DIGITAL TRANSFORMATION UNDER A PANDEMIC: A CASE STUDY OF COVID-19 CONTACT TRACING IN NORWAY

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Abstract

In March 2020 the number of confirmed COVID-19 cases in Norway increased rapidly, and the efforts to trace contacts of positive cases were under severe pressure. Contact tracing in Norway is the responsibility of the municipalities, and no standardized or coordinated contact tracing practices were at the time in place on the national level. The afflicted municipalities did their best to cope with the chaotic situation and did contact tracing using excel spreadsheets or pen and paper. These approaches have their flaws, and in particular, failed to scale in several municipalities. In this paper, we report from a case study of collaborative efforts made to address this challenging situation by the University of Oslo (UiO), the Norwegian Association of Local and Regional Authorities (KS), the Norwegian Public Health Institute (NPHI), and several municipalities. The DHIS2 software platform and experiences implementing DHIS2 for contact tracing in other countries were the basis for these efforts. We describe the process of designing and implementing DHIS2 to date and the experiences so far. We pay particular attention to the potential long-term implications of this process, which we see as a digital transformation of contact tracing in particular and disease surveillance in general in Norway. Our contribution is a rich case description as well as the identification of themes relevant to the further development of DHIS2 for contact tracing as well as other systems in a similar context. These themes include cross-municipal collaboration and information sharing across judicial/legal boundaries, standardisation and centralization of support structures, and potentially transformation of contact tracing practices.

1 Introduction

The SARS-CoV-2 virus, causing the outbreak of the COVID-19 disease, has severely affected health, economy and social interaction globally in 2020. While Norway so far is spared the high numbers of infected, hospitalized and fatalities seen in other countries, the disruption of the economy is massive and people's lives have changed.

The Norwegian health authorities responded to the pandemic along two different paths: an infection control strategy to reduce transmission and a treatment strategy to prevent deaths among people who become severely ill. The infection control strategy aimed to delay the onset of the epidemic and give the healthcare service more time to prepare, and then slow down transmission so that the epidemic is spread over a longer period and fewer become infected overall.

On March 12, 2020, the Norwegian Institute of Public Health (NIPH) had registered 500 people with COVID-19, many of them returning to Norway from abroad. On the same day, Norway closed down universities, schools and kindergartens, restricted the number of people that could gather for any kind of events and implemented other restrictive measures to control the spread of the virus. With a peak in the daily reported cases in late March, the number steadily dropped and stayed low during summer, and started rising again after July. This is considered as an effect of the society opening up again and travel restrictions being lifted. Clusters of infected persons have emerged in places where people meet, for example cruise ships, weddings and gyms. Continuously identifying and monitoring infected persons and identifying their contacts is crucial to break chains of infection and keep the situation under control. This contact tracing work is complex, resource intensive and is considered as a cornerstone in the response to limit the spread of COVID-19 until a vaccine is available to the general public.

When patients are confirmed as positive cases, 'contact tracers' in the municipalities call them and write down a list of their recent contacts, who in turn will be contacted and advised on how to behave. This contact tracing practice was done variously on paper or with electronic spreadsheets. While these practices have sufficed for handling other infectious diseases in Norway, neither of them scaled sufficiently to deal with the rapid increase of COVID-19 infected in March 2020. No national information system existed for this contact tracing, partly because of the decentralized structure giving much responsibility to the 356 municipalities.

The development and deployment of DHIS2, a health management information system, in the Norwegian health sector is our empirical case. We look at existing and emerging challenges related to the information system, the way contact tracing is carried out now, and what potential paths we see for this in the future. As will be discussed, there are indications that the efforts to use IT to cope with scale and complexity of contact tracing is indeed pointing to a digital transformation of contact tracing. Our research question is thus; *how does the interplay between technology and work practice influence contact tracing of COVID-19*?

2 Digitization, digitalisation and digital transformation

One way to approach the potential and related challenges of the change processes within contact tracing is to make a distinction between digitization, digitalization and digital transformation (Osmundsen et al 2018). Primarily used to discuss changes in specific markets, with a focus on competitive edge, value creation etc (Vial et al 2019), we also find these concepts relevant to discuss and improve our understanding of the changes involved in our case.

The introduction of IT in work practices is a well-known topic in the information systems research field (Sandahl 1999). However, the role of technology will differ depending on the organization and the individuals within the organization using it (Mergel et al 2019).

