



Emergency circumstances call for extraordinary measures: a study of research council COVID-19 emergency call projects

Trust Saidi & Magnus Gulbrandsen

To cite this article: Trust Saidi & Magnus Gulbrandsen (2023): Emergency circumstances call for extraordinary measures: a study of research council COVID-19 emergency call projects, Innovation, DOI: [10.1080/14479338.2023.2187813](https://doi.org/10.1080/14479338.2023.2187813)

To link to this article: <https://doi.org/10.1080/14479338.2023.2187813>



© 2023 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



[View supplementary material](#)



Published online: 13 Mar 2023.



[Submit your article to this journal](#)



[View related articles](#)



[View Crossmark data](#)



OPEN ACCESS



Emergency circumstances call for extraordinary measures: a study of research council COVID-19 emergency call projects

Trust Saidi  and Magnus Gulbrandsen 

Centre for Technology, Innovation and Culture, University of Oslo, OSLO, Norway

ABSTRACT

Medical research and innovation to meet urgent demands in society is crucial, but the process contains many challenges. Moreso, impacts from medical research and innovation can take many years to materialise, not least because these activities are infused with various types of complexities due to heterogeneous networks, systems, and contexts. Although acceleration is currently a trending topic, little is known about the temporal complexities embedded in research and innovation processes. This paper analyses the time dimension of medical research and innovation through an empirical investigation of 30 research projects that were set up to respond quickly to the COVID-19 situation from June 2020 to July 2022. Funders and scientists were able to find ways to speed up many tasks, but many of the projects also saw delays and deceleration. An important explanation is that temporality is tied to a myriad of contextual characteristics that limit the opportunities of project leaders for coordinating and accelerating activities and outcomes. Attempts at acceleration seem to work best when substantial ongoing research activities can be shaped incrementally into new directions. Nevertheless, the results of the projects may be of limited value to the pandemic which served as their rationale, but they can serve as a foundation for better policies and practices that invoke the need for rethinking medical innovation in the future.

ARTICLE HISTORY

Received 17 February 2022

Accepted 1 March 2023


KEYWORDS

Emergency; medical research; funding; temporality; temporal complexities; Covid-19

Introduction

Medical research, innovation and their diffusion are often lengthy processes. Although there are examples of fast innovations and rapid implementation of research breakthroughs, process studies have found that it often takes many years, if not decades, for effective outcomes to appear (e.g., Matt et al., 2017). This is not least seen in biomedical research, where lengthy processes are explained by the regularity of various ‘translation gaps’ (Hanney et al., 2015). Such gaps are tied not only to strict procedures for testing and implementation but also to social and cognitive boundaries between professions that hinder diffusion of innovations (Ferlie et al., 2005). The long time from medical research to societal impact for example, in the form of new medical treatments or practices, is

CONTACT Trust Saidi  trust.saidi@tik.uio.no

 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/14479338.2023.2187813>

© 2023 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way.

generally seen as one of the most difficult aspects of impact assessment (Greenhalgh et al., 2016).

This is the backdrop against which many emergency medical research and innovation projects were launched as a response to the global coronavirus situation. New vaccines have emerged in remarkably short time frames, yet we also know that they were built upon research dating back a long time for example, tied to mRNA. The outbreak and rapid spread of coronavirus called for swift actions and preparation to ensure the best outcomes for patients and society at large (Lancaster et al., 2020). It demanded expediting medical research with the aim of generating knowledge to address the multi-faceted challenges arising from the pandemic, which created an urgent need for critical reflection and new knowledge production (Solbakk et al., 2020). This called for imminent action despite the prevailing knowledge gaps and multi-level uncertainty. Consequently, priority was given to the speedy translation of knowledge generated from research on the disease into decision-making. Emergency funding was allocated to scientists to initiate medical research in an expedited effort to understand, prevent and treat the disease (Messersmith et al., 2021).

Given previous responses to health emergencies, the widespread and fast-tracking of pandemic-directed medical research is not surprising. Funding instruments are regarded as efficient mechanisms to trigger rapid public health response towards generating knowledge on clinical characterisation, treatment and validation of new diagnostics (Harris et al., 2020). Although medical and scientific responses to past crises suggest that the results from emergency funding can positively influence decision-making, there is also a risk of compromising research quality and ethics, which may in turn jeopardise public confidence in science (Solbakk et al., 2020). This invokes the need for rethinking the many routines and processes of medical innovation and reassessing our knowledge in relation to the temporal complexities associated with Covid-19.

More theoretically, specific characteristics of science and innovation processes may constitute barriers to rapid production and diffusion of research and innovations, named 'complexities' by Garud et al. (2013). Complexities emerge because innovations are most often co-evolutionary and relational and thereby involve different actors immersed in specific time frames and institutional settings, leading to four ideal complexity types: evolutionary, relational, cultural and temporal (Garud et al., 2013). Especially, the latter is relevant for understanding the urgency of a pandemic, and temporal complexity is seen as an 'under-researched area' requiring 'additional research and theorisation' (Garud et al., 2013, p. 800). This is also stressed by authors interested in the social aspects of time in innovation and projects (e.g., Halbesleben et al., 2003; Dille et al., 2022). We simply know very little about the interplay between temporal complexities and the extent to which it affects medical research and innovation processes. In a review of the complexity perspective in innovation studies, Poutanen et al. (2016) recommended that research adopt a reflexive stance to allow for studies of failure and chaotic ongoing situations. In addition to the basic characteristics of research and innovation processes, we assume that complexities in emergency funding of medical research projects can be tied to the need for rapid access to new scientific data and the threat of producing incomplete results due to constrained time frames. Against this background, this paper explores how emergency funded projects deviate from normal medical innovation. The medical innovation process is normally highly regulated and lengthy to avert potential risks and

uncertainties. Institutional time cultures within medical innovation involving multi-year research cycles are complex, time-consuming and contingent on many factors (Rau et al., 2018).

Our main aim is to add to the understanding of medical research and innovation by highlighting how temporality plays out in medical projects that have been selected with a primary emphasis on speedy results and accelerated knowledge production. We believe that this is a particularly relevant empirical setting for studying temporality in research and innovation, not least in the multi-faceted and socially embedded processes tied to medicine. Our research is based on the following exploratory research questions:

- (i) What is the nature of the temporal complexities that emerge from accelerated knowledge production in emergency-funded projects?
- (ii) Which practices and experiences are involved in the temporal complexities of emergency-funded projects?
- (iii) What lessons can be derived from the temporal complexities of emergency-funded projects?

The paper is structured as follows. [Section 2](#) substantiates our theoretical underpinnings by connecting temporal complexity to the medical research and innovation landscape, setting up analytical lenses for the empirical work. [Section 3](#) presents our data and methodology, while [section 4](#) contains the results of the study in the form of themes that were derived from the coding process of empirical data. [Section 5](#) discusses our findings against the backdrop of temporal complexity, while [section 6](#) wraps up the study through implications and promising avenues for future research.

Theoretical perspectives: temporal complexity in medical research and innovation

Innovation is fruitfully seen as a process and not just an outcome of the invention, development and implementation of ideas; it is complex but important as a source of transformative change in society (Garud et al., 2013). It holds the potential to bring profound change to the basic routines, resources and authority flows of the social system in which it is embedded (Westley & Antadze, 2010). A process orientation of innovation and research is not a denial of the existence of outputs, states or entities, but it puts emphasis on unpacking them to reveal the activities and transactions that take place and contribute to their constitution (Langley & Tsoukas, 2016).

Temporal complexity arises due to the evolutionary, collaborative and interactive nature of most research and innovation activities, which means that they involve organisations and settings with different logics or structures related to time, such as how deadlines and goals are defined and implemented (e.g., Butler, 1995; Dille et al., 2022). Because of these fundamental differences, research and innovation activities need to become ‘synchronised’ or ‘entrained’ to avoid delays and setbacks (Dille et al., 2022). As such, activities and transactions embedded in temporal complexity are tied to the speed and rate at which the projects are executed and lead to various effects. These are key themes for the analysis in this paper, which seeks to provide fresh insights into the temporal aspects of accelerated medical research and innovation processes.

