co-creation events were seminal in the social innovation process because leaders and central actors were part of these events. As these actors were also the ones who were involved in influencing regulations, we can further suggest that the examined co-creation events were the ones where much relevant knowledge to influence regulations was shared.

Our study's main empirical contribution to the co-creation and social innovation literature is that it shows that co-creation in social innovations in a highly regulated sector such as healthcare can contribute to adjusting or changing regulations, a form of formal

institutions. Thus, co-creation may be relevant in solving healthcare challenges and other great social challenges, for which social innovations are often praised. However, whether such changes and adjustments can contribute to larger-scale institutional change on the healthcare systems' level – especially considering our finding that the social innovation actors only influenced rather detailed regulations, not ones that concern a broad field in healthcare – remains an open question. Nonetheless, at least one issue speaks in favour of a possible larger-scale change: institutional change may come about gradually, not always abruptly (Mahoney and Thelen 2009). Considering the challenges faced by the healthcare systems in Switzerland and other high-income countries in recent decades and the fact that these challenges may worsen in the future (Broerse and Grin 2017), we can expect social innovations to increasingly address healthcare challenges on local, regional, and national scales. As such, co-creative activities in social innovations may increase and thus support regulatory changes. Co-creation not only *in* but also *among* social innovations may increase, which is crucial because social innovations must involve coalitions that unite diverse actors to enact transformative change in institutions (Strasser, de Kraker, and Kemp 2019; Haxeltine et al. 2017). Uniting actors for new co-creation is facilitated in social innovation ecosystems (Eckhardt et al. 2021; Terstriep, Rehfeld, and Kleverbeck 2020) that are bound to certain regional circumstances, such as the existence of supporting actors, including universities, third-sector organisations, and public actors. However, given that social innovations in healthcare often emerge in regions lacking such circumstances – particularly rural and/or peripheral regions (Farmer et al. 2018; Noack and Federwisch 2020) – their power to transform institutions may be limited.

Nonetheless, we believe that co-creation increased the transformative potential of the social innovations in our study. However, actually enacting such institutional change takes time. We need to gain a deeper understanding of the ways co-creation in social innovation processes can further exploit the transformative potential of social innovation. Firstly, future research could analyse the potential to change regulations in other highly regulated sectors. Conversely, it could also analyse the potential to change institutions other than healthcare regulations. In any case, research would benefit from a deeper assessment of institutional changes by involving a more comprehensive set of methods than those applied in this study (e.g. policy analysis) or by considering a wider range of stakeholders, such as the actors affected by regulatory changes.

Co-creation can support social innovation actors in influencing formal institutions in highly regulated sectors. However, by itself, co-creation is not sufficient to influence institutions or to enact large-scale institutional transformation. Requirements unrelated to co-creation, such as access to actors with formal authority and skills in persuading others, are at least as important for influencing institutions. Co-creation in social innovation processes should thus be seen as a way to support social innovation actors in institutional change but not as a guarantee for it.

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Appendix

Table A1. Details of co-creation events, in which social innovation actors had to cope with healthcare regulations.

Co-creation event	Primary actor types involved in co-creation event	Primary regulation types the actors had to cope with in the event	Overarching goal pursued by co-creating actors	Primary knowledge & skills used in the co-creation event that were applied to influence regulations (excluding knowledge about regulations)	Timing of the event
Birth centre					
1 – Talks/negotiations with heads of the regional hospital.	Leaders (e.g. one of the birth centre's co-managers)	Finance: cantonal regulations on financing healthcare facilities and services (e.g. obligation to finance basic healthcare services)	Integrating the birth centre into the regional hospital (failed).	Healthcare processes and medical procedures: hospital-specific.	Several meetings over several weeks
2 – Visit to a birth centre in an urban area.	Leaders (the birth centre's co-manager) & external helpers (e.g. manager of the urban birth centre)	Service safety: regulations on emergency requirements for healthcare services	Learn from already operating birth centre.	Healthcare processes and medical procedures: specific for birth centres.	Several full days over several weeks
3 – Preparing and furnishing the rooms of the birth centre.	Central internal actors (e.g. a retired local spatial planner) & external helpers (e.g. a local craftsman)	Service safety: regulations on emergency and sanitation requirements for healthcare services	Prepare adequate rooms for operating the birth centre.	Healthcare processes and medical procedures: specific for birth centres.	Several days over several weeks
4 – Writing the operating approval for the birth centre.	Leaders (the birth centre's co-managers)	Finance: regulations about reimbursement of services by healthcare insurers Service safety: emergency and sanitation requirements	Put the birth centre into operation.	Analytical/scientific: data from studies about safety in (rural) birth centres.	Several days over several weeks

(*Continued*)

Table A1. Continued.

