Reducing Waiting Times to Switch General Practitioners in Norway

1 Challenges and needs

General practitioners (GPs) play a central role in almost all Universal Healthcare Systems. They serve as patients' first and primary point of contact with the healthcare system, help patients manage basic healthcare needs such as prescriptions and preventative care, and guide patients toward appropriate secondary or post-secondary care. In Norway, the GP system (*fastlegeordingen*) aims to provide all individuals a GP with whom they can have a long-term relationship. A cornerstone of this system is that individuals have free choice of GP. Operationally, this means that individuals are free to switch their GP at any time, to any other GP who has spare capacity on their patient panel (subject to a limit of two switches per year). While in theory this affords people substantial freedom in choosing their GP, in practice this freedom is severely restricted. Over time, the number of GPs with spare capacity has been decreasing. In 2016, 40% of GPs in Norway had available spots on their panel. By the end of 2019, only 28% of GPs did. As of August 2022, **only 12% of GPs had spare capacity**, and the share was even smaller among female GPs (9%) and in many geographic areas (for example, **0% in Bergen kommune** and **6% in Trondelag**) (Søraas & Skirbekk 2022).

As one way to address this challenge, in 2016 the Norwegian Directorate of Health (*Helsedirektoratet*) developed a system by which individuals can join a waiting list for a GP whose panel is at full capacity. The waiting lists operate on a first-come first-served basis. Once spots on the desired GP's panel become available––when incumbent patients switch away to another GP, emigrate, or die—individuals at the front of the waitlist are reassigned. Though the waitlists improved the process of switching GPs, they have also steadily grown in length over time. As of January 2020, over 110,000 people were standing on a waitlist to switch their GP (See Figure 1), having already waited for an average of 8 months (See Figure 2). **As of August 2022, the number of people standing on a waitlist has grown to 250,000.**

Figure 1. Growth of waitlists over time

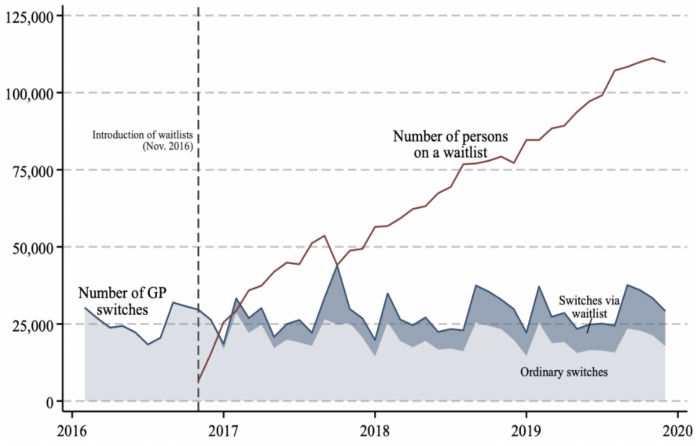
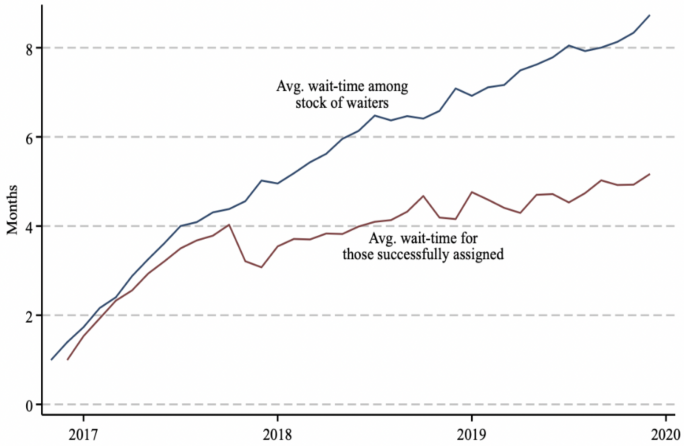