Innovation studies have repeatedly shown that innovation is not linear – it does not follow an orderly path from research to development. Complexity framings of innovation are tied to this, and as argued by Dryden Palmer et al. (2020), complexity is a relevant analytical tool when there are multiple steps, numerous stakeholders and interactions across disciplinary or professional groups. In this paper, our focus is on understanding the ‘timescape’ (Adam, 2005) of research during the COVID-19 pandemic where the context was characterised by the language of acceleration and faster delivery of innovations. Thus, the temporality of research and innovation is an overarching concept through which different forms of complexity are analysed in this paper.

Our empirical context is where there is a clear expectation that research will lead to or inspire various forms of practical changes – which can be defined as innovations – in how the pandemic is handled. Complexity thus refers to different aspects of research and innovation processes in addition to representing an implicit critique of simple explanations of cause-and-effects, outcomes and other aspects. The open and systemic nature of these processes is one such aspect (see Fagerberg et al., 2005). Another is that many important outcomes and events in research and innovation – not least within medicine – are ‘hidden’ in the sense that they are often not covered by conventional indicators and are not communicated outside of specialised communities (e.g., Hopkins, 2006). As such, complexity is intimately tied to the lengthy nature of research and innovation processes.

A temporal perspective is consequently tied to organisational and institutional features of research and innovation. Temporality may involve an emphasis on how activities and effects can be sped up, captured in management approaches like ‘rapid prototyping’, ‘accelerators’ and ‘fail fast’ approaches. However, this implies a focus only on some aspects of temporality (speed and duration) and an underlying perspective that time should primarily be seen as linear, tied to ‘clock time’ (Butler, 1995). More fundamentally, the temporal dynamics associated with research and innovation present organisational actors with multiple agentic orientations and multiple rhythms and experiences (Garud et al., 2011). Time delays, lags and differences in rhythms render knowledge development to be a ‘compulsive process’ (Garud & Nayyar, 1994). This means that research and innovation processes cannot be determined a priori, but they contain moments of serendipity and flashes of insights, which are unpredictable (Dew, 2009). In research, it is common that earlier results are rediscovered at a later stage and put into use, a phenomenon referred to as sleeping beauties (Van Raan, 2004, 2015). Despite the spontaneity of these moments of ‘eureka’, search or confluence, it is imperative that effort is made towards creating a conducive environment for such occurrence, often expressed with Pasteur’s famous quote that ‘chance favours only the prepared mind’ (Garud et al., 2011). In a study by Medase (2020), ‘slack time’ was found important because research and innovation can flourish on redundancy and is hampered when individuals in these activities are constantly strained or stretched.

A key contribution to temporality frameworks is Butler (1995), who argued that organisations frequently differ in their basic time frames, which refers to how the organisation interprets and experiences events in the present, through knowledge derived from the past and visions about the future. Events are socially significant occasions that require some sort of response, and they constitute the basis of our experience of time. Time frames are intersubjective, which means that how time is experienced, depends upon the group, organisation or community one belongs to. Several different

characteristics make up a time frame. These include linearity (are events similar and sequential), novelty (do contexts change, how often do sporadic events occur), regularity (irregularity increases disconnect between experienced time and clock time), movability (to what extent can something be postponed versus has to happen under specific conditions), concurrence (events that take the attention away from other tasks and events) and pace (degree to which time is paced beyond the control of actors).

Temporal complexity is not an isolated attribute of science and innovation processes but tied to other complexities (Garud et al., 2013). The increasingly composite organisation and production of research can be attributed to the interactions among heterogeneous elements, such as large-scale collaboration across institutions, technology platforms and disciplines (Webster, 2019). The interactive process is a potential source of ambiguity, which is generated by what Garud et al. (2013) describe as the multiple and sometimes conflicting inputs offered by different actors, which result in innovation progressing through the challenging task of resolving tensions. Tensions are often generated by varying frames of reference (beyond temporality) between the actors as well as the affordances that arise through their actions.

For our purpose, tensions are likely to arise between the different organisations involved in medical research and innovation. The emergence of multiple temporal rhythms generates asynchronies not only in the different elements of the innovation process but also in the infrastructure required for its development and subsequent implementation (Garud et al., 2013). Temporal complexity is intensified when some organisations primarily have future orientations (Van Lente, 2000), while others are immersed in the present (Garud et al., 2013). Uncertainties can also interfere with medical research and innovation by perpetuating practices that are wasteful in the use of time, inhibiting research and undermining public trust (Oxman et al., 2022). This invokes the need to orchestrate the innovation process to deal with temporal differences and unanticipated barriers requiring changes in plans (Doganova & Eyquem-Renault, 2009). Research funders may to a greater extent work within a clock time frame, with a congruence in future goals (like alleviating the pandemic) and a low novelty and bureaucratic regularity in calls for projects and their evaluation, selection and monitoring. Research organisations, on the other hand, are likely to function in what Butler (1995) refers to as an organic time frame, with, for example, a higher degree of novelty and concurrence and a lower degree of regularity. Users of medical research in hospitals and industry may have other time frame characteristics, such as shorter memories of the past as compared to research and research funding organisations. These tensions may generate gaps and challenges, not least in situations where speedy responses are needed.

Related constructivist perspectives on time explore aspects such as 'temporal institutional work' (Granqvist & Gustafsson, 2016) and 'temporal coordination' (Scarborough et al., 2015). Temporal institutional work concerns how actors 'construct, navigate, and capitalise on timing norms in their attempts to change institutions', which includes promoting a sense of urgency, irreversibility, momentum and various forms of synchronisation between actors, which contributes to establishing 'windows of opportunity' (Granqvist & Gustafsson, 2016). We see this perspective as interesting yet perhaps of less relevance in a study of urgency projects during the coronavirus pandemic, as the pandemic itself serves as a powerful synchronisation of the sense of urgency and the projects themselves signify a window of opportunity. Temporal coordination is necessary

when an overall innovation requires the input of many different teams, and where delays are frequent and costly (Dille et al., 2022; Scarbrough et al., 2015), which may also be the case in some types of medical innovation. Coordination often happens through boundary and epistemic objects like schedules and wider conceptual plans, which aim to remove unproductive gaps and delays from the process. It is envisaged that coordination through improved information technologies can promote timely delivery of medical research results through fostering an open innovation culture based on the collaborative creation and sharing of ideas (Naqshbandi & Jasimuddin, 2022). We expect that this may be difficult in medical research because gaps and delays may be beyond the control of single agents.

The temporal complexities in medical research and innovation can be accentuated by the context in terms of compelling events. For example, Al-Omouh et al. (2020) argue that social capital and collaborative knowledge creation were prominent mechanisms for enhancing organisational agility during the COVID-19 pandemic, which induced urgency in the delivery of results. The challenges that were posed by the pandemic pushed organisations to respond swiftly, adapt in order to thrive in an unknown landscape and operate rapidly in new ways to cope with the situation (Dahlke et al., 2021; Lyytinen, 2022; Redlbacher & Hattke, 2022; Xie et al., 2022). However, the use of new strategies to accelerate service delivery, such as digitalisation, during the period of COVID-19 invoked the need for updated global governance mechanisms that reflect the contemporary geopolitical order, which encourage international collaboration (Ekström et al., 2021). It demanded global governance strategies that are oriented towards shifting from a lack of interconnectivity in national systems, which often results in self-protecting silos towards a unified system that fosters rapid response to crisis (Lal et al., 2021). It can be noted that a lot of things have changed during the pandemic, and it is more likely that research and innovation may see some of these. Due to restrictions that were introduced to ameliorate the devastation of the pandemic, digitalisation is emerging as an important aspect of temporal complexity, and we are curious to see how this plays out in urgency-induced medical research and innovation projects.

