Stabilizing the Danish ICU influenza surveillance network

- An Actor-network theory perspective

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Preface

This master's thesis is written by Ali Shah and Nichlas Brødegaard Larsson as the conclusion of the Cand.merc.(it.) program at Copenhagen Business School. This thesis deals with understanding, analyzing and enhancing the current influenza surveillance system in the intensive care unit level, by applying a customized framework of Actor-network theory (ANT). The primary audience for this master thesis is the department for Infectious Disease Epidemiology at Statens Serum Institut, as well as any practitioners interested in the actor-network theory and its appliance in a case study. Our ambition with this thesis is not solely to help SSI understand the situation with an Actor-network theoretical perspective, but to apply the theory to help them resolve complications with the ICU surveillance system. The title: *Stabilizing the Danish ICU influenza surveillance network* represents the goal of achieving an ideal situation for the involved stakeholders in the system.

We would like to thank our supervisor Tina Blegind Jensen for her constructive guidance throughout this thesis. Furthermore, we would like to thank the department for Infectious Disease Epidemiology at SSI for their involvement and contribution to this study. Their assistance in involving the Danish Regions has enabled the results of this thesis. While our time at SSI was certainly rewarding for the study, it was also enjoyable, and we would like to extend our thanks to the individuals and institutes we approached. Finally a special thanks goes out to the talented and sincere Iain Foss for proof reading our thesis.

Enjoy your reading.

Frederikbsberg, August 2013

Ali Shah *Nichlas Brødegaard Larsson*

Executive summary

Since its establishment, during the 2009/2010 pandemic, the actor-network intensive care unit (ICU) influenza surveillance has become unstable. This study takes an actor-network theory perspective in identifying how SSI can stabilize the ICU surveillance network.

We approached the problem with a three-phase research method. This involved conducting a preliminary exploratory research, which determined the scope of the study. Next, we conducted interviews and used our observations to analyze the interactions between human and non-human actors.

This study determines the instabilities by analyzing the establishment of the ICU influenza surveillance network. By analyzing four Danish Regions we found four patterns in these actor-networks and dissected seven issues, which lead to network instability. We present five recommendations, which SSI can implement to again restore the stability of the actor-network.

Three theoretical findings come from studying this case of cross-organization actor-networks. Firstly, the focal actor of a network must understand the interests of actors in the network, to ensure continuous alignment of interests. Secondly, finding is that studying associations between human and non-human actors can be used to determine why and how actor-networks are formed. Finally, the finding is that one must consider multiple social contexts when constructing inscriptions in artifacts and thus reduce the development of anti-programs.