Figure 2. Growth of waiting times over time



Source: Authors' calculations

Though the GP system is currently facing many challenges, there are two important limitations that are specific to the waitlist system. The first, and most striking, is that **the strict first-come first-served system causes substantial congestion in the waitlist reassignment process, unnecessarily lengthening the time it takes to many individuals to switch GPs**. To see why this happens, consider the following hypothetical situation. Two GPs, one in Ålesund and one in Bergen, each have a full patient panel. Ten patients from the GP in Ålesund move to Bergen and would therefore like to switch to the GP in Bergen. At the same time, ten patients from the GP in Bergen move to Ålesund and would like to switch to the GP in Ålesund. In theory, all of these patients could switch to their preferred GP immediately, without either GP exceeding their capacity. In practice, however, the current system does not allow such "swaps" to occur. Instead, each person must wait for a spot to open up through other means (i.e., wait for someone on the opposite panel to switch away to a third GP, or to leave the system entirely). The same situation could of course arise with more than two GPs:

for example, with a patient on GP panel A wishing to switch to GP B, a patient on panel B wishing to switch to GP C, and a patient on panel C wishing to switch to GP A. Such "cycles of swaps" could be formed with any number of individuals. **As of January 2020, 18% of people standing on a waitlist list could have been reassigned immediately via such swaps.** And in certain areas the number is even higher: for example, **31% of people standing on a waitlist in Bergen kommune** were in such a situation.

The second challenge is that patients do not always have enough information to make an informed choice. A central consideration in choosing which waiting list to join is how long it might take to be successfully reassigned. The current system informs users about the number of persons standing on each waitlist, but provides no information about how this translates into expected waiting time. Since waiting time may depend on difficult-to-observe factors that differ across GPs (for example, the number of elderly persons currently enrolled), patients may have limited ability to estimate waiting time on their own.

Helsedirektoratet has been aware of these limitations for some time, but has not had the tools or resources to tackle them. This project proposes a collaboration between *Helsedirektoratet* and researchers in Norway and the U.S. who specialize in health economics and waiting list design. Though the ideas of allowing individuals to swap GPs and providing information on waiting times are conceptually straightforward, they are in practice challenging for a number of reasons. First, designing an algorithm that efficiently finds and implements swaps within a large and complex waitlist system is extremely challenging. Though theoretical bases for the design of such an algorithm exist, there are a number of reasons why the present setting is unique and raises distinct challenges. This means that novel research in this area will be required, and that the resulting work product will represent a substantial innovation in the context of public resource allocation. Second, estimating waiting times is a complicated endeavor. It relies on a predictive simulation model of individuals' behavior in the context of the waitlist system. Implementing such a model has been outside the scope of *Helsedirektoratet*'s expertise.

This project aims to significantly reduce waiting times to switch GP by improving the design of the waitlist mechanism using an innovative waitlist algorithm. **The primary objective is to reduce the time it takes Norwegians to switch their GP.** We expect that this objective will have two direct and immediate effects: (i) increasing patient satisfaction with the GP system (*fastlegeordingen*) and therefore contributing to its long term sustainability, and (ii) better utilization of existing resources in the GP system by allowing more individuals to obtain their desired GP. **While this project cannot increase the number of GPs available in Norway, it can make substantial progress in using existing resources more effectively.**

The secondary objective of this project is to provide the foundational research and practical knowledge needed to implement a more effective waitlist mechanism for public resource allocation at a national level. We expect that the resulting knowledge base will be applicable to other capacity-constrained public services, such as kindergarten spots, non-emergency medical procedures, and affordable housing.

2 Research and innovation

2.1 The innovation

2.1.1 The innovation concept

The proposed innovation is a new waiting list system that will shorten the time it takes individuals in Norway to switch their GP. Concretely, the new waiting list system will consist of a revised computational algorithm with which *Helsedirektoratet* will process waiting list reassignments, as well as additional information about waiting times provided to users via the "*Bytte Fastlege*" tool on Helsenorge.no.

The new waitlist system will: (i) directly reduce waiting times by processing swaps wherever these exist, and (ii) provide users with information about expected waiting time. These proposed features are new to the GP allocation system in Norway, and to our knowledge, no waitlist system in any other country incorporates both

of them. Moreover, a system that involves repeated possibilities to switch has not been directly studied in the academic literature. **The implementation of our proposed changes to the GP waiting list system will therefore represent an innovation both in the context of the Norwegian primary care system, as well as in the context of public resource allocation systems worldwide.**

2.1.2 Knowledge needs

While the limitations of the current GP waiting list system are clear, determining the exact means of addressing them requires additional research for two main reasons. First, despite considerable theoretical work on waitlist systems, no existing algorithmic solution perfectly fits the present context. The first part of our research will therefore be to develop a new waitlist algorithm that is compatible with Norway's specific institutional features. Past collaborations between academic researchers and policymakers have yielded allocation algorithms that we can build on, but these algorithms are tailored to specific environments: for example, Pathak & Shi 2013 and Abdulkadiroglu et al. 2020 for allocating students to schools, and Roth et al. 2005 for kidney exchanges. In addition, the existing theory primarily considers settings in which participants are allocated only once, at a specific point in time, and do not have the opportunity to switch. In the GP allocation context, the problem is inherently *dynamic*: individuals may want to switch GPs at different points in time, and may wish to do so more than once. Furthermore, when one person switches GPs, they open up a slot on their former GP's panel. Because of these dynamic interactions, algorithms proposed in prior studies will likely not work well in the present context, and basic questions need to be reevaluated——for example, how waiting time should be used to prioritize individuals, and how frequently reassignments should be processed.