Summing up, our starting point for empirical analysis, which emerged from the synthesis of various concepts on tensions linked to time, builds upon the need to better understand the temporal complexity of research and innovation processes (Garud et al., 2013). This complexity includes analyses of speed and changes in speed, gaps, and delays, which often stem from how research and innovation involve multiple actors, institutional contexts and regulatory settings. Actors may represent different fundamental time frames (Butler, 1995; Dille et al., 2022), a concept useful for understanding multi-stakeholder processes. In our case, we expect that the research funder and research performers may represent different time frames, but also that temporal complexities may stem from the different disciplines and organisational settings involved in pandemic-relevant research. Key concepts for our empirical analysis are timescape, temporal institutional work, temporal coordination and windows of opportunity.

Methods and data

Our empirical study is based on a COVID-19 Emergency call for proposals by the Research Council of Norway (RCN): collaborative and knowledge-building projects for

the fight against the disease, which is of interest also because of the tight time frame in which the call was made. The call was expedited due to RCN's desire to contribute to the global response to the COVID-19 outbreak and mobilise the Norwegian research system for this purpose. The funding was aimed at supporting research that would enable Norway to understand and contain the new virus, as well as to improve efficient patient management and public health preparedness and response to the current and analogous outbreaks in the future. The acceleration of the process of applying for funding and implementation of the projects, as well as the expectation of speedy research and returns, offer an opportunity to gain insights into the temporal complexities of medical research and innovation. The timeline for the projects is shown in [Figure 1](#).

The period from the announcement of the call to the submission of two-page project drafts was 2 weeks followed by another 2 weeks for a full proposal, while ordinary calls by the Research Council of Norway can take several months. The funding period was for 2 years, and the budget had a limit of 5 million kroner (around half a million EUR) for each project. Moreover, 128 project drafts and 79 full drafts were submitted in response to the call, and 30 were funded. RCN used the two-pagers to obtain an overview of engaging potential reviewers in advance and to promote and facilitate collaboration between similar projects by encouraging principal investigators. This has resulted in new collaborations between some research groups. All projects targeted the pandemic and how it can be dealt with, but they came from different disciplines including biomedicine, biology, health systems research, welfare, global health, social science and security, public health, communication science and social science. A summary of the projects' themes and disciplines is shown in Appendix A.

Research design, method and sample

Emergency funded COVID-19 oriented projects were chosen for this study because of the urgency of the process from the call for proposals to dissemination of results. We sought to understand the process through which emergency funded research projects were implemented and managed, and the experiences of the central stakeholders with the accelerated approach. We are primarily interested in understanding what goes on in these projects, focusing on aspects, such as the extent to which the work differs from regular medical research and innovation activities, particular initiatives (if any) taken to ensure rapid impact, and measures for dealing with different forms of temporal complexities. Our research questions are exploratory, which calls for qualitative data. Although we have reviewed relevant theories for understanding temporal complexities, we are interested in the subjective experiences of project participants and funders. This means that we want the main narrative of the case to emerge from the data rather than from pre-

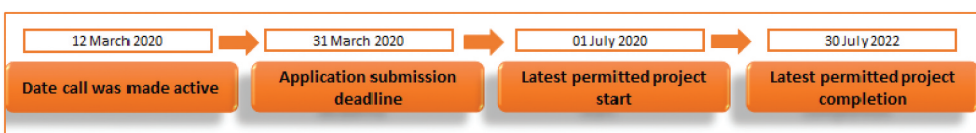


Figure 1. Timeline of emergency funded projects.

conceived concepts and constructs (Meriam & Tisdell, 2016; Glaser & Strauss 1967) and tie the data and our theoretical considerations together at the end.

We built up a database of the 30 projects funded by the Research Council of Norway, which contains publicly available information about the projects, their hosts and principal investigators. Using the contact information in the database, we conducted 19 semi-structured interviews with principal investigators from May to December 2021. The interviews were done during the period of COVID-19 induced lockdown, so they were done digitally, and the first three by both authors. Ethical approval for the project had been granted by the Norwegian Data Centre for the Social Sciences (NSD), and interviewees were asked for consent to record. All accepted this, and the voice recordings were used to transcribe the interviews and put them into the NVivo software. We also attended two digital seminars convened by the Research Council of Norway where the project leaders presented their experiences and preliminary results, where we took notes.

Our coding of interviews followed a systematic approach through several steps. First, each author did a thematic coding of three interviews, similar to the general open coding of qualitative data (Corbin & Strauss, 2014; Gioia et al., 2013). There were only minor differences in the thematic codes, which we interpret as high intercoder reliability, a term that for us also implied making both authors deeply familiar with the data and improving reflexivity (O'Connor & Joffe, 2020). We agreed on a preliminary scheme used by the first author to code the rest of the interviews. These codes were generic and covered broad aspects important to the interviewees like 'funding', 'partnerships', 'publishing' and 'time issues'. A second coding round was done after both authors went through the thematic codes one by one. This was closer to axial coding where an important part was to tie the many statements in the 'time issues' category to other codes (Corbin & Strauss, 2014) and to synthesise them into larger categories. The codes that emerged here were 'speed and delays', 'window of opportunity', 'project temporal logics', 'rules and norms about time' and 'temporal entanglements', and we have structured the empirical presentation in the next section using these categories. These categories are tied to important concepts from the literature review in our discussion and conclusion sections, where we also seek to tease out implications for our understanding of medical research and innovation and how to manage and organise these activities.

Time-oriented practices and experiences

Speed and delays

The urgency of the emergency funding was reflected in the whole process of research starting from the call for proposals to the dissemination of results. The nature of the funding invoked the need for speeding up the execution of the projects, for example, the process of ethics approval was expedited in conformity to the acceleration triggered by the emergency-funded projects, which was well received among the interviewees:

[T]hat was an important and good thing, actually, because only money from the research council would not help our project to move faster. We were dependent on the ethics committee and data protection agency and all those others to work fast as well (Interviewee 005).

There was a reduction in the processing time of the applications for ethical approval from about 5 weeks prior to the pandemic to less than a week. The emergency-funded projects, by virtue of being funded for a relatively short period of time compared to regular RCN projects, appealed for fast-tracking the process of ethical clearance to avoid delaying the research process. The reduction of ethics approval time removed an idle period, a potential temporal gap, in which researchers tend to stay put before proceeding with data collection.

However, ethical approval does not provide a guarantee that the research process will move faster. In our data, lockdowns, shutdowns and other restrictive measures to control the spread of the pandemic have made it difficult for the researchers to travel to different sites for fieldwork. Still, the travel restrictions opened an opportunity for the use of online data, which for some accelerated the process of data collection:

We are talking about data on a number of people tested in various countries, number of people being positive, number of people being hospitalized, and death, mobility, data of various kinds which is readily available online. I mean, I have never in my life had a situation where we are sitting back in an armchair, saying that it would be interesting to develop a structured model with different social interaction patterns. [. . . W]e can now apply this to ten countries, in all parts of the world. And the next day, we have the data online. Unbelievable (Interviewee 001).

Sharing pandemic information digitally made it possible for several of the interviewees to have access to data that would take time to collect under normal situations, partly due to stringent authorisation procedures. The emergency situation made the researchers amenable to digital platforms for accessing health-related data across borders, which, according to some, accelerated the projects also because of the new opportunities it provided for empirical analysis.

Despite efforts made to accelerate the implementation of the projects, some delays were described as inevitable. For example, the travel restrictions that were imposed to control infections resulted in interruptions in the supply chain of materials for laboratory research:

The other part of the laboratory work is taking so long as the supply chains have been horrible. Some stuff, we could get right away, but the stuff that I ordered in June last year (. . .) arrived in January. (. . .) When you are used to a one-week turnaround time to get something in and then it takes a month, or five or six weeks, it puts a lot of delays in the project (Interviewee 003).