Digitization is seen as a conversion of data and documents from an analogue to a digital format in order to make them programmable, addressable, traceable and communicable (Osmundsen et al 2015). This will typically involve scanning existing documents and converting them into a digital format. Digitization can be cumbersome but comes with the potential to support automation of data processing and improved data accessibility. At the same time, the aim of digitization is not to change and improve work processes.

Digitalization is more profound, where introduction of IT entails changes in work practices and workflows. Thus digitalization involves both technical and social aspects. It involves changing workflows in general and describes how digital technology changes socio-technical structures (Osmundsen et al 2015).

Digital transformation is a term adopted from the private sector. It involves fundamental changes in leadership, processes, people and politics. In the public sector, as opposed to the private sector, fundamental change is mostly analyzed under the term e-government (Mergel et al 2019). It implies a change in delivery services and new ways of direct interaction with the citizens. We will not discuss e-government in detail here, just state that in this context e-government is seen as a set of techniques that affect the modernization of the public sector (Meijer & Bekkers 2015). We have summarized these different concepts in table 1 below.

Processes	**Definition**
Digitization	Conversion of data and documents into a digital format
Digitalization	Changing work practices and workflows based on IT
Digital transformation	Significant changes in work processes in and among organizations

Table 1 Definition of digitization, digitalization and digital transformation

3 Methods

This paper is the result of an on-going interpretive case study. Since a couple of the authors have or have had active roles in the development of the system in question, it is similar to a participative case study (Baskerville, 1997).

Various authors have been involved at various times with the case, approaching it from different angles and looking at different themes. While the University of Oslo and DHIS2-team currently have a contractual agreement for supporting the configuring and continuous management of the "Fiks Contact Tracing" system, two of the authors were engaged in the project prior to this formalization in May 2020, e.g. with risk and vulnerability analysis of DHIS2 and helping the first interested municipalities to test the system. One of the authors has later worked daily with the design and implementation of the system since early May 2020. She has among other tasks, contributed to prioritization of functionality, gathered requirements, conducted functional design work and advised KS on architectural decisions.

Through this engagement, the team has worked closely with several municipalities as well as relevant national stakeholders such as the Norwegian Institute of Public Health and the Norwegian Association of Local and Regional Authorities. Two municipalities have been visited to observe work practices and interview contact tracers. Four additional municipalities have been interviewed online. Several user forum meetings have been attended, where multiple municipalities are present and discuss requirements for the new system. Our data material is based on notes from these interviews and meetings, emails, development discussions, and risk analysis exercises as part of the design process.

A challenge with this retrospective approach is that data was not necessarily collected with a common theme in mind. A benefit is that it is richer and broader, which fits well with the research aim of this paper.

3.1 Data analysis

Data analysis has been inductive, where themes have been emerging from the data and our involvement in the development of the system. Concretely this took place as the various authors shared and discussed their data and reflected upon what they meant. Together as a group we identified main challenges currently faced in the project. The challenges were then grouped along what we identified as root causes , which are presented as themes in the analysis section below. Two examples of this inductive process are shown in the table 2 below.

Data	**Challenge**	**Theme**
The need to develop support for "cluster events"; outbreaks with many people tied to a particular place and time	"Clusters" are registered in one municipality, no clear legal path to sharing sensitive data with other municipalities	Pandemic is borderless, pandemic response is tied to municipal structure
User forums for municipalities to discuss system requirements	Very different needs, small and large municipalities, urban and rural, etc	Decentralization vs centralization of system development

Table 2 Definition of digitization, digitalization and digital transformation

The themes note how the technological and organizational context of contact tracing is challenged both by a sense of urgency and confusion, by new knowledge of how the disease is spreading, and by the potential and limitations of the technology. These challenges will potentially lead to radical organizational and institutional changes, which we link to the concept of digital transformation.

4 Digital support for contact tracing in Norwegian municipalities

The responsibility for testing, registering, contact tracing and reporting of suspected and confirmed cases of COVID-19 fell on 356 municipalities, initially with no central support with regards to information systems. In Norway many of the municipalities' system for infection tracing has been in a rudimentary stage and consisted of procedures executed with pen and paper or Excel spreadsheets. Such systems quickly faced challenges to cope with the scale and complexity of contact tracing for COVID-19. As one municipal contact tracer puts it to us;

"I used to be responsible for registering Tuberculosis cases in my municipality. This was done either by pen and paper or by filling out a pdf-form. But Tuberculosis is a slow developing disease. It takes between eight to nine weeks before you get back the test result which shows if you are positive or negative and the likelihood you will develop the disease is very small. COVID-19 spreads quickly. Many of the infected became ill and when the pandemic hit we were already behind on the contact tracing. The pressure on registering COVID-19 cases was so high that we did not even have time to create schedules."