Second, when making changes to a system that impacts such an important aspect of peoples' lives, it is critical to first carry out extensive testing. Once we develop an algorithm that, in theory, will improve the GP waitlist system, the second part of our research will predict how this change will quantitatively impact waiting times, both overall and in different population subgroups. We will use data on the current allocation system to simulate what would happen should the allocation system change. Because there are not similar systems we can look to as a reference, and because theory alone cannot predict outcomes under a new system, empirical simulations will be critical in evaluating our theoretical proposals.

2.2 R&D activities

2.2.1 R&D objectives

- **Design a new, theoretically motivated algorithm** for operating the GP waitlist system that will find and implement swaps wherever they exist.
- **Develop a simulation model** of the GP waitlist system to prospectively evaluate our proposed changes. The simulation model will be critical for evaluating the effectiveness of our proposed changes, as well as in providing estimated waiting times. These waiting time predictions will also be a key input to the new information provided to users in the next stage of the project.
- **Design and implement changes to the user interface of the "*Bytte Fastlege*" tool on Helsenorge.no** to provide information about expected waiting times and help users understand the changes to the waitlist system. Implementation of our novel waitlist algorithm in a national public resource allocation setting represents the key aspect of our innovation.
- **Carry out impact evaluation** by carefully monitoring the new system. This step will be critical to ensuring that our innovation has been effective and can continue to be used in perpetuity.

2.2.2 R&D challenges, design and scientific methods

We have extensively reviewed the scientific literature on centralized assignment and waitlist algorithms. With this existing work as a starting point, our R&D challenges can be classified into five categories.

1. **Developing and establishing theoretical properties of waitlist algorithms that can process "swaps."** The first challenge is the limited theoretical research on algorithmic solutions to the type of *repeated* matching problem present in Norway's GP allocation system. There is work on settings where assignments occur over time, such as in affordable housing or organ transplants (Su & Zenios 2004; Leshno 2017; Bloch & Cantala 2017; Arnosti & Shi 2019), and on re-matching a set of agents with items they already own (Abdulkadiroglu & Sonmez 1999, Sonmez & Unver 2005), but the combination of time dynamics *and* re-matching has received limited attention. The few studies that do consider it limit the analysis to two time periods (e.g., Narita 2018). As a result, existing theory offers limited guidance on how to design an algorithm that combines both waitlists and swaps, or on the consequences of implementing such an algorithm. Would such a system reduce waiting times for everyone, or might some patients have to wait longer than they would under the current waitlist system? Would it affect which GP a patient chooses, given that the patient may face a trade-off between waiting for less time and being assigned to their most preferred GP? To what extent do the answers to these questions depend on the details of the algorithm?

   The first part of our project will conduct theoretical investigations into these questions. We will begin by extending existing theoretical frameworks to incorporate repeated matching, and then consider different ways of implementing swaps when these arise. Most likely, rather than establishing general theoretical results that are relevant to broad classes of repeated rematching algorithms, we will consider more limited extensions of the existing theory that apply to specific algorithms that may be reasonable for the present setting.

2. **Empirical predictions under alternative waiting list designs.** The second, related challenge is that the existing literature has not developed standard empirical techniques to predict outcomes in environments with repeated re-matching. While researchers have developed simulation-based modeling techniques for dynamic assignment systems (Waldinger 2021; Agarwal, Ashlagi, Rees, Somaini, Waldinger 2021; Verdier & Reeling 2021), an important difference in the GP waitlist setting is that the availability of slots depends directly on the assignment process. Organ transplants that take place today do not directly influence the future supply of donor organs. In contrast, because the supply of GP slots is roughly fixed, when one individual switches their GP, a slot at their new GP becomes unavailable, and a slot at their prior GP opens up. We will therefore need to extend existing equilibrium concepts and computational techniques to incorporate this interdependence.