Not only did the pandemic affect the shipping of research materials but also the production process as some companies temporarily closed in compliance with territorial guidelines. Under such circumstances, affected researchers had no choice other than waiting until the deliveries were ready. This was also the case with a researcher who faced methodological challenges in the implementation of the project:

We thought that we would be able to figure this out this method a lot quicker than we did. But it was just a much more difficult project that we envisioned. So, we honestly thought we were going to be collecting data in a couple of months . . . But here we are, almost nine to ten months later, and we're still working on the technique that we thought was going to be really easy to do, and we still have not produced data. We haven't been able to do all the other things that we wanted to do in parallel with the lab work (Interviewee 005).

The interviewee argued that the hurdles that were faced in the application of new research methodologies could not be determined a priori. In planning the projects, the researchers assumed that the process of running the projects would flow uninterrupted, only to realise later that it was not possible. This shows that despite efforts to speed up the research process, there are unknown risks and uncertainties beyond the control of researchers, which affect the delivery of the intended results. Some of these are inherent to the research process itself rather than caused by the pandemic.

Regarding Covid-19, the situation was incalculable. For example, when the call for proposals was made, many researchers planned for the first wave, and little did they know that the pandemic would unfold into many waves:

This pandemic is moving all the time and changing all the time. It's just very hard to shoot on a moving target. We did not know how the surge of the pandemic would go and how many participants that we would get. So it's been ongoing a little bit longer than what we planned. It makes the project take longer (Interviewee 011).

Due to unforeseeable circumstances, which in this case was the evolving of the pandemic into a series of waves, it was difficult to stick to the timelines in many of the projects. As the disease evolved, projects also changed accordingly to remain relevant. This induced temporal complexities as the research process was prolonged and in some cases it was difficult to deliver the promised results because of the indeterminate nature of the pandemic.

Opening of windows of opportunities

The outbreak and rapid spread of COVID-19 created a window of opportunity for the Research Council of Norway to mobilise resources for funding the emergency projects. It emerged from the interviews that several researchers who responded to the call for the emergency funded projects were working on other projects, but they decided to grab the opportunity to contribute to addressing the challenge:

I think that this pandemic situation from a scientific point of view just forced itself and we had to join forces and get the job done (Interviewee 006).

Researchers from different disciplines, including those who had never conducted research on pandemics or health-related issues, saw the call for research as a chance to engage in real-time research tied to the challenge. The nature of the pandemic in terms of its magnitude and impacts on society provided an impetus for researchers from different disciplines to work together:

I have never seen a call like this that would actually work. Honestly, I think that if it had not been for the pandemic, where people realise the importance of communicating science, yes, we would never have gotten the funding. I think the pandemic also made people truly realize that communication actually matters. You cannot just say something, it has to be said the right way (Interviewee 008).

In health-related research, epidemiologists and researchers in public health tend to get a preference for funding, but in the case of Covid-19, other disciplines were eligible as well. Not only were different disciplines of research funded but also interdisciplinary

collaboration was promoted as the pandemic provided the right set of circumstances for different disciplines to converge towards a common goal.

We just don't have the habit of working with other people from different disciplines. I mean, we work pretty well within our research group, and we do not go out of our way to share results while we are working on projects. So that was kind of new to be more open to collaboration with other disciplines (Interviewee 003).

This and other interviews indicate that people are willing to do things that they would not do under normal circumstances when there is a demanding situation, which in this case was the pandemic. Some indicated that this cross-disciplinary interaction might continue also after the pandemic, as new contacts and practices had been made.

While the emergency funded projects resulted in the opening of windows of opportunities, it came at a cost to the researchers. For instance, the call for funding came at a time when many researchers were working on other projects, which were crowded out. The time constraints in the execution of the emergency funded projects exerted a lot of pressure on the researchers, especially those who did not have sufficient financial resources for recruiting personnel. Several researchers referred to the period as stressful, but they were motivated by the window of opportunity:

When we do real research, usually we set aside like 30% of our work time for that project. For this project, for me, it should have been 10 to 20%. But I don't have that time, actually, because I have two other jobs that are 50% each. And I work as a clinician one day each week, so I'm already over booked on this project on top (Interviewee 005).

Acceleration, especially in the sense of shorter deadlines for planning and setting up projects, thus has a cost side for the researchers. Because of the uniqueness of the situation, they indicated that they were willing to work unusually long hours and delay other projects and activities.

Another window of opportunity arose from the emergency funded projects in which it presented a platform for the researchers to transform the work they were previously engaged with to fit into the thematic areas of the call:

I have for more than 20 years been working on plague, bacteria plague that caused the black death. And two other pandemics. (...) I said to my colleagues that we should actually use our insights into this kind of dynamics. Plague is a bacterial disease, COVID-19 is a viral disease, but they have similar population features, just spreading in different ways (Interviewee 001).

Other interviewees indicated similar adaptations. The prior knowledge that the researchers had on previous pandemics, comparable microorganisms, other healthcare system responses and so on made it easier to engage in COVID-19 projects. It meant that the projects did not start from scratch as the researchers capitalised on the existing knowledge and infrastructure to make a head start. This explains why some projects produced deliverables as high as seven articles in peer-reviewed journals in just 2 years. However, there was one project that was not linked to earlier work, and it proved difficult for the researchers here to reach their goals.

Differences in the temporal logics of funded projects

The maximum funding of the emergency-funded projects (around half a million Euros) and the 2-year maximum brought challenges in the execution of the projects as some researchers found it inadequate. It interfered with the execution of the projects:

We run our projects with high quality, ensuring safety of our participants and personnel. And as fast as we can, but you know, there is a contradiction between acceleration and very limited funding. For example, we would have liked to collect and store of all the specimens, for example but that also takes a lot of time that impinges on the quality and the speed of the project (Interviewee 001).

For this and some other interviewees, funding can influence the speed at which the projects are implemented. Funding (and time constraints) made comprehensive data collection impossible for some. Increased funding would have meant hiring more personnel. However, recruiting PhD researchers who are a crucial resource in many research projects was complicated because the two-year funding period was not aligned to the 3-year minimum of doctorate studies:

We got funding for two years, and 5 million Norwegian kroner. So that was the frame, as far as I remember. That means that we needed high speed also in getting the candidates to do the research. For example, we had the call for a PhD candidate. It took us half a year to have the candidate in place, and then we had one and a half year to finish the project. So that was a challenge, both in the timeframe and in the financing, because we did not have sufficient funding for a PhD candidate. The funding was for two years but we needed more (Interviewee 002).

For academic project leaders, the funding period of 2 years resulted in complexities regarding the staffing process. Some of them came up with new ways of addressing the challenge. For example, one project leader made use of available resources by mobilising and engaging PhD fellows and postdocs who were working on other projects but could not proceed due to the pandemic. These were PhD fellows and postdocs whose work was adversely affected by the pandemic and therefore had time to work on emergency funded projects. However, some institutions complemented the efforts by the research council by topping up the funding to ensure that postdoctoral and PhD fellows could be hired:

We got 5 million kroner from the research council, but the university and the faculty added six and a half million on top of that. So the 5 million kroner . . . ended up giving six, seven more. So now it's like a 12 million kroner project (1.2 million EUR). So now we can do something. . . . (Interviewee 008).

The investigators who got additional financial support naturally found it easy to navigate the complexities associated with running projects. The researchers were given the chance to hire a PhD by RCN, but the institutions were supposed to guarantee the third year of study for the student. Some institutions that were not able to secure more funding struggled even with engaging partners if partners required funding too, impacting the speed at which the projects were executed:

The sad thing of course, it's a little bit embarrassing to come with an externally funded project and ask for [internal funding], . . . for new collaborating institutions to contribute with resources, to ask them to come with that amount of funding is a little bit embarrassing

and actually complicated. It also puts constraints on how much you can demand from them (Interviewee 004).

With what they saw as inadequate funds, some project leaders had to go out of their way, as indicated in the interview, to request partners to contribute both financially and in kind. To some project leaders, the 2-year funding period meant lost opportunities as they intended to continue working on the research. They saw the formal project end after 2 years as ‘premature’ and wanted to pursue their objectives further:

Regrettably, we are so constrained in terms of funding. We cannot do what better resourced studies can do, that is to store the specimens also from those who do not have the virus. And that is genuinely frustrating, because we literally have a gold mine. And we had the opportunity to generate a scientific goldmine by collecting and storing also the negative specimens, but we simply have to throw them away, because that would incur huge additional costs. . . . I am literally scratching my head, looking into the possibility of expanding, if we could maybe continue the project two years from now (Interviewee 014).