Co-creation event	Primary actor types involved in co-creation event	Primary regulation types the actors had to cope with in the event	Overarching goal pursued by co-creating actors	Primary knowledge & skills used in the co-creation event that were applied to influence regulations (excluding knowledge about regulations)	Timing of the event
5 – Writing approval for the birth centre to be recognised as an official healthcare provider.	Leaders (the birth centre's co-managers)	Finance: regulations about reimbursement of services by healthcare insurers	Authorisation to reimburse services by healthcare insurers.	Analytical/scientific: data from studies about birth centres and other birthing facilities.	Several days over several weeks
6 – Writing (first) application to integrate the birth centre into the regional hospital.	Leaders (the birth centre's co-managers) & internal helpers (e.g. a midwife working for the birth centre)	Finance: cantonal regulations on financing healthcare facilities and services (e.g. regulations on financing birthing services)	Integrating the birth centre into the regional hospital (failed).	Healthcare processes and medical procedures: hospital-specific.	Several days over several weeks
7 – Talks/negotiations with heads of the regional hospital about the (first) application to integrate the birth centre into the regional hospital.	Leaders (the birth centre's co-managers and the president of the birth centre cooperative)	Finance: cantonal regulations on financing healthcare facilities and services	Integrating the birth centre into the regional hospital (failed).	Healthcare processes and medical procedures: hospital-specific.	Several meetings over some weeks
8 – Writing (second) application to integrate the birth centre into the regional hospital.	Leaders (the birth centre's co-managers) & internal helpers (e.g. a retired head physician of the regional hospital)	Finance: cantonal regulations on financing healthcare facilities and services	Integrating the birth centre into the regional hospital (failed).	Healthcare processes and medical procedures: hospital-specific.	Several days over several weeks

9 – Talks/negotiations with heads of the regional hospital about the (second) application to integrate the birth centre into the regional hospital.	Leaders (the birth centre's co-managers and the president of the birth centre cooperative)	Finance: cantonal regulations on financing healthcare facilities and services (e.g. regulations on subsidies for securing the healthcare supply of peripheral regions)	Integrating the birth centre into the regional hospital (failed).	Healthcare processes and medical procedures: hospital-specific.	Several meetings over some weeks
10 – Writing application to implement a service to give women who give birth by caesarean section the opportunity to stay in the birth centre during the postpartum period.	Leaders (the birth centre's co-manager) & central internal actors (e.g. a gynaecologist practising in the region)	Finance: regulations about reimbursement of services by healthcare insurers and on financing innovative healthcare services (like the one considered here) Service safety: regulations on emergency requirements for healthcare services	Partial integrating of services of the birth centre into the regional hospital (succeeded).	Healthcare processes and medical procedures: gynecologically specific. Local, contextual: behaviour/perceptions of local (female) patients.	Several days over several weeks
11 – Talks/negotiations with heads of the regional hospital about the application to implement a service to give women who give birth by caesarean section the opportunity to stay in the birth centre during the postpartum period.	Leaders (the birth centre's co-manager) & central internal actors (e.g. a retired local spatial planner)	Finance: regulations about reimbursement of services by healthcare insurers Service safety: regulations on emergency requirements for healthcare services	Partial integrating of services of the birth centre into the regional hospital (succeeded).	Healthcare processes and medical procedures: gynecologically specific. Local, contextual: behaviour/perceptions of local (female) patients.	Several meetings over some weeks
Integrated healthcare network					
12 – Conceptualise alternative regional healthcare supply models.	Leaders (healthcare consultant responsible for the organisation and moderation of the workshops) & central internal actors (e.g. representative of the regional hospital's management)	Finance: cantonal regulations of financing healthcare services (e.g. subsidies)	Providing number of alternative regional healthcare supply models as a basis for further discussion.	Local, contextual: perceptions/opinions of regional population about healthcare provision. Analytical/scientific: data about patient flows, claimed medical services etc. in (rural) regions/ hospitals.	Several days over several weeks

(*Continued*)

Table A1. Continued.