Several municipalities were investigating digital solutions to support contact tracing. There are a few solutions available globally, of which this paper focuses on District Health Information Software 2 (DHIS2), an open source platform used primarily in developing countries, based on World Health Organization recommendations.

DHIS2 is an open source health management information platform developed by the Health Information Systems Programme (HISP) at the University of Oslo. DHIS2 is a flexible platform supporting ready-made metadata packages, often developed in collaboration with the World Health Organization (WHO), as well as configurable implementations based on local needs. The DHIS2 software in general has evolved from a tool for collection, storage, validation, analysis, and presentation of aggregated health data to also support patient management and individual records (Adu-Gyamfi, Nielsen, & Sæbø, 2019). Additionally, the open source code base enables anyone to use, modify and redistribute the software with very few copyright restrictions (dhis2.org), enabling innovation of novel software. The platform is in use in 72 countries today, with Norway as the first European country.

When COVID-19 was defined as pandemic a COVID-package was created based on WHO guidelines. The COVID-package was widely adapted by a range of countries (currently 36 countries use DHIS2 for COVID-19) and attracted attention in Norway. While some municipalities, The Norwegian Institute of Public Health (NIPH) and UiO were exploring the use of this module in Norway, The Norwegian Association of Local and Regional Authorities (KS) assumed responsibility of creating a contact tracing solution based on DHIS2 that would be available to all municipalities; "FIKS contact tracing" (FIKS 2020).

Figure 1 Important dates

KS is an organization that, among other functions, is a development partner for Norwegian municipalities and contributes to the digitalization of services by offering a platform called FIKS. The FIKS platform consists of different digital solutions that KS recommends to the municipalities. The system is installed on KS's common platform for shared municipal IT services. The platform contains other services to support messaging between the municipality and public agencies such as social services building and planning authorities. Through offering the contact tracing system on this platform it is available as a web application to all municipalities that sign up to use it, see figure 2.

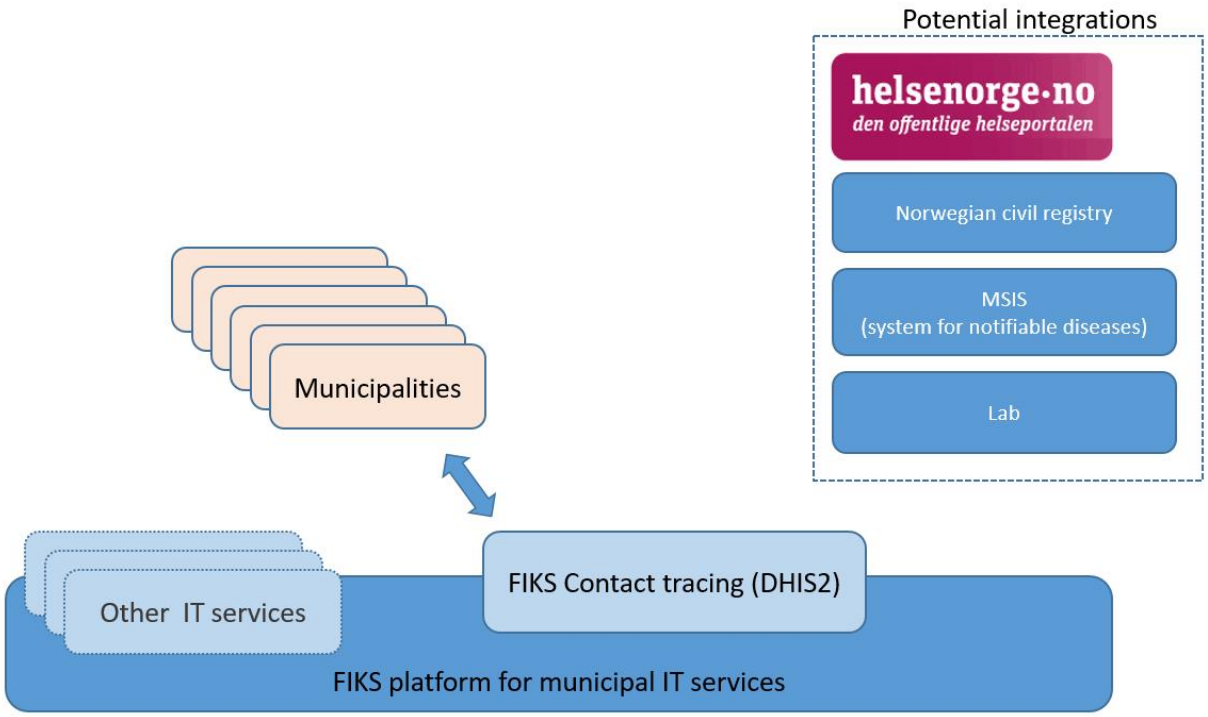

Figure 2 A simplified architecture model of the FIKS platform illustrating the relation between the installation of the DHIS2 contact tracing module and the municipalities, and a list of possible integrations.