Project duration and funding were for some two sides of the same coin. For example, interviewee 014 needed more funding beyond the two-year period to conduct a rigorous study, yet to some, it was sufficient to run their projects. However, the Research Council of Norway had strategically designed the funding to bring a sense of urgency to the research as there was a need for quick results to address the situation that was unfolding due to the pandemic. From RCN’s perspective, the financial support for a two-year period was meant to serve as seed funding that was expected to attract more financial resources for projects that produced interesting results. While the funding was inadequate for some projects, others had challenges in spending the money, considering that travelling for workshops and conferences was not possible:

We had planned for physical workshops and travels, we had this idea that this pandemic would last for a year. We thought, probably in 2021, we will be able to arrange some workshops. Unfortunately, these new variants made it very difficult for all of us. So, we had to do everything digitally. In that sense, the funding that we allocated for travels, we have not been able to use it (Interviewee 010).

The paradox is that while some researchers were running short of funding, others were struggling with spending it. This was a complexity that the research council had to deal with.

Time as mediated by rules and norms

The interplay of regulations had far-reaching repercussions on the execution of the funded projects. Although RCN could influence several aspects of the speed of the research, that was not possible beyond Norway. As the emergency-funded projects promoted collaboration, the process was complicated, particularly with international collaborators. There were instances whereby, instead of speeding up the projects, COVID-19 slowed them down:

For two or three years, we have been enrolling children to our trial, then there was, of course, a stop, because the Ugandan authorities sensibly said that, before you do any studies, we need to be sure that your infection control measures are adequate. So actually, they didn’t allow for studies to start before late fall [six months+ delay]. (Interviewee 004).

Despite the urgency in framing the projects, the researchers had no choice other than to abide by the national regulations in the countries where collaborating partners were based. The paradox is that the Research Council of Norway in its funding letter required the researchers to confirm that the COVID-19 situation would not impinge on the steady progress of the projects, but the situation on the ground was different. The projects that involved collecting data from both inside and outside Norway invoked the need to observe national guidelines. In an emergency, the bureaucratic processes of accessing data caused what some saw as unnecessary delays in the implementation of the research:

Another important challenge is that we use national health registries, many different ones that we had to apply for, and that application period for getting the data was 10 months because of the procedures. So now, these days, we are getting the data, and now we have spent 10 months since the project started (Interviewee 002).

The successful execution of emergency-funded research projects depended to a great extent on access to data. Some projects could easily get the needed data, but for others, lengthy procedures had to be followed. This exemplifies the complexities in the execution of projects with tight time frames which render it difficult to implement concrete timelines. The research council as a funding body facilitated the speedy execution of the projects, especially at the national level, but there were cases where its influence was limited, resulting in milestone delays.

The pandemic provided a unique situation where the production and dissemination of results was expedited. In the applications for funding, the researchers made a commitment to deliver results, but meeting the targeted time proved problematic for most. For example, there was need to accelerate the dissemination of results yet maintaining research integrity, such as subjecting the results to peer review:

I have an article, popular science for newspaper, ready to be sent in, but I do not want to before we have this Norwegian vaccination paper (scientific) accepted. . . . I am of the opinion that we should communicate science that has been peer reviewed. And it should be after it has been peer reviewed, not before . . . the minute I get the message that it is either accepted or conditionally accepted [I will submit the article]. (Interviewee 001).

The dilemma was about whether to share with the public results that had not been peer-reviewed. Other interviewees echoed this, and several made critical comments about non-reviewed preprints or gave examples of early results that had been retracted. This was something they strongly wanted to avoid but represented a temporal complexity.

Temporal entanglements

The call for emergency funded projects was made when the pandemic was spreading fast across the world. It meant that the researchers had to conduct fast research in the midst of the pandemic but were vulnerable just like other people. This was a challenge of researching a pandemic, during a pandemic:

It is like you want to help by coming up with some scientific contributions, you also want to take care of the people who are delivering. This is an example of a complexity or challenges that you face. My colleagues have become sick, they themselves have personally had Covid-19. Some have lost close relatives. We are not only scientists, but we are also mothers and

fathers and sisters and brothers that is what we are in our lives also personally affected by the pandemic (Interviewee 007).

What emerged from the interviews was that the researchers themselves were affected by the pandemic and that it adversely affected their plans. They wanted to work on the projects at an accelerated pace, but they were situations beyond their controls, such as sickness and deaths, which resulted in the time being used not according to plan. In addition, working during the time of the pandemic resulted in the researchers working during odd times in an endeavour to quicken the research process:

The problem is that it is a two-year deadline, we had to do our interviews during the summer holidays. Well, we got funded that's a great thing. But people like us work long hours every single day. And it is sad that you have to spend your summer holiday as well, doing interviews with people. And I don't like the fact that even though I work a lot, I have to bug people during their summer holidays for references and stuff (Interviewee 016).

However, many people were positive as the pandemic was special in that it demanded urgent action. With lockdowns and travel restrictions, it was not possible to cast the net wider during the process of recruitment, which resulted in the recruitment being limited to local applicants and close networks. Furthermore, the Covid-19 restrictions affected not only the hiring process but also the collaboration among project partners:

You know, the only one thing I would have liked, though, is to have specific meetings with partners first face to face. So, it's extremely difficult to start up a new project with entirely new people. That is always easier if you can actually meet the people. So that is one constraint, which we faced in running of the project. (Interviewee 012).

It was easier for the project leaders to collaborate with partners whom they had worked with before but in some cases, there was a need to engage the services of new partners. It was a challenge as revealed in the interview that relying on digital platforms for interaction with partners without having established the relationship through physical meetings can be problematic. Despite this challenge, several researchers were forced to engage partners digitally and that presented problems in coordination of the research projects:

I thought we can go to conferences, at least in the fall of 2021 or the spring of 2021, which obviously was not possible. I am pretty sure that if we had been able to travel and meet, we could sit together for two days with project partners, think and use post it notes. That part of the process has been really challenging. And I am not so good in (digital) technology (Interviewee 014).

Other informants stated that digital tools were effectively used to save time by project partners who had established strong relationships before the pandemic and those who had the competence to use them. For example, digital platforms were used by researchers who were working in isolation and getting overwhelmed to interact as a team:

Covid 19 has affected the way we are interacting. We, at our university got nine proposals funded through this call. So, I said to the Dean, we are starting something that no one really has experienced . . . So, we should take these nine projects and form a platform where we could discuss regularly. We now have a COVID-19 platform, we come together once every second month and exchange results, problems etc. It has actually changed the way we interact, I have never actually interacted with people that I have been competing with in a call, and never really made contact with them (Interviewee 001).

The establishment of the platform for researchers from the University of Oslo was a way of bringing together stakeholders who were getting overwhelmed by working on their own. The Research Council of Norway also started a seminar series where project leaders presented their work and experiences as a way of supporting each other. These initiatives addressed the temporal complexities of managing emergency funded projects in an environment that was characterised by uncertainties. Despite the effort that was made to create a supportive environment for conducting medical research and innovation in the midst of the pandemic, the situation was complicated by the fact that the researchers themselves were vulnerable to Covid 19, which resulted in some projects that were earmarked for acceleration slowing down.

Analysis

The emergency funded projects provide interesting insights into the temporal complexities of medical research. Although the main stakeholders tended to conceive time in a linear fashion in how the research process was set up, there are temporal complexities that interfere with the execution of projects. The temporal complexities were prominent in emergency funded projects, which by their nature were designed to bring a sense of urgency in their implementation. Based on the research findings, several temporal complexities emerge.