Table of contents

1. Introduction 7

1.1 Surveillance of the severity of influenza 8

1.2 Scope of research 9

1.3 Research question 12

1.4 Research approach 12

1.5 Structure of report 13

2. Theoretical foundation 15

2.1 Literature Review 15

2.2 Principles of Actor-Network Theory 18

2.3 Analysis strategy 28

3. Research method 31

3.1 Scientific discipline 31

3.2 Design of the research method 32

4. Case description 48

4.1 Prevention and control cycle 49

4.2 Identification of a problem 50

4.3 Intervention 52

4.4 Surveillance 53

4.5 Economic burden of influenza epidemics 59

4.6 Danish Regions governs health care 60

5. From action nets to actor-network 62

5.1 Establishment of the network – the early stages 62

5.2 Redefining the actor-network 68

5.3 Controversies leading to instability 73

6. Understanding the actor-networks 76

6.1 Outlining the actor-network of SSI 76

6.2 Outlining the networks of the Danish Regions 85

6.3 State of the regional actor-networks 99

7. Comparative analysis of an unstable network 100

7.1 Patterns of actor-network 100

7.2 Identified issues within the patterns 105

8. Recommendations 107

8.1 Understand the interest of the actors 108

8.2 Revise the data requirements of the stakeholders 109

8.3 Substitute regional contacts for non-human actors 110

8.4 Enforce inscription of technological artifacts 112

8.5 System owner to again become indispensable 113

9. Discussion 115

9.1 Discussion of analysis results 115

9.2 Theory discussion 119

9.3 Method discussion 123

10. Conclusion 126

11. Bibliography 129

Table of figures

Figure 1: Illustration of the scope of the research 10
Figure 2: Report structure 14
Figure 3: Illustration of the effectiveness of programs and anti-programs, within hotel guests, who are encouraged to leave their room keys when leaving the hotel. 26
Figure 4: The application of ANT concepts in this thesis. 30
Figure 5: The three phases of the research method used to analyze the ICU influenza surveillance system. 33
Figure 6: Matrix of statements from semi-structured interviews using the collaborative tool Google Spreadsheets. 42
Figure 7: Legend of colors used in illustrating the coded primary data 43
Figure 8: Results of preliminary data coding organized by ANT terminology (the full illustration in A - 1 Data coding development) 44
Figure 9: Grouping sub-category systems within each category system 45
Figure 10: Example of color-coded statements that show which regions that had statements within this sub-category system. 46
Figure 11: Control and prevention cycle organized by SSI. 49
Figure 11: Map of Europe which illustrates the intensity of influenza in European countries, who are members of ECDC 51
Figure 13: Overview of levels of infection surveillance used by Statens Serum Institut (Sundhedsstyrelsen, 2013). 54
Figure 14: Screenshot for MiBA database website. 57
Figure 15: Geographical illustration of the Danish Regions (Danske Regioner, 2012). 61
Figure 16: The system of association within the network 65
Figure 17: The associations between SSI and the regions. Association with 'Region A' is stronger than the remaining regions. 73
Figure 18: The actor-network of the epidemiologist at SSI 77
Figure 19: Screenshot of Capevo. 79
Figure 20: Excel worksheet used to collect data from ICUs (see Appendix G). 80
Figure 21: Laboratory confirmed influenza A and B, and percentage of tested persons identified with influenza (Statens Serum Institut, 2013) 83

Table of tables

Table 1: Patterns identified in the analysis of the actor-networks 101
Table 2: Overview of the issues within the identified patterns 106
Table 3: Mapping of recommendations and issues identified in the analysis 107

1. Introduction

The risk of global pandemics is increasing. Some observers have pointed towards the increasing globalization as the main cause of viruses which can spread quickly across borders. Government organizations use extensive resources to observe and take preventive actions against epidemics, as there are substantial direct and indirect costs associated with an infected population (World Health Organization, 2009).

The problem with influenza is that it is very unpredictable. How bad is it and how is the development? There is a fairly normal curve, but it may be different this year.

Administrator, 'Region C'

Influenza is a respiratory viral infection. The incidence of infection in the population is periodical, occurring every year during the winter months from December to March (Statens Serum Institut, 2012). Seasonal influenza is linked to an increase in hospitalizations and mortality. Once every 2 to 3 years the affecting strain of influenza is especially severe, ultimately resulting in a pandemic. The Danish Emergency Management Agency estimate that 5-10% of the population is infected during a regular seasonal influenza epidemic. For an actual pandemic, the percentage of infected persons is estimated to be up to 20% of the population (Beredskabsstyrelsen, 2013).

Initiating interventions, such as vaccines, is an important step towards reducing both the cost and health burdens of influenza. However, recommendations from the World Health Organization on the 2009/2010-influenza response, suggest more appropriate interventions that should be staged by affected countries (World Health Organization, 2012). The recommendations are based on evaluations of Member States' pandemic plans and experiences during the 2009/2010 pandemic. The report shows that European countries need to improve

their surveillance systems, as significant investigative gaps led to an underestimation of the true burden of the pandemic, and so to mismanagement.