   Following prior work, we will first develop an empirical simulation model of individuals' waitlist choices (as part of main activity H2). We will rely on data from 2018—2019, during which the waiting list system was well-developed and widely used, but prior to the onset of the COVID-19 pandemic. Once the data becomes available, we will also use data from the year 2022. Our simulation model will rely on data on the characteristics and panel capacities of all GP panels in Norway; the GP allocations and waiting list choices of all residents of Norway; and a codification of the current system's rules and the many special circumstances that can arise. We will then be able to "replay" GP allocations from Jan. 2018 to Dec. 2019. Once the simulation is able to match observed GP allocations, we will be able to simulate changes——for example, allowing "swaps"——to predict how they would have affected GP assignments and waiting times. The predictions from these simulations will be a key input into discussions of which version of our algorithm to ultimately adopt and implement.

   We view this research challenge as moderately ambitious, and are optimistic that we will be able to develop detailed predictive models even in the absence of sharp theoretical results. Nevertheless, our ability to predict outcomes under allocation systems we have not yet observed is inherently limited. Participants could always respond to changes in unanticipated ways, and we will view predictions as an educated guess rather than a precise description of what will happen.

3. **Providing new information in the user interface on Helsenorge.no.** Our third challenge will be to update the user interface to provide users with new information about the waitlist system. The current interface reports the number of people currently on each GP's waitlist. Under our proposed algorithm, an individual's expected waiting time for a GP depends not only on the length of that GP's waitlist, but also on the likelihood they will be able to participate in a swap. This in turn depends on the number of persons who are currently waiting for their current GP. Providing patients with accurate waiting time estimates for different GPs will therefore require a detailed predictive model of waiting times. Our simulation model of the GP system will allow us to estimate waiting times as a function of the characteristics of the requested GP's panel (e.g., panel capacity, age distribution of incumbents), the number of persons already on the waiting list, and the identity of the individual's own GP. An additional column ("*Forventet ventetid*") will be added to the current informational table displayed to users, and new informational text will be displayed that describes why individuals with different current GPs may see different predicted waiting times.

   A key challenge will be to present the information in a user-friendly, understandable way. Research on information design in matching platforms has shown that not only the *type* of information provided, but also *how* it is provided, can influence participants' decisions (Allende & Nielsen 2020; Arteaga et al. 2020; Bergman et al. 2020). The user testing segment of the project (main activity H5), as well as the extensive experience of *Helsedirektoratet* and *Helfo* in communicating with users of public health services, will inform our choices of how to present information in the clearest way possible.

4. **Implementation.** Once we have selected an algorithm and changes to the user interface, our fourth challenge will be to actually implement these changes. Implementation will involve coordination between many parties. While *Helsedirektoratet* has direct responsibility for the GP allocation system, changes must also be coordinated with *Helfo*, Helsenorge.no, and *Norsk helsenett*. Within *Helsedirektoratet*, implementation will involve making changes to the codebase used to run the GP allocation system, known as "FLO." These "back end" changes will then need to be reflected in the "front end" user interface on Helsenorge.no. User interface updates will be coordinated with the website team responsible for maintaining Helsenorge.no (part of *Helsedirektoratet)*. All changes will also need to be carefully communicated with *Helfo*, as they will be primarily responsible for communicating with users and responding to user concerns. Finally, updates will need to be made to the relationship between FLO and the *Norsk helsenett*, which is responsible for maintaining the data infrastructure of the Norwegian healthcare system. Each of these changes will be coordinated and implemented by *Helsedirektoratet*.

5. **Impact evaluation.** The final challenge is to evaluate the impacts of the changes made. An appropriate evaluation is challenging because we will never observe what would have happened had things stayed the same, or had different changes been made. This is a common challenge in empirical studies of the effects of policy changes. Most studies adopt a pre/post research design, effectively using pre-reform years as a comparison for post-reform years (Abdulkadiroglu et al. 2017; Moriguchi et al. 2020). In rare cases, reforms have a staggered rollout across different geographic regions (Arteaga et al. 2020; Kutscher et al. 2020), which permits a more credible "event study" research design that compares regions where the reform was implemented at different times. *Helsedirektoratet* will consider piloting solutions in a single region before extending the reform to all of Norway. Alternatively, if it seems best to implement the changes all at once, we will adopt a pre/post design. Regardless, continuous monitoring will take place for 24 months months after the implementation of changes, and final impact evaluation will take place after 2 years.