There was time disjuncture in the emergency funded projects, which reflected the different project logics between the funding body and the researchers, supporting Butler's (1995) idea that organisations tend to differ in their basic time frames. This was evident in the 2-year funding that presented challenges to the academic researchers as they are used to projects that are aligned with the duration of PhD studies. For the research council, the basic idea was to indicate the urgency of the matter with reduced project duration, although it did not change its expectation to project activities and outcomes.

Challenges in the recruitment process during the pandemic further complicated the issue as the funding period in practice was reduced to less than 2 years, making it hard to recruit PhD students to do the bulk of the work. This form of complexity shows how the lack of synchronisation in temporal institutional work (Granqvist & Gustafsson, Gustafsson; Dille et al., 2022) can present challenges in the coordination of projects. In this study, the temporal framing of projects by the funders failed to fit into the logistics of the researchers who were responsible for implementation. Such asynchronies can interfere with the execution of research as argued by Garud et al. (2013) that they affect the mobilisation of resources for the implementation of projects. For many of the researchers, this has become a situation where the research council wanted 'more for less', and many of them talked about time and budget strains. This is in line with an argument by Butler's (1995) who pointed out that organisations tend to differ in their basic time frames, in terms of their interpretation of the past, present and future. All this can be linked to the context, which was characterised by the rapid spread of the pandemic and uncertainty that demanded swift action by researchers to address the situation.

Research projects that are funded in response to unique situations, such as the spread of the pandemic across the globe, may be part of institutional work to open what Granqvist & Gustafsson (Gustafsson) name windows of opportunities. Our study clearly depicts the pandemic as such a window, although its dire and global nature meant that

little work was needed to mobilise various actors (researchers, funders, and ethical boards). A downside of this context was that many of the research units stopped other activities they were engaged in, implying that as a window of opportunity opened for pandemic-relevant research, it also signalled that other opportunities might in practice close. As the windows of opportunities opened, prioritising the allocation of resources, such as time, funding and manpower for projects focusing on the pandemic, there were circumstances that interfered with their full exploitation. This was manifested in the imposition of lockdown measures, which according to Dahlke et al. (2021) interfered with the execution of the research projects with some slowing down due to unexpected logistical challenges.

The emergency funded projects provided opportunities for collaboration as that was one of the basic requirements of the funding. With the pandemic spreading across the globe, it was difficult to meet physically, and the use of digital methods became a *de facto* way of interaction. This was challenging for research partners who had not met physically due to the complications emanating from heterogeneity and diversity among actors (Lal et al., 2021; Oxman et al., 2022). Perhaps more interesting in our study is the widespread use of digital methods and data. At least for some types of research, the pandemic offered an opportunity for sharing data about different aspects of public health, the virus itself and more, and a few interviewees framed this as a starting point for more openness in research. There seems to be a distinction in our material between researchers using primarily digital or easily digitised data compared to the ones that require physical work like administering tests to or interviewing people. It emerged from the study that the researchers whose activities could be done digitally proceeded faster than those who needed to be in the laboratory or the field. The latter had to wait until it was possible to conduct their activities, implying that there was redundancy in the implementation of their projects. The redundant time typified slack time, which Medase (2020) describes as being crucial for research and innovation to flourish. However, the slack time can be fruitful when it is not imposed by circumstances, such as the pandemic in this study, where some researchers were in an uncertain slack phase at the very beginning of their projects. This portrays that the timing is important as some opportunities may open too early or late, leading to temporal complexity.

Research is not a single linear process, but a set of sub-processes tied to activities, such as gathering or getting access to data, hiring staff members, gaining ethical approval and analysing and processing data. Some of these processes could be accelerated, like ethical approvals, while others could not. For example, the regulations governing the management of the pandemic proved to be binding and inflexible, not least for researchers needing access to sensitive public health data from more than Norway. Several research sub-processes are beyond the control of both researchers and funding bodies, and changing their speed may not be possible without much more intensive temporal institutional work. It can be even more complicated where rules and routines are rigid and fixed without leaving room for flexibility (Cowan et al., 1994). The research council's own practices were flexible enough to accommodate more expedient project support for example, quicker application deadlines, faster review process and faster start-up phase including contracting and ethical approval. Practices in the research system proved more problematic to speed up, such as hiring procedures, the scientific publication process and some forms of data access. Interestingly, in very open interviews about research processes

and speed, few of the interviewees talked to any extent about the core of the research process itself – gaining insight and new knowledge. Instead, their experiences focused more on administrative, practical and resource issues.

There is a complex relationship between time and funding. On the one hand, time is regarded as a resource tied to how many hours (or weeks, months) of work you can pay the relevant staff members. On the other hand, this does not mean that extra funding would speed up the process. No amount of funding seemed to matter to the interviewees, who had to wait months on relevant data (although an extended deadline might have helped them). Increased funding may also imply a larger pool of people who may need time to blend and work harmoniously, especially if they come from different academic backgrounds. According to Garud et al. (2013), the engagement of different actors can generate multiple and sometimes conflicting inputs, which may result in an overall research process that is slower (but perhaps better) rather than faster. Several interviewees also indicated that there might be a tension between acceleration and research quality, especially linked to the publication process. Some researchers were sceptical of fast tracking the implementation of their projects due to the risks of compromising the quality of the results. According to Solbakk et al. (2020), acceleration can, if not done with due diligence pose the risk of compromising research integrity, which be detrimental in undermining public confidence. Speeding may thus prove to be less beneficial if the outcomes fail to meet the acceptable standards of research.

Finally, considering preconditions for speeding up the implementation of research projects, an important one seems to be having existing projects with personnel and infrastructure in place. The existing projects can be translated into new projects by adjusting for example, through the change of focus from bacterial to viral infections or from other intensive healthcare responses to pandemic responses. By nudging existing research into a new direction, many complexities can be ameliorated. This is particularly important in healthcare institutions, which are complex environments for knowledge translation, hence the need to capitalise on existing relationships, social networks and organisational structures (Dryden Palmer et al., 2020). Incremental changes may remove the pressure to hire new researchers as the existing ones can be mobilised to undertake new tasks. This can work well with contract research where researchers work on projects, and it is easier to reassign them to areas where there is an urgent need. However, the downside might be that dealing with temporal complexities can create new ones like path dependencies and lock-ins.

Discussion and conclusions

This paper sets out to analyse the temporal complexity of emergency funded projects to generate insights into how urgency plays out in the health-oriented research process. Temporal complexity is an important and understudied aspect of medical research and innovation processes and a major explanation for why these processes play out over long time periods and often in unpredictable and seemingly inefficient ways (e.g., Garud et al., 2013). It is rooted in different experiences of time – time frames – tied to institutional and organisational characteristics (Butler, 1995), which can be influenced by agents who work to establish synchronicity, construct windows of opportunity and coordinate different actors (Granqvist & Gustafsson, Gustafsson; Dille et al., 2022). Our exploration has

provided some conceptual and practical contributions to the greater academic and policy discussion about acceleration and related topics.

A key finding in our work is that temporal complexity is difficult to discuss, also in an empirical context because there are confusing and sometimes contradictory ways in which concepts related to time are used. For example, several informants mix the time-scape (Adam, 2005) dimensions ‘speed’ and ‘duration’, seemingly assuming that changing one will influence the other, which might not be the case. A research project that lasts 2 years instead of three has shorter duration, but the research is not necessarily faster. There is also a relative aspect to time concepts tied to taken-for-granted time frames and institutional conditions. For example, a researcher may rightfully claim that getting seven published articles within a two-year project is ultra-fast, yet it might still not be fast enough to be applied to the urgent needs of policymakers during a pandemic. Project leaders themselves most often expressed that their research ‘would be relevant for the next pandemic’. There is also a clash between a research funder’s need to have shorter projects to meet a crisis and the three-year PhD process (the workhorse of large parts of the research system) as well as the often lengthy progression of high quality peer review. These aspects vary according to discipline and whether the research is carried out in an academic or another setting.