4.1 FIKS contact tracing

The structure of the Norwegian public health FIKS Contact tracing consists of two modules; one for registration and follow up of the index case and one for registration of close contacts. In the index case module the person with a positive test is registered with contact details, information about the health status, the potential source of infection, travel history and if they have been in contact with others in the days leading up to the positive test result. Future dates for follow-up can be scheduled in the system, see figure 3.

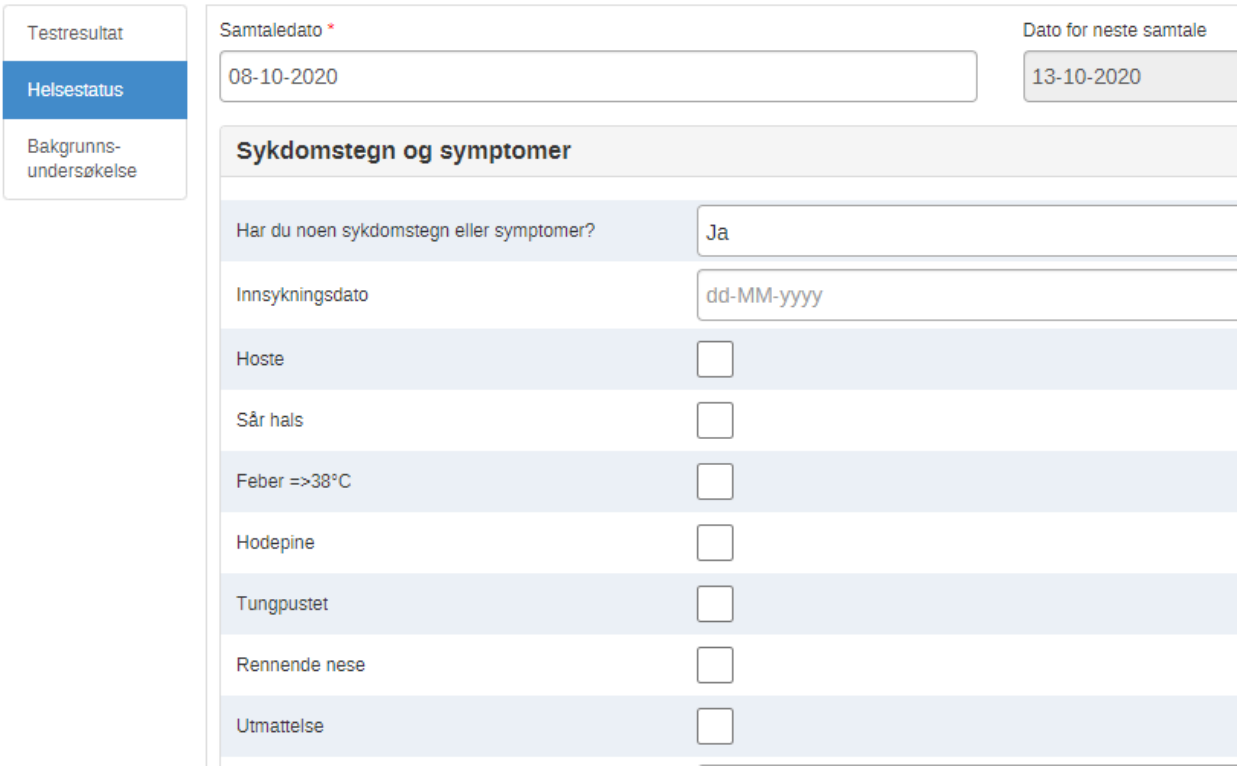

Figure 3 Form for registration of index case

Contacts are registered separately and are linked to the index case through a function in DHIS2 called relationships. This makes it possible to see who the contacts are and what the nature of the relationship is, for example through school, work or social setting. The figure below shows the list of contacts, as well as the nature of their contact, for an index case.

For each contact, the contact tracer registers information about the contact, such as personal details, test results and dates for quarantine and scheduled follow-ups, see figure 4. Once a contact tests positive for the virus they become an index case. They will keep the relationship as contact to an infected person and can in turn have their own contacts.