Our project seeks to implement a substantial change to a centrally important public service in Norway. While there is some existing research on related settings, the problem of operating a waiting list system in a setting where individuals continually have the opportunity to switch is more complicated than what has been studied

in the theoretical literature to date. Moreover, there are not closely related systems in other countries that we can look to for direct evidence. Our project will therefore need to push scientific and practical boundaries along multiple dimensions. We expect that our research will interest a broad, international academic community—particularly in the fields of Health Economics and Market Design. More practically, as with any ambitious R&D project, there are many factors that pose potential risks. For one, we cannot be certain beforehand how users will feel about changes to the system. If after receiving user feedback, proposed changes appear to be deeply unpopular, we will need to consider whether they can in fact be implemented. For another, various stages of the project could take longer than we have projected. We have worked to minimize this risk by conducting preliminary research and planning discussions already, well before the project's official start date.

3. Impact

3.1 Potential for value and benefit creation

Improving access and efficiency in the healthcare system is a central goal of the project applicant (*Helsedirektoratet)*. Improving the GP allocation process using the tools of economics will therefore materially contribute to the applicant's core mission. Statistics Norway, as a project partner, will also advance one of its organizational missions of using research to improve the quality of life of Norwegian citizens. The target group of this innovation is residents of Norway who participate in the public GP system (99%of the population). By enabling a large portion of those wanting to switch GPs to do so more quickly, we expect with a great deal of confidence that our proposed innovation will increase satisfaction with the GP system. While this system is currently facing a number of substantial challenges, we see this project as one relatively straightforward way in which the system can be improved and therefore made more sustainable.

Our project also directly relates to the UN Sustainable Development Goal aimed at promoting good health and well-being for all. As noted in the Goal, a well-functioning primary care system is critical to maintaining a healthy population. Allowing individuals to smoothly switch their GP when the need arises supports the goal of a well-functioning primary care system.

3.2 Utilization of results

3.2.1 Plan for the realization of the innovation

We intend that the improved process that results from this project will continue to be used in perpetuity as part of *fastlegeordningen*. The associated benefits will begin to be realized once the new GP waitlist system is implemented (at project milestone H6). We note that it is also possible that certain benefits can be realized sooner (after project milestone H3). This is because implementing swaps to reduce waiting times does not in principle require any changes to the user interface on Helsenorge.no; it only requires changes to the "back end" algorithm for processing waitlist reassignments. If preliminary testing is overwhelmingly positive, we may be able to implement this change prior to the implementation of changes to the web interface. As *Helsedirektoratet* solely manages the waiting list allocation system via FLO, it will be straightforward to implement "back end" changes once the revised code is developed.

The expected benefits of this project will accrue to individuals who wish to switch GP and who will be able to enroll with their preferred GP sooner. There may also be unexpected benefits, for example increased primary care visits if more people are matched with a GP that better suits their needs. After the project period ends, *Helsedirektoratet* will have the tools (in the form of programmatic algorithms) to continue using the new waitlist system indefinitely. A key deliverable at the end of the project will be a technical report detailing the operation of the new waitlist process and explaining the algorithm as a reference for future employees at *Helsedirektoratet*. If unforeseen issues that are not covered in this report arise after the project period ends, the

research team commits to making themselves available for troubleshooting conversations with the team at *Helsedirektoratet* at any point in the future.

Tabell 1: Risk Management for Realization of Gains

Description of risk	Probability	Management of risk
Unexpected technical difficulties implementing back end changes to waitlist codebase (FLO)	low	The project manager (Lund) was the original designer of the waitlist system and oversees its operation. While it is possible that FLO will not be easily compatible with the proposed changes, close collaboration during the research phase between the research team and the coders at *Helsedirektoratet* will minimize this risk.
Delays in implementation of changes to user interface on Helsenorge.no	middel	Changes to Helsenorge.no can be delayed if other, more urgent changes are needed. While we cannot prevent unforeseen events that overload the web design team, we will manage this risk by providing long lead times (at least 12 months). We can also implement "back end" changes before "front end" changes so that some of the benefits are realized sooner if there are delays.

3.2.2 Dissemination, sharing and exploitation

The research undertaken in this project and the practical knowledge gained from it have a strong potential to be useful in other segments of the public sector. For example, similar allocation procedures are used in Norway for the allocation of student housing, kindergarten slots, non-emergency medical procedures, and school enrollment switches. There is a clear possibility to take the insights gained in this project and apply them in these alternate settings. Toward the end of this project, we will write a report (in both Norwegian and English) aimed at a general audience, in which we explain our experience implementing these changes and detail our findings. We will send this report to the authorities in charge of these other public systems. More broadly, we will produce between 2–3 academic articles aimed at publication in highly-ranked international economics journals, and we will present our research at international academic conferences.