Time is intimately tied to project characteristics like deadlines and milestones. These can be easily tweaked by the funder, but we have seen that a number of tensions may arise because of other aspects of the research process and may give rise to discussions about funding levels (Garud et al., 2011). We find evidence of successful attempts at acceleration especially tied to administrative procedures like proposal submission, evaluation and approval. Nevertheless, in the bigger picture of the impacts of research and innovation on society, saving a few weeks on such procedures may not make much of a difference. It is also noteworthy that the emphasis on speed seems to favour digital methods and data over more conventional approaches in medicine and related fields. This is an interesting topic for further research.

Emergency situations that call for swift action in the execution of projects thus see many barriers that interfere with speed. Some of these stem from the serendipitous and unpredictable nature of medical research and innovation processes, which may be inherent characteristics (Dew, 2009). As such, they are likely to be difficult to influence and perhaps also be tied to successful outcomes. The most significant delays in our material stem from gaining access to various forms of data. Here, open science policies might be helpful for removing gaps and delays, especially if open science policies cut across the global scientific community and make data and other materials more readily available for everyone.

All attempts at acceleration in our material target the researchers, which can be criticised for representing another manifestation of a problematic linear way of thinking about medical research and innovation. The sense of urgency of the pandemic also encompassed industry, healthcare providers and the public. There may be a big potential in better understanding temporal complexity of the user – societal – side of medical research and innovation both for further theoretical development and for science and innovation policy. It may also be valuable to explore aspects that can be transferred to a situation with less of the pandemic urgency yet still tied to important societal goals requiring quick solutions, such as

other health and environmental problems. An important precondition may be to facilitate coordination (Naqshbandi & Jasimuddin, 2022) by setting up a strong dialogue between research, innovation and societal actors that makes it possible to make new directions that build upon existing competences, lines of work and societal challenges. Our material indicates promise in bringing different types of researchers working on similar challenges together, which might be transferred to a less urgent context. It is still uncertain whether competitive funding is the best or only way to achieve acceleration in the impact of medical research and innovation.

Findings from the study are useful in rethinking medical innovation from the funding of medical research and innovation to the spread and implementation of results. Temporal complexities, as depicted in this study, can interfere with the delivery of results, hence the need to reorient medical innovation. While time is important, approaching it from a one-dimensional perspective can obscure the complexities that are embedded in medical innovation. For example, the quick approval of ethical clearance and disbursement of research funding gives an immediate impression of speeding up research and innovation but obscures the temporal complexity. While fast tracking medical innovation may be strived for in the face of emergency situations, there are limits to acceleration in relation to the quality of the results. It is cogent to get rid of idle time which causes unnecessary delays without compromising the integrity of medical innovation.

The temporal complexities of medical innovation are tied to the structural characteristics of the research organisations. The orientation of organisations ranging from academic institutions to research institutes and firms provides insights into how the temporal complexities in medical innovation play out. Remarkably, academic institutions with their traditional fixed three-to-four-year funding structures for PhD researchers proved less flexible to fit the constrained time frame for the emergency projects. Institutions with an inclination towards contract research seemed better positioned to work on emergency funded projects as they could reassign the researchers in response to the urgency. This indicates that if medical innovation is to be accelerated, organisational-level characteristics matter.

It emerged from the study that the urgency that was invoked by the pandemic resulted in many activities being done faster and over a short duration. This was made possible by new activities which were adopted to facilitate the execution of the projects, such as the strengthening of existing networks, sharing of data and using digital tools for virtual interaction. The urgency of the pandemic gave rise to cross-project meetings that facilitated a shared perspective to come up with quicker but also higher-quality results. While the new initiatives were driven by the need to make medical innovation faster, there were positive externalities, such as making the research relevant and impactful. It resulted in the pandemic not being approached as a medical, but as a broader social, economic and political challenge. This is an interesting trajectory in medical innovation considering that speed is important to ensure timely delivery of results but that should be guided by the broader societal impact. Thus, the temporal complexity of medical innovation need not be viewed in isolation but in relation to the value to the intended beneficiaries. On this basis, we recommend further research on the societal impacts of similar emergency or challenge-oriented projects, which may also constitute a fruitful starting point for research funding initiatives.

Acknowledgments

We are grateful to Simona Grasso from the Research Council of Norway and colleagues from Oslo Institute for Research on the Impact of Science (OSIRIS) for the constructive feedback on the draft article. We acknowledge the comments that we received from EU-Spri 2021 conference, where we presented our first draft. We are indebted to the recipients of the COVID-19 Emergency funded projects who participated in this study.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by the Research Council of Norway through Oslo Institute for Research on the Impact of Science-OSIRIS and Centre for Connected Care-C3. [project number 256240 and project number 237766/O].

ORCID

Trust Saidi  <http://orcid.org/0000-0002-9337-4268>

Magnus Gulbrandsen  <http://orcid.org/0000-0001-9976-1608>

References

- Adam, B. (2005). *Timescapes of modernity: The environment and invisible hazards*. Routledge.
- Al-Omouh, K. S., Simón-Moya, V., & Sendra-García, J. (2020). The impact of social capital and collaborative knowledge creation on e-business proactiveness and organizational agility in responding to the COVID-19 crisis. *Journal of Innovation & Knowledge*, 5(4), 279–288. <https://doi.org/10.1016/j.jik.2020.10.002>
- Butler, R. (1995). Time in organizations: Its experience explanations and effects. *Organization Studies*, 16(6), 925–950. <https://doi.org/10.1177/017084069501600601>
- Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage publications. <https://uk.sagepub.com/en-gb/eur/basics-of-qualitative-research/book235578>
- Cowan, G., Pines, D., & Meltzer, D. E. (1994). *Complexity: Metaphors, models, and reality*. Westview Press.
- Dahlke, J., Bogner, K., Becker, M., Schlaile, M. P., Pyka, A., & Ebersberger, B. (2021). Crisis-driven innovation and fundamental human needs: A typological framework of rapid-response COVID-19 innovations. *Technological Forecasting and Social Change*, 169, 120799. <https://doi.org/10.1016/j.techfore.2021.120799>
- Dew, N. (2009). Serendipity in entrepreneurship. *Organization Studies*, 30(7), 735–753. <https://doi.org/10.1177/0170840609104815>
- Dille, T., Hernes, T., & Vaagaasar, A. -L. (2022). Stuck in temporal translation? Challenges of discrepant temporal structures in interorganizational project collaboration. *Organization Studies*, 01708406221137841. <https://doi.org/10.1177/01708406221137841>
- Doganova, L., & Eyquem-Renault, M. (2009). What do business models do?: Innovation devices in technology entrepreneurship. *Research Policy*, 38(10), 1559–1570. <https://doi.org/10.1016/j.respol.2009.08.002>