1.1 Surveillance of the severity of influenza

Statens Serum Institute (SSI) is the Danish governmental unit responsible for the surveillance of epidemic diseases. The organization manages a national network of reporters from different health care institutes. They maintain a surveillance system to monitor the severity of respiratory infections in Denmark, including influenza epidemics. SSI uses the surveillance system to carry out a weekly analysis of the current state of influenza in the population and then publishes the results of their studies. There are three target groups for SSI; health care professionals, politicians and the public. SSI uses the output of the surveillance system to allow these stakeholders to make well-informed decisions regarding infectious outbreaks, here influenza.

> *As part of the preparation for a pandemic, it is important to establish a surveillance system and define indicators that are crucial to use in the monitoring of a pandemic. The aim is not only to measure trends and patterns of illness, but also to control rumors and to reassure the population and decision makers that the society can deal with the epidemic with an acceptable level of harm.*
>
> (Mølbak, et al., 2011)

One segment of the surveillance system covers patients who are diagnosed with influenza and who are hospitalized on any intensive care unit (ICU) in Denmark. SSI has taken part in establishing a network of regional contact persons for acquiring data on influenza patients hospitalized in ICUs. There are five regions in Denmark, each with a contact person, who is responsible for the gathering of data from their respective ICUs once a week. The epidemic researcher at SSI analyzes any and all development regarding influenza patients in ICUs (for example,

number of hospitalizations, risk factors and treatment methods), to produce an aggregate national overview. The aggregate analysis is supported by a case-based analysis of the patients' risk factors, based on their individual diagnosis.

SSI is responsible for the ICU surveillance system, but relies on the involvement and activities of other entities. These entities are both organizational units, such as the Danish Regions, but also other information systems. In 2009 when the system was established, the Danish Regions were not present in the process of gathering data from ICUs. Instead, SSI had direct contact with all 44 ICUs, but had a hard time motivating their contacts to their findings (Gubbels et al., 2013, p. 768). The coordination costs of this system were too high for the epidemiology researchers and consequently regional contacts were assigned for the 2010/2011-influenza season. Although the regional contacts have eliminated the need for individual ICUs to coordinate themselves with SSI, the new system posed a new set of issues. Since the establishment of the ICU influenza surveillance, the network has faced multiple issues with regards to its stabilization. It has become evident that associations between these organizational units affect the stability of the newly imposed system.

1.2 Scope of research

Epidemic surveillance is carried out in multiple instances within the Danish health care system and the information from these surveillance systems provides the basis that SSI uses to make their analysis of the severity of influenza. Stakeholders, to make informed decisions, use these analyses in their assessment of influenza severity.

The scope of this study is intended to provide an analysis of the epidemic surveillance network of patients hospitalized at ICUs. The current network was established during the 2009/2010 pandemic, but its arrangement has since then been altered numerous times.