4 Implementation

4.1 Project plan for the R&D project

4.1.1 Main activities of the R&D project

H1. Basic research on dynamic patient-GP waiting lists [Industrial research]: We will conduct basic theoretical research and develop code to implement several possible versions of a first-come first-served waiting list algorithm that implements swaps.

Primary project partner: Statistics Norway
Key participants: Huitfeldt, Marone, Waldinger
Important deliverables: Academic research article, proposed algorithm(s), computer programs

H2. Simulations [Industrial research]: We will perform empirical simulations testing our proposed algorithms on data from the GP allocation system. At the end of this stage, we will disseminate our theoretical and empirical work by presenting at international academic research conferences and by soliciting feedback from leading practitioners in the economics subfield of Market Design.

Primary project partner: Statistics Norway
Key participants: Huitfeldt, Marone, Waldinger, Crawfurd, Seljetun
Important deliverables: Academic research article and technical report detailing new waitlist algorithm and their predicted impacts on waiting times

H3. Solution selection [Milestone]: At this stage, all stakeholders will have a meeting to decide which version of the algorithm to implement. These key stakeholders will be: researchers at Statistics Norway (Bensnes, Huitfeldt, Marone, Waldinger), practitioners at *Helsedirektoratet* (Eriksson, Seljetun, Crawford), senior leadership at *Helsedirektoratet* (Lund, Mathisen), subject experts at the Norwegian Institute of Public Health (*FHI*) (Telle), and user representatives from *Helfo* (Vartdal).

H4. Design, prototyping, and testing of user interface [Experimental Design]: Having selected the exact design of the changes we will implement, we will now begin the process of designing how to present new information to users via the *"Bytte Fastlege"* user interface on Helsenorge.no.

Primary project partner:	*Helsedirektoratet*
Key participants:	Crawfurd, Kalhagen, Lund, Seljetun
Important deliverables:	Prototyped design of new information to be presented via user interface on Helsenorge.no

H5. Solicitation of user feedback on interface [Experimental Design]: We will solicit feedback from user representatives at *Helfo*, subject experts at *FHI*, and the general public via the beta-testing procedures in place at Helsenorge.no. We will gather feedback on the clarity of the new information provided through the interface. After this feedback is gathered, appropriate adjustments to the beta version will be made.

Primary project partner:	*Helsedirektoratet*
Key participants:	Crawfurd, Lund, Vartdal
Important deliverables:	Report detailing feedback on changes to user interface

H6. Implementation of changes to waitlist mechanism and user interface [Milestone]: At this stage, we will be ready to implement changes to the "back end" algorithm of the waitlist mechanism as well as make the associated changes to the user interface live on Helsenorge.no. A press release will be prepared describing the changes to the system and user outreach will take place via *Helfo*. An internal report detailing changes to the waitlist mechanism will also be distributed to applicable personnel at *Helfo* and *Helsedirektoratet* so that all user-facing parties are fully informed about the changes.

H7. Monitoring and evaluation of effectiveness [Experimental Design]: With the redesigned waitlist live and running, we will continually monitor for problems and effectiveness. Each month, we will examine GP assignments to ensure accuracy of the redesigned system, in line with the current practices in place at *Helsedirektoratet*. We will also continually monitor the feedback received from users via *Helfo*.

Primary project partner:	*Helsedirektoratet* and *Helfo*
Key participants:	Bensnes, Huitfeldt, Crawfurd, Kalhagen, Lund, Seljetun, Vartdal
Important deliverables:	Quarterly reports on system performance and user feedback

H8. Finalize write-up of research and practical findings [Milestone]: Once the system has been in place for 24 months, we will move back to the standard level of monitoring as is carried out today by the team at *Helsedirektoratet*. The research team at Statistics Norway will finalize the set of academic research articles about what has been learned through the practical implementation of economic theory. The teams at both Statistics Norway and *Helsedirektoratet* will finalize two reports: (i) a technical report on the project documenting in detail the various challenges and solutions encountered, and (ii) a summary report written (in both Norwegian and English) for a general public audience, which can be shared with other government agencies that use similar waiting list mechanisms.