- Dryden Palmer, K., Parshuram, C., & Berta, W. (2020). Context, complexity and process in the implementation of evidence-based innovation: A realist informed review. *BMC Health Services Research*, 20(1), 1–15. <https://doi.org/10.1186/s12913-020-4935-y>
- Ekström, A. M., Berggren, C., Tomson, G., Gostin, L. O., Friberg, P., & Ottersen, O. P. (2021). The battle for COVID-19 vaccines highlights the need for a new global governance mechanism. *Nature Medicine*, 27(5), 739–740. <https://doi.org/10.1038/s41591-021-01288-8>
- Fagerberg, J., Mowery, D. C., & Nelson, R. R. (Eds.). (2005). *The Oxford handbook of innovation*. Oxford university press.
- Ferlie, E., Fitzgerald, L., Wood, M., & Hawkins, C. (2005). The nonspread of innovations: The mediating role of professionals. *Academy of Management Journal*, 48(1), 117–134. <https://doi.org/10.5465/amj.2005.15993150>
- Garud, R., Gehman, J., & Kumaraswamy, A. (2011). Complexity arrangements for sustained innovation: Lessons from 3M corporation. *Organization Studies*, 32(6), 737–767. <https://doi.org/10.1177/0170840611410810>
- Garud, R., & Nayyar, P. R. (1994). Transformative capacity: Continual structuring by intertemporal technology transfer. *Strategic Management Journal*, 15(5), 365–385. <https://doi.org/10.1002/smj.4250150504>
- Garud, R., Tuertscher, P., & Van de Ven, A. H. (2013). Perspectives on innovation processes. *Academy of Management Annals*, 7(1), 775–819. <https://doi.org/10.5465/19416520.2013.791066>
- Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking Qualitative Rigor in Inductive Research. *Organizational Research Methods*, 16(1), 15–31. <https://doi.org/10.1177/1094428112452151>
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Sociology Press.
- Granqvist, N., & Gustafsson, R. (2016). Temporal Institutional Work. *AMJ*, 59(3), 1009–1035. <https://doi.org/10.5465/amj.2013.0416>
- Greenhalgh, T., Raftery, J., Hanney, S., & Glover, M. (2016). Research impact: A narrative review. *BMC medicine*, 14(1), 1–16. <https://doi.org/10.1186/s12916-016-0620-8>
- Halbesleben, J. R. B., Novicevic, M. M., Harvey, M. G., & Buckley, M. (2003). Awareness of temporal complexity in leadership of creativity and innovation: A competency-based model. *The Leadership Quarterly*, 14(4–5), 433–454. [https://doi.org/10.1016/S1048-9843\(03\)00046-8](https://doi.org/10.1016/S1048-9843(03)00046-8)
- Hanney, S. R., Castle-Clarke, S., Grant, J., Guthrie, S., Henshall, C., Mestre-Ferrandiz, J., Pistollato, M., Pollitt, A., Sussex, J., & Wooding, S. (2015). How long does biomedical research take? Studying the time taken between biomedical and health research and its translation into products, policy, and practice. *Health Research Policy and Systems*, 13(1). <https://doi.org/10.1186/1478-4505-13-1>
- Harris, C., Carson, G., Baillie, J. K., Horby, P., & Nair, H. (2020). An evidence-based framework for priority clinical research questions for COVID-19. *Journal of Global Health*, 10(1). <https://doi.org/10.7189/jogh.10.011001>
- Hopkins, M. M. (2006). The hidden research system: The evolution of cytogenetic testing in the national health service. *Science as culture*, 15(3), 253–276.
- Lal, A., Erondou, N. A., Heymann, D. L., Gitahi, G., & Yates, R. (2021). Fragmented health systems in COVID-19: Rectifying the misalignment between global health security and universal health coverage. *The Lancet*, 397(10268), 61–67. [https://doi.org/10.1016/S0140-6736\(20\)32228-5](https://doi.org/10.1016/S0140-6736(20)32228-5)
- Lancaster, E. M., Sosa, J. A., Sammann, A., Pierce, L., Shen, W., Conte, M. C., & Wick, E. C. (2020). Rapid Response of an Academic Surgical Department to the COVID-19 Pandemic: Implications for Patients, Surgeons, and the Community. *Journal of the American College of Surgeons*, 230(6), 1064–1073. <https://doi.org/10.1016/j.jamcollsurg.2020.04.007>
- Langley, A., & Tsoukas, H. (Eds.). (2016). *The SAGE handbook of process organization studies*. Sage. <https://doi.org/10.4135/9781473957954>
- Lyytinen, K. (2022). Innovation logics in the digital era: A systemic review of the emerging digital innovation regime. *Innovation*, 24(1), 13–34. <https://doi.org/10.1080/14479338.2021.1938579>

- Matt, M., Gaunand, A., Joly, P. B., & Colinet, L. (2017). Opening the black box of impact–ideal-type impact pathways in a public agricultural research organization. *Research Policy*, 46(1), 207–218. <https://doi.org/10.1016/j.respol.2016.09.016>
- Medase, S. K. (2020). Product innovation and employees' slack time. The moderating role of firm age & size. *Journal of Innovation & Knowledge*, 5(3), 151–174. <https://doi.org/10.1016/j.jik.2019.11.001>
- Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative Research: A Guide to Design and Implementation* (4th ed.). Jossey Bass.
- Messersmith, J., Stoddart-Osumah, C., Lennon, M., & Wirtz, D. (2021). Emergency seed funding for COVID-19 research: Lessons from Johns Hopkins University. *The Journal of Clinical Investigation*, 131(1). <https://doi.org/10.1172/JCI145615>
- Naqshbandi, M. M., & Jasimuddin, S. M. (2022). The linkage between open innovation, absorptive capacity and managerial ties: A cross-country perspective. *Journal of Innovation & Knowledge*, 7(2), 100167. <https://doi.org/10.1016/j.jik.2022.100167>
- O'Connor, C., & Joffe, H. (2020). Intercoder reliability in qualitative research: Debates and practical guidelines. *International Journal of Qualitative Methods*, 19, 1609406919899220. <https://doi.org/10.1177/1609406919899220>
- Oxman, A. D., Fretheim, A., Lewin, S., Flottorp, S., Glenton, C., Helleve, A., Vestrheim, D. F., Iversen, B. G., & Rosenbaum, S. E. (2022). Health communication in and out of public health emergencies: To persuade or to inform? *Health Research Policy and Systems*, 20(1), 1–9. <https://doi.org/10.1186/s12961-022-00828-z>
- Poutanen, P., Soliman, W., & Stähle, P. (2016). The complexity of innovation: An assessment and review of the complexity perspective. *European Journal of Innovation Management*, 19(2), 189–213. <https://doi.org/10.1108/EJIM-03-2014-0036>
- Rau, H., Goggins, G., & Fahy, F. (2018). From invisibility to impact: Recognising the scientific and societal relevance of interdisciplinary sustainability research. *Research Policy*, 47(1), 266–276. <https://doi.org/10.1016/j.respol.2017.11.005>
- Redlbacher, F., & Hattke, F. (2022). How virtual meetings stimulate process innovations in organisations: Mixed-methods evidence from emergency response providers. *Innovation*, 1–22. <https://doi.org/10.1080/14479338.2022.2045998>
- Scarborough, H., Panourgias, N. S., & Nandhakumar, J. (2015). Developing a relational view of the organizing role of objects: A study of the innovation process in computer games. *Organization Studies*, 36(2), 197–220. <https://doi.org/10.1177/0170840614557213>
- Solbakk, J. H., Bentzen, H. B., Holm, S., Heggestad, A. K. T., Hofmann, B., Robertsen, A., Alnæs, A. H., Cox, S., Pedersen, R., & Bernabe, R. (2020). Back to WHAT? The role of research ethics in pandemic times. *Medicine, Health Care, and Philosophy*, 24(1), 1–18. <https://doi.org/10.1007/s11019-020-09984-x>
- Van Lente, H. (2000). *Forceful futures: From promise to requirement*. (R. Brown, B. Rappert, & A. Webster, Eds.). Ashgate Publishing.
- Van Raan, A. F. (2004). Sleeping beauties in science. *Scientometrics*, 59(3), 467–472. <https://doi.org/10.1023/B:SCIE.0000018543.82441.f1>
- Van Raan, A. F. (2015). Dormitory of physical and engineering sciences: Sleeping beauties may be sleeping innovations. *PLoS One*, 10(10), e0139786. <https://doi.org/10.1371/journal.pone.0139786>
- Webster, A. (2019). Accelerating innovation: Complexity, regulation, and temporality. *Frontiers in Sociology*, 4, 13. <https://doi.org/10.3389/fsoc.2019.00013>
- Westley, F., & Antadze, N. (2010). Making a difference: Strategies for scaling social innovation for greater impact. *Innovation Journal*, 15(2), 1–19. https://www.innovation.cc/scholarly-style/2010_15_2_2_westley-antadze_social-innovate.pdf
- Xie, X., Wu, Y., Palacios-Marqués, D., & Ribeiro-Navarrete, S. (2022). Business networks and organizational resilience capacity in the digital age during COVID-19: A perspective utilizing organizational information processing theory. *Technological Forecasting and Social Change*, 177, covidwho-1665493. <https://doi.org/10.1016/j.techfore.2022.121548>