Co-creation event	Primary actor types involved in co-creation event	Primary regulation types the actors had to cope with in the event	Overarching goal pursued by co-creating actors	Primary knowledge & skills used in the co-creation event that were applied to influence regulations (excluding knowledge about regulations)	Timing of the event
13 – Review of the regional hospital's accounting.	Central internal actors (representative of the cantonal health department)	Finance: cantonal regulations of financing healthcare services (e.g. subsidies)	Find funding sources for alternative regional healthcare supply models.	[none]	Several days over several weeks
14 – Assessment of needs for healthcare in the region (during the phase when several models besides the healthcare network still being were discussed).	Central internal actors (e.g. mayors of the municipalities concerned)	Finance: general regulations on financing healthcare services (e.g. financial takeover of service costs by the Canton)	Choosing alternative healthcare supply models that suit the regional population's needs.	Local, contextual: perceptions/opinions of regional population about healthcare provision.	Several days over several weeks
15 – Assessment of needs for healthcare in the region (during the phase when the healthcare network was a decided matter and a concrete design plan was discussed for it).	Central internal actors (e.g. mayors of the municipalities concerned)	Finance: general regulations on financing healthcare services	Choosing healthcare services for the healthcare network that suit the regional population's needs.	Local, contextual: perceptions/opinions of regional population and healthcare providers about the future healthcare network.	Several days over several weeks
16 – Assessment of future developments of the regional hospital in terms of location and financing (during the phase when several models besides the healthcare network were still being discussed).	External helpers (e.g. experts in hospital construction)	Finance: general regulations on financing healthcare services (e.g. subsidies for securing the healthcare supply of peripheral regions)	Choosing the right development for the regional hospital.	Local, contextual: perceptions/opinions of regional healthcare providers about funding services and access to the future regional hospital.	Several days over several weeks

17 – Assessment of future developments of the regional hospital in terms of location and financing (during the phase when the healthcare network was a decided matter and a concrete design plan was being discussed).	External helpers (e.g. a local architect and a local engineer)	Finance: general regulations on financing healthcare services	Choosing the right development for the regional hospital.	Local, contextual: perceptions/opinions of regional healthcare providers about funding services and access to the future regional hospital.	Several days over several weeks
First responder system					
18 – Conceptual work on a smartphone application to alert lay helpers.	Central internal actors (person in charge of alarming first responders) & central external actors (computer scientists from an application development company)	Data protection: regulations on personal patient information that can be shared with third persons	Effective alerting of lay helpers.	[none]	Several days over several weeks
19 – Implementation of the smartphone application to alert lay helpers.	Central internal actors (person in charge of alarming first responders) & central external actors (computer scientists from an application development company)	Data protection: regulations on personal patient information that can be shared with third persons	Effective alerting of lay helpers.	Analytical/scientific: collection of data about deployment of lay paramedics. Local, contextual: Alerting preferences of regional lay paramedics.	Several days in several weeks
20 – Implementation of an add-on for the smartphone application for alerting professional paramedics who are off duty.	Leaders (Head of a regional emergency corps and president of the first responder association), central internal actors (person in charge of alarming first responders), & central external actors (computer scientists from an application development company)	Finance: regulations on services that can be financed through emergency service organisations	Improving the emergency service quality in the first responder system.	Analytical/scientific: collection of data about deployment of lay paramedics. Local, contextual: Alerting preferences of professional paramedics.	Several days over several weeks

(*Continued*)

Table A1. Continued.