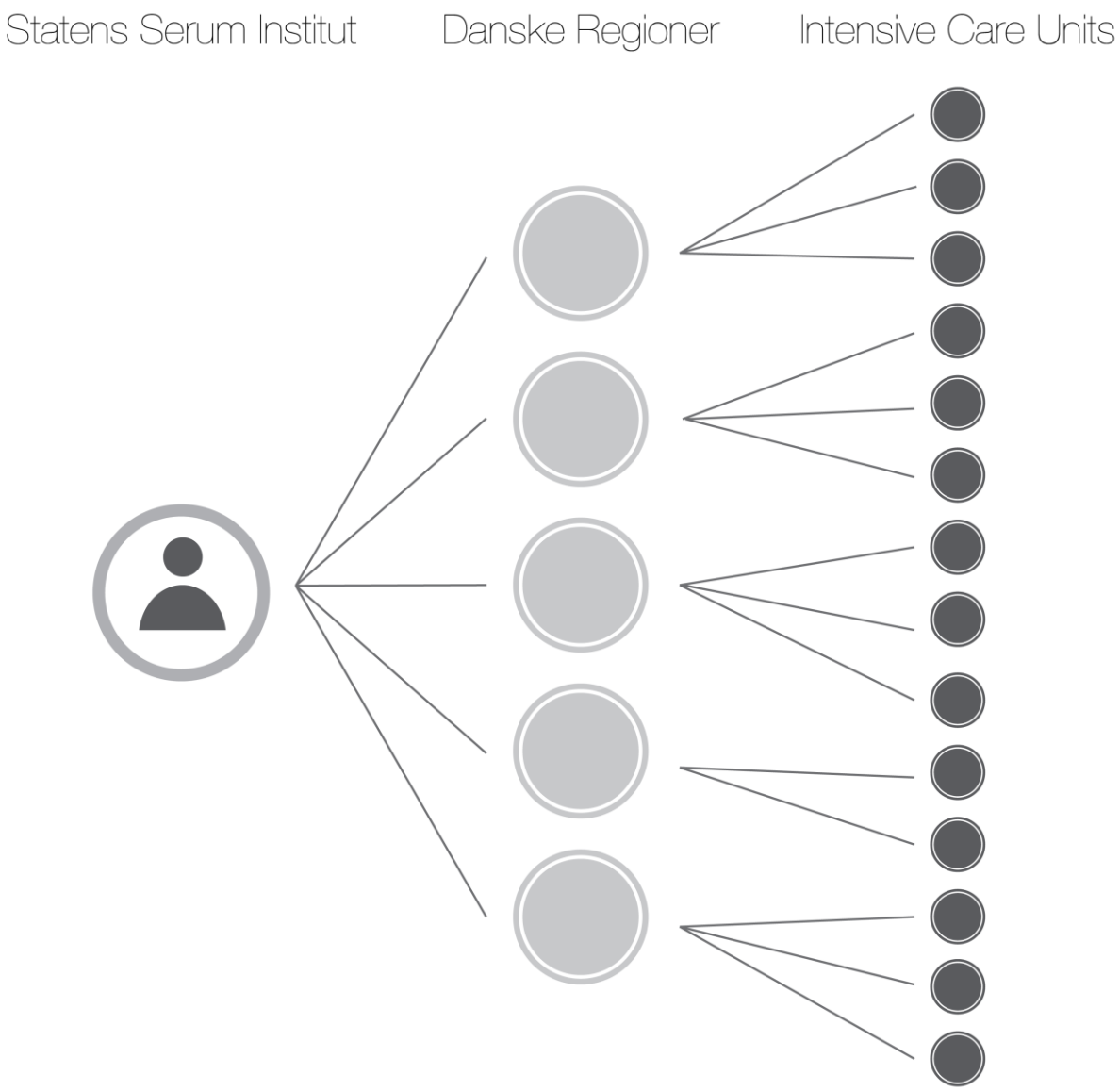


Figure 1: Illustration of the scope of the study

Figure 1 illustrates the organizations involved in the surveillance network of ICUs. In this study, we take the perspective of SSI, as it is their administrative responsibility to maintain this national network. The Danish Regions are important in the current network, as they are involved in all communications between SSI and the ICUs.

The Danish Health and Medicines Authority have determined the importance of surveillance of ICU influenza patients. Likewise, WHO has recommended

initiatives that are more appropriate and systems of surveillance which are able to match the severity of influenza epidemics. SSI currently manages a complex and unstable network, where coordination happens across organizations and entities.

The interaction between SSI surveillance and the Danish Regions consists of both human actors, such as an epidemiologist, regional contacts, and ICUs, and non-human actors such as an Excel worksheet form, a file exchange system, several databases, mail systems, weekly ICU reports and statistical analysis systems. The non-human actors have been developed and implemented in the network mainly by SSI. The intention was to enhance the system and facilitate coordination between entities. Eventually, due to the lack of interest alignment, the regions generated different interpretations of the non-human actors and their use. These differing interpretations resulted in incomprehensible behavior that did not adequately translate between the increasingly divergent systems. The result of this was then increasingly problematic interactions between the Danish Regions. The intensions of introducing the non-human actors became blurred and soon the stability of actor-network was threatened.

1.3 Research question

Based on the challenges of ICU influenza surveillance, we will address the following questions:

How