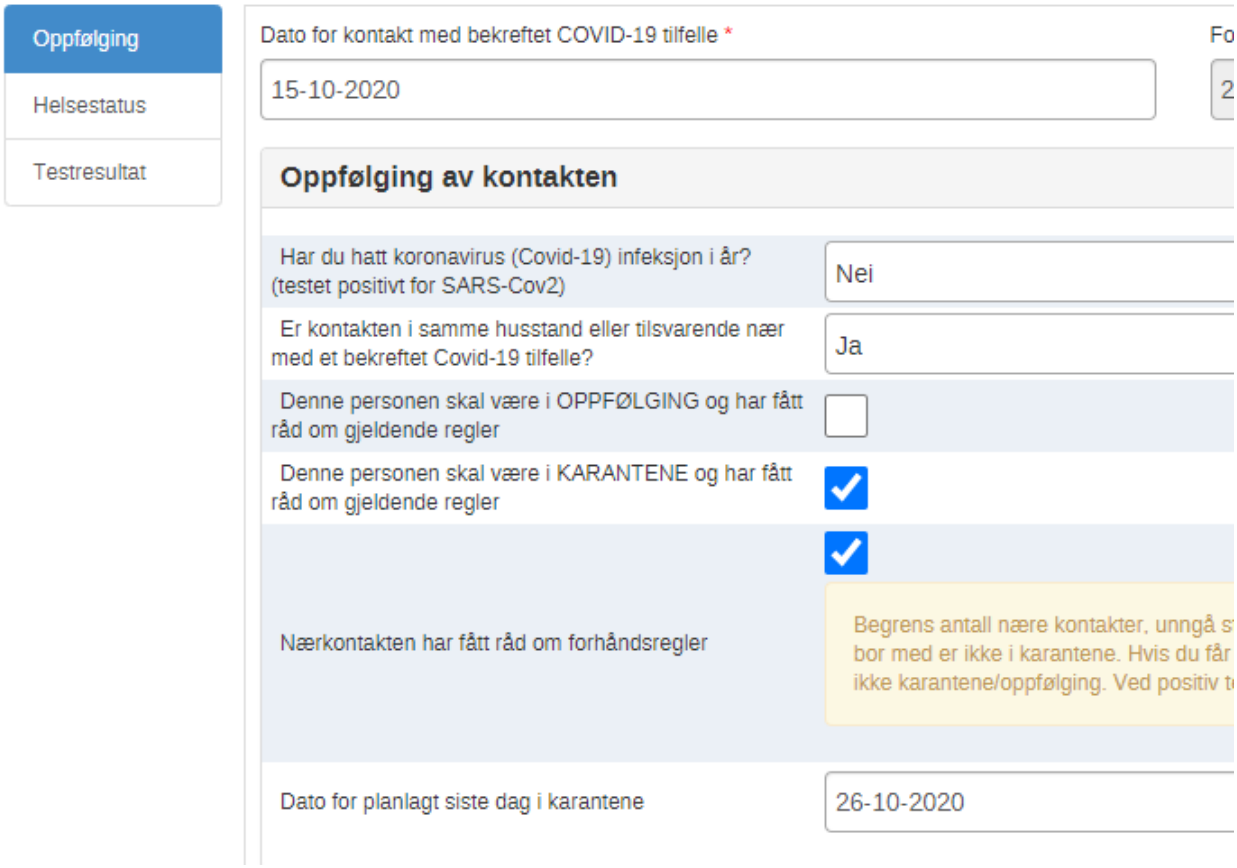

Figure 4 Form for registration of index case.

To support the everyday work of the contact tracer, "KS Contact Tracing" displays lists of upcoming scheduled follow-ups - both index cases and close contacts. The system also facilitates visualization of data through preconfigured dashboards showing for example numbers required for reporting to the health authorities or maps showing where people have been exposed for the virus. At the time of writing (October 2020), the system is in use in 110 municipalities (one third of the municipalities).

In the next section we provide our analysis of the issues relevant to the design and implementation of FIKS Contact tracing in Norwegian municipalities.

5 Analysis

We identify three emergent themes to organize a rather blurred and rapidly changing situation. They are 1) borderless pandemic meets the institutional arrangements of municipal health services, 2) contact tracing as decentralized responsibility with need for national digital support and coordination, 3) work and workload changes.