Co-creation event	Primary actor types involved in co-creation event	Primary regulation types the actors had to cope with in the event	Overarching goal pursued by co-creating actors	Primary knowledge & skills used in the co-creation event that were applied to influence regulations (excluding knowledge about regulations)	Timing of the event
21 – Implementation of service to alert lay helpers when elderly people press an emergency button installed at home.	Leaders (Head of a regional emergency corps and president of the first responder association) & central internal actors (e.g. operation manager of the first responder system)	Finance: regulations on services that can be financed through emergency service organisations	Expand services of the first responder system to help more vulnerable people.	Analytical/scientific: collection of data about deployment of lay paramedics.	Several days over several weeks
22 – Implementation of a single health and legal protection insurance for lay helpers when they are on duty.	Central external actors (solicitor affiliated with a regional hospital) & external helpers (representative of insurance company)	Service safety: regulations on safe behaviour in emergency situations	Reduce personal risk of lay helpers.	Analytical/scientific: insurance law specifics.	Several days over several weeks
23 – Implementation of an indemnity insurance for public automated external defibrillators.	Central external actors (solicitor affiliated with a regional hospital) & external helpers (representative of insurance company)	Finance: regulations about reimbursement by indemnity insurers	Reduce financial risk of public providers of automated external defibrillators.	Analytical/scientific: insurance law specifics.	Several days over several weeks

Table A2. Details of the used and analysed data.

Methodological step	*Birth centre*	*Integrated healthcare network*	*First responder system*
1. Narrative interviews with persons who have been strongly involved in the social innovation for a long time (one per social innovation).	Interviewed person: president of the birth centre Main interview questions about: • The starting point of the social innovation. • The circumstances under which it grew and spread. • The role of the actors involved in the social innovation and their tasks and knowledge. • How the collaboration of the involved actors worked. • The milestones and barriers faced while implementing the social innovation. • The value the social innovation creates.	Interviewed person: former head physician of regional hospital	Interviewed person: head of one of the cantonal emergency corps
2. Comprehensive desk research of newspaper articles, websites, annual reports and other documents.	Analysed documents: • Two annual reports of the birth centre • Several articles of local newspapers (from the years 2013-2021) • Birth centre's website	Analysed documents: • Several articles of local newspapers (from the years 2008-2021) • Video recordings and protocols of several workshops about the healthcare network (accessible on a public website)	• Analysed documents: • Two annual reports of the First responder Bern association • Several articles of local and regional newspapers (from the years 2010-2021)

(*Continued*)

Table A2. Continued.

Methodological step	*Birth centre*	*Integrated healthcare network*	*First responder system*
3. Nineteen semi-structured interviews with actors active in the social innovations (four to eight per social innovation).	Interviewed persons: • Three midwifes (two of them co-managers of the birth centre) • Gynaecologist • Butcher • Admin worker • Retired spatial planner • Electrician	Interviewed persons: • Healthcare consultant • CEO of a construction company • President of the regional mayors' council • High school teacher • CEO of an elderly home • Employee of the cantonal health department • Representative of the regional hospital • Mayor of one of the municipalities of the healthcare network	Interviewed persons: • Three professional paramedics • Employee of an emergency call centre
	Main interview questions about: • The role of the interviewee in the social innovation. • The form and content of collaborations of the interviewee with other actors. • The type of knowledge and tasks the interviewee and others who are involved in the social innovation use. • Where the interviewee and others who are involved in the social innovation acquire(d) the necessary knowledge. • How the above-mentioned issues changed over time in the social innovation process.		

(*Continued*)

Table A2. Continued.

Methodological step	*Birth centre*	*Integrated healthcare network*	*First responder system*
4. Nine semi-structured interviews with social innovation actors who were knowledgeable about regulatory issues and who were active in carrying out concerns of the social innovation to the outside world (three per social innovation).	Interviewed persons: • Retired midwife (former co-manager of the birth centre) • Midwife (former co-manager of the birth centre) • Politician (president of the birth centre)	Interviewed persons: • Employee of the cantonal health department • Representative of the regional hospital • Mayor of one of the municipalities of the healthcare network	Interviewed persons: • Head of one of the cantonal emergency corps • Professional paramedic • Employee of an emergency call centre
	Main interview questions about: • The role of the interviewee in the phases of the social innovation process where he/she had to deal with/adjust to healthcare regulations. • The way healthcare regulations influence the work/activities of the interviewee and other actors involved in the social innovation. • Whether the interviewee and/or other actors could change or influence healthcare regulations to the advantage of the social innovation; how they did this and what kind of knowledge and skills were necessary to do this; and which of this knowledge and these skills they learned during certain co-creation events.		