Tabell 2: Rollefordeling

Partner-kategori	Navn på partner	Ansvarlig for hovedaktivitet:	Deltar også i hovedaktivitet:	Rolle og begrunnelse for deltakelse
O1	Helsedirektoratet	H4, H5, H7	H2	Holds primary responsibility for implementation of GP allocation system
O2	Helfo	H7	H5	Holds primary responsibility for communicating with users of GP allocation system

F1	SSB	H1, H2	H6, H7	Supports researchers with extensive experience working with data derived from GP allocation system and designing waiting list mechanisms

Tabell 3: Risikohåndtering for FoU-prosjektet

Description of risk	Probability	Management of risk
Delays or problems accessing data on GP allocation system or individual demographics	low	The research team at Statistics Norway has extensive experience applying for and gaining access to these types of data, and has worked with the GP allocation system data for many years. Even so, the data acquisition process can take longer than expected, so we would begin this process the moment the project is funded.
Operational challenges implementing algorithm to find and process swaps, for example code taking a long time to run on such a large dataset	middel	The GP system in Norway involves many more individuals than other waitlist systems for which similar algorithms have been used. There is therefore some risk that the proposed algorithms will be very slow on such a large scale. That said, the practitioners at *Helsedirektoratet* have extensive experience working with these data, and will play an integral role in operationalizing the code. Discussions about timing, programmatic language, memory, and computational needs will occur before the research team writes and tests the algorithm.

Tabell 4: Gantt Chart

Main Activity	Category	Activity	2023			2024				2025				2026				2027
			Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
H1	**IF**	Basic research on dynamic patient-GP matching																
H2	**IF**	Simulations																
H3	**Milestone**	Solution selection																
H4	**EU**	Design, prototyping, and testing of user interface																
H5	**EU**	Solicitation of user feedback on interface																
H6	**Milestone**	Implementation of changes																
H7	**EU**	Monitoring and evaluation of effectiveness																
H8	**Milestone**	Finalize write-up of research and practical findings																

4.1.2 Project organization, cooperation, and support

The project will be carried out in two phases: a Research Phase and an Implementation Phase. All project partners (*Helsedirektoratet*, *Helfo*, and Statistics Norway) will be involved in both phases, but the organization and management structure in each phase will be distinct.

The Research Phase consists of main activities H1–H3. In this phase, the primary project partner will be Statistics Norway, and the managing project participant will be Ingrid Huitfeldt. Huitfeldt will coordinate the collaboration between the researchers at Statistics Norway (Huitfeldt and Simon Bensnes) and the two external researchers (Victoria Marone and Dan Waldinger). Marone and Waldinger are economics professors at U.S. institutions as well as affiliated researchers at Statistics Norway. The individual-level administrative data housed at Statistics Norway will be a key input to this phase of the project. Huitfeldt has extensive experience with both obtaining access to and carrying out research using this data, and will be able to get the necessary data infrastructure into place rapidly. Bensnes is a health economist who has studied the GP allocation system for many years. Marone is a health economist who has experience working with similar datasets in the U.S., and who has conducted highly related research using data from the GP allocation system during a recent year-long academic visit to Statistics Norway (2020–2021). Waldinger is a Market Design economist who has studied the optimal design of waiting list mechanisms in a number of related settings, including public housing systems and donor organ transplant systems. These four researchers comprise the core *research team*.

The Implementation Phase consists of main activities H4–H8. In this phase, the primary project partner will be *Helsedirektoratet*, and the managing project participant will be Jon Georg Lund. Lund will oversee the activities of the key employees at *Helsedirektoratet* who are responsible for maintaining the GP allocation system: Helle Crawfurd, Espen Kalhagen, and Henning Seljetun. He will also coordinate directly with Steinar Mathisen, who will represent senior leadership at *Helsedirektoratet*, and Trond Vartdal, who will represent

Helfo. Lund is the Senior Manager in the healthcare reimbursement department (*avdeling for helserefusjoner*) in the health economics and competence division (*Divisjon helseøkonomi og kompetanse*) at *Helsedirektoratet*. He has worked with the health and welfare system for 16 years, and specifically with the GP allocation system for 12 years. In 2016, he led the implementation of the initial version of GP waiting lists (a project budget of 45 million NOK). Mathisen is the Department Director (*avdeling for helserefusjoner*) at *Helsedirektoratet*. Vartdal is a senior advisor in the Communications department at *Helfo*. Crawfurd is the manager of the GP allocation system codebase (FLO) team; Kalhagen and Seljetun are IT specialists that work on this team. Together, the team from *Helsedirektoratet* comprise the core *implementation team*. While they will carry out much of the on-the-ground work during this phase of the project, they will remain in close contact with the research team, who will offer advice and feedback throughout the implementation process.