5.1 Borderless pandemic meets the institutional arrangements of municipal health services

The organization of primary health care services and contact tracing affects both how the follow-up of index cases and contact tracing is performed, and it imposes legal restrictions when it comes to sharing data. Hence, there is a mismatch between pandemic as a borderless phenomenon and the legal and organizational setup of the health sector.

The scale of the COVID-19 pandemic brings this challenge to the surface. While there are legal obstacles to sharing data across municipalities, there are also legal responsibilities in certain cases, such as when there is a life-threatening situation or national public health interests are at stake. Due to this legal environment some municipalities requested a clarification on how to interpret the legal boundaries and

responsibilities of information sharing. The Directorate of Health (Helsedirektoratet 2020) concludes that the contacts of an index should be counted as probably infected (no need for symptoms to be present) and given the seriousness of COVID-19 this data can be shared across municipalities.

In practice this means that when an index case or contact is registered in a municipality, they are by default only visible to that municipality. The contacts should however be monitored and followed up in the municipality where they currently reside. This means that a contact may be followed up in another municipality or country from that where they were registered. The contact can be easily transferred between municipalities using the same system, but for municipalities using other systems the contact is moved manually/via phone.

A related challenge is that of handling clusters, which is high on the development agenda as it is not yet supported in the system. A cluster is when more than two infected cases originate from the same source - usually defined by a geographical site and time. There have been numerous examples in the media over the summer, such as weddings, parties, and other social gatherings. A cluster is "owned" or registered by the municipality in which it takes place but can have associated index cases in several other municipalities and thus clusters need to be visible to all relevant municipalities. The design process needs to balance the need for information about the cluster (e.g. where, when, who) with the sensitive information the cluster can disclose (a health institution, meeting at a political party, private gathering etc.).

5.2 Contact tracing as decentralized responsibility with need for national digital support and coordination

At the moment there are at least four specific digital contact tracing solutions in use in Norway; "KS Contact Tracing", "Remin" – also built on DHIS2 with a different user interface on top, and a custom built solution from Dignio used in Oslo Municipality, as well as Bærum municipality's own built solution. "KS Contact Tracing" covers a subset of the municipalities. There is no integration between the different systems at the time of writing and limited work has been done from national level to integrate the different solutions or to provide functionality that will benefit them all.

The decentralized organization of contact tracing affects the design process of "KS Contact Tracing". Municipalities have differing workflows and present different requirements for the design of the solution that shall be available for all municipalities. Some examples are how to register BMI, the structure of reports or how to register potential points of exposure. These are examples of areas where municipalities have had slightly different work practices and wishes for changes to the system.

KS prioritizes new functionality together with their users (municipalities) through formal user forums held twice a month. This forum is composed of 5-6 municipalities. Additionally, they call for meetings twice a year with all users to get their feedback and inform them about the way forward. This prioritization means that each municipality needs to make compromises to have a unified solution.

The public health authorities sometimes have diverging interest from the municipalities. While the contact tracing team needs detailed data to break a specific chain, the public health authorities need information that can be aggregated to inform policy. One example is how to register relevant information for place of exposure; a municipality would need to register the exact shop, kindergarten or nursing home, down to a specific floor or department. The public health authorities on the other hand need information on whether infected people were exposed to the virus in "a health institution", "a school" or "a private function".

Another challenge which became apparent in several municipalities during the process of adopting the DHIS2 module was assessing the data privacy. Each municipality had to do their own data protection impact assessment (DPIA). One municipality manager explains how the assessment of the balance between societal preparedness and risk of infection, and the individual's need for privacy in a situation which no one has ever experienced before is something they do not have the competence to do. The manager further explains that the uncertainty municipalities have, due to the requirement to do an own DPIA, is enormous. KS has made a template DPIA to address this.

5.3 Work and workload changes

With COVID-19 the pressure on health professionals to register cases increased drastically and many municipalities experienced a sudden resource problem. There was a need to create processes for COVID-19 contact tracing. This involved putting in place a contact tracing team with a schedule to handle all the calls from residents who suspected they were infected. The municipalities also identified the need to digitalize the contact tracing process.

The workload on contact tracing still varies greatly as the infection rates increase or decrease. For many municipalities it has been a challenge to scale up staff needed to handle requests from the public.

To be able to scale up the contact tracing team you need staff with the knowledge of COVID-19 and the regulations set in place by the government. However, municipalities experienced that information from NIPH and the Norwegian Directorate of Health (NDH) could sometimes be inconsistent. The municipalities' own regulations were sometimes stricter than the advice from NDH. In addition the information, regulations and advice have changed several times over the months since Norway experienced its first COVID-19 case. Keeping up with the information "overload" has in itself been a challenge.

The contact tracers consist of health professionals that usually hold other positions in the municipal health care system, such as school nurses and physiotherapists. Thus, the contact tracing staff in many municipalities have been working as this temporary and part time. The municipalities have had to quickly mobilize staff from one place to another, not only for contact tracing but also for areas such as testing and information hotlines.

Hence, the contact tracing teams experienced a multiple burden of training; staff quickly need to learn both the trade and the tool simultaneously, in addition to keeping up with the changes in advice and regulations from the government. The need for user friendly solutions and proper training material has been important and a key improvement area in the project.

As soon as DHIS2 was up and running the training started. By then there was a backlog of suspected and confirmed cases that needed to be registered. One municipality used the backlog to train the staff in the use of DHIS2. This form of training worked well, until contact tracers were interrupted due to their other work obligations.

During low-infection periods, municipalities decreased their contact tracing team as they were needed back to their original job in the organization. The problem, however, became apparent when there was a new burst of infections and the situation once again required an increase of staff. The people called in for the contact tracing team the second time did not necessarily have to be the same as before, which ultimately meant that the competence of the previously trained got lost and new training sessions had to take place.

Some municipalities have been able to create functional contact tracing teams with working schedules and the ability to scale up in case of a rise in the infection rate; "At first we did not even have time to create proper schedules but now, with the assistance of DHIS2, we are able to scale up and down according to the rise and decline of enquiries from inhabitants who suspect they might be infected with the Coronavirus."

6 Discussion

Paper based contact tracing systems have long been known to be challenging (Satin 1977). They are typically tainted with incomplete data about contacts, loss of contact lists, inadequate data and delays in communication and following up the contacts (Danquah et al. 2019). Compared to pen and paper, spreadsheets are an improvement (you don't lose them as easily as you lose a piece of paper). Still, both paper and spreadsheets are suited for slow developing diseases and for a controlled situation where there are few infected. While IT based solutions may address these issues, they may also introduce new challenges related to security and privacy-infringement (Ryan 2020).

The introduced electronic system offers the required support in a more complex and uncontrolled situation with the ability to scale rapidly. This includes features for sharing information about cases between different users which improves accessibility. Even if we can assume that a certain standardisation of practice has occurred in municipalities using the same system, it has not yet changed the overall practice of contact

tracing. As an example, we note that the practice of filling out the digital forms are dictated more by what the contacts recollect and how the conversation with the contact tracers unfold than by how this is organized in the software. What we do observe is that KS contact tracing, as well as the nature of COVID-19, has pushed the limits of the existing contact tracing practices. Contact tracing is the responsibility of the municipality, with clear legal and organizational boundaries, while tracing COVID-19 contacts requires cross-municipal collaboration. The new digital system supports this, while the legal environment is more unclear.

At this point of the implementation of the KS contact tracing system we thus see so far primarily a process of digitizing and digitalization. There is a slight change in work practices and workflows. There is also a feeling of being more in control as the contact tracers are now able to handle rise in the infection rate. At one point, due to a sudden rise in infection rates, one of the municipalities also assisted another municipality that has not implemented DHIS2 in informing their contact tracers about infected residents. While there is limited digital transformation so far, we would nevertheless expect to see changes that are more radical over time.

One such radical change may be self-registration of contacts, which has already been suggested by some municipalities (and is in fact supported by some of the other applications in use in Norway). Such a digital transformation of the contact tracing process can contribute to lower the pressure on contact tracers as well as reduce the amount of work and be more agile in responding to changing volumes of infections. It will probably change the institution of contact tracing, and even change or eliminate the role of contact tracing teams. With a massive increase in capacity, given the devolution of the tasks to all citizens rather than small teams, this may in turn affect what data is collected. We note a different motivation for data between the current actors, ranging from clinical needs to research and policy needs.

Another more comprehensive change would be a wider integration of relevant information systems, and a corresponding clarification of roles among the actors currently supporting them. With its open APIs, DHIS2 is well suited for integration with other systems including the Norwegian Surveillance System for Communicable Diseases (MSIS) and the National Population Register (NPR). There is already an integration in place between “Kjernejournal” and MSIS and the DHIS2 team is in conversations with both NIPH and NPR about integration possibilities between DHIS2, and MSIS and NPR respectively. This will require solving confidentiality and security issues.

Lastly, with a digital solution used across the municipalities, there is a potential to change from a municipality-focus to an index-focus. Giving clusters and individuals’ priority over geography will, again, require legal issues to be sorted.

We would further argue that digital transformation is a necessity. The resources needed and costs associated with handling COVID-19 in general and contact tracing in particular are substantial. Over time, we cannot expect excessive resources to be available. The number of infected may increase rapidly in the future, and resources will in any case need to be rapidly scaled up or down. We thus need to find new ways to do contact tracing.

We briefly summarize our discussion so far in the table below.

Process	**Definition**	**COVID-19 contact tracing**	**Status**
Digitizing	Conversion of data and documents into a digital format	From pen and paper to spreadsheet or pdf	Municipalities still using digital and non-digital solutions
Digitalization	Changing work practices and workflows based on IT	From spreadsheet or pdf to DHIS2	May: 7 municipalities participated in a pilot to test and give feedback to the solution. The solution formally went in to production on June 4th. By 03/9-

			2020 - 76 municipalities are using KS Contact tracing.
Digital transformation	Significant changes in work processes in and among organizations	Centralized and standardized DHIS2 in FIKS, integration with MSIS etc., cross communal contact tracing, index-focus, and self reporting	Some in effect, like a national contact tracer team by NIPH. Others planned, like integration with other systems. Self reporting discussed

Table 3 Findings related to digitization, digitalization, and digital transformation

While the transformative potential of DHIS2 is not yet realized related to COVID-19 contact tracing in Norway, the digital platform nature of DHIS2 has played an important role. As a platform primarily developed for reporting, analysis and dissemination of aggregated health data in developing country contexts, it has shown the required flexibility to be adapted to new usages in a new context. This required agility, supported by the already existing global COVID package and the availability and eagerness of DHIS2 experts working with the municipalities. The DHIS2 team has continued the agile work process where KS and the municipalities decide which changes and new features the DHIS2 team is to prioritize. This has proven to be an efficient work process (Vinekar, Slinkman and Nerur, 2006, Dingsøyr et al. 2017).

While DHIS2 is a more scalable solution compared to pen and paper, spreadsheets and pdf, the scaling of contact tracing is a socio-technical challenge. When the infection and the related need for contact tracing is on the rise, new contact tracers will be recruited and rapidly trained. If contact tracing is based on standardised tools, training can also be standardised and streamlined. At the same time, if digital tools are used, they need to be designed for users novel to the tools. From a socio-technical perspective, the relevance of digital tools in contract tracing can also be discussed. On the one hand, if there are very few infected, pen and paper solutions may be good enough. On the other hand, if the number of infected passes a certain threshold, it is virtually impossible to do contact tracing as long as people will be involved in identifying and by making calls to contacts.

In the case of availability and distribution of a vaccine we will hopefully see a decline in COVID-19 cases. However, the world will at some point in the future experience other epidemics or pandemics. Health care workers are also required to register their patient's infectious diseases such as Tuberculosis, and as of today there is no software to aid contact tracing of other infectious diseases. Thus, one could argue that there is a need for a generic software where health professionals, contact tracers and others could register different infectious diseases. The infrastructure and capacity related to DHIS2 is now established and can be adjusted to cater for any sort of contact tracing.

7 Conclusion

Our research question for this study was *how does the interplay between technology and work practice influence contact tracing of COVID-19.* We see several indications of a more profound change in the way contact tracing is done. First and foremost this is related to the legal environment, which is challenged by the need for much better coordination across municipalities. The current strong emphasis on patient data confidentiality caused confusion whether or not contact tracing could be properly performed across municipalities, and a clarification was needed. We also see moves towards new models of inter-municipal authorities and responsibilities, towards integration of a wider ecosystem of relevant information systems, and towards a refocusing on indexes and clusters rather than residency. Lastly, we see interest in a change to self-reporting.

5 months after the initial testing of the KS contact tracing system in Norwegian municipalities, we see little of direct change in work practices, except being able to handle increased scale. This is in itself the most important outcome from a public health point of view.

A limitation of our study is that it is still early in the process of digitalization of contact tracing, and thus our research question is perhaps too ambitious at the current stage. A second limitation is that we have less direct observation of the work practices than we wanted. This is natural given the strict social distancing regulations in place, coupled with our intention not to disturb the work of the contact tracers too much.

Future research should, in addition to follow the potential digital transformation of contact tracing and disease surveillance in general, look at the important process of moving from urgency to routine. It is likely that COVID-19 does not disappear but joins the plethora of diseases present in the global population. How will the KS contact tracing system evolve into a generic system that can easily accommodate the needs to counter also future diseases, known and unknown?

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