Finally, the project will benefit from the insight of subject expert Kjetil Telle, who is the Director of Health Services Research at *FHI* as well as the director of a recently convened Expert Committee to study possible solutions to improve *fastlegeordningen*. Telle will contribute in an advisory role at all stages of the project.

5 References

Abdulkadiroğlu, A., Agarwal, N., Pathak, P.A., 2017. The Welfare Effects of Coordinated School Assignment: Evidence from the NYC High School Match. American Economic Review 107, 3635-3689. https://doi.org/10.1257/aer.20151425

Abdulkadiroğlu, A., Che, Y., Pathak, P.A., Roth, A.E., Tercieux, O., 2020. Efficiency, Justified Envy, and Incentives in Priority-Based Matching. American Economic Review: Insights 2, 425-442. https://doi.org/10.1257/aeri.20190307

Abdulkadiroğlu, A., Sönmez, T., 1999. House Allocation with Existing Tenants. Journal of Economic Theory 88, 233–260. https://doi.org/10.1006/jeth.1999.2553

Agarwal, N., Ashlagi, I., Rees, M.A., Somaini, P., Waldinger, D., 2021. Equilibrium Allocations Under Alternative Waitlist Designs: Evidence From Deceased Donor Kidneys. Econometrica 89, 37–76. https://doi.org/10.3982/ecta17017

Arnosti, N., Shi, P., 2019. Design of Lotteries and Wait-Lists for Affordable Housing. Management Science 66, 2291-2307. https://doi.org/10.1287/mnsc.2019.3311

Arteaga, F., Kapor, A.J., Neilson, C.A., Zimmerman, S.D., 2021. Smart Matching Platforms and Heterogeneous Beliefs in Centralized School Choice [WWW Document]. www.nber.org. URL https://www.nber.org/papers/w28946 (accessed 8.15.21).

Bergman, P., Chan, E.W., Kapor, A., 2020. Housing Search Frictions: Evidence from Detailed Search Data and a Field Experiment [WWW Document]. www.nber.org. URL https://nber.org/papers/w27209 (accessed 9.8.21).

Bloch, F., Cantala, D., 2017. Dynamic Assignment of Objects to Queuing Agents. American Economic Journal: Microeconomics 9, 88–122. https://doi.org/10.1257/mic.20150183

Kutscher, M., Nath, S., Urzua, S., 2020. Centralized Admission Systems and School Segregation: Evidence from a National Reform [WWW Document]. papers.ssrn.com. URL https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3614253 (accessed 9.8.21).

Leshno, J.D., 2017. Dynamic Matching in Overloaded Waiting Lists. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.2967011

Narita, Y., 2018. Match or Mismatch? Learning and Inertia in School Choice [WWW Document]. papers.ssrn.com. URL https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3198417

Allende, C., Neilson, C., Gallego, F., 2019. Approximating the Equilibrium Effects of Informed School Choice [WWW Document]. dataspace.princeton.edu. URL https://dataspace.princeton.edu/handle/88435/dsp01fj2364948 (accessed 9.8.21).

Pathak, P., Shi, P., 2013. Simulating Alternative School Choice Options in Boston.

Roth, A.E., Sönmez, T., Utku Ünver, M., 2005. Pairwise Kidney Exchange. Journal of Economic Theory 125, 151–188. https://doi.org/10.1016/j.jet.2005.04.004

Sonmez, T., Unver M.U., 2005. House Allocation with Existing Tenants: an Equivalence. Games and Economic Behavior 52, 153-185. https://doi.org/10.1016/j.geb.2004.04.008

Su, X., Zenios, S., 2004. Patient Choice in Kidney Allocation: The Role of the Queueing Discipline. Manufacturing & Service Operations Management 6, 280–301. https://doi.org/10.1287/msom.1040.0056

Søraas, Lars Haakon and Helge Skirbekk, Med rett til å Bytte? Ventetider for å bytte fastlege i Norge, Legelisten.no, 2022. https://www.legelisten.no/blogg/209-lange-ventetider-for-a-bytte-fastlege

Verdier, V., Reeling, C., 2021. Welfare Effects of Dynamic Matching: An Empirical Analysis. Review of Economic Studies *(forthcoming)*. https://www.dropbox.com/s/eag20nwlosvjzpr/DynamicLottery.pdf

Waldinger, D., 2021. Targeting In-Kind Transfers through Market Design: A Revealed Preference Analysis of Public Housing Allocation. American Economic Review 111, 2660–2696. https://doi.org/10.1257/aer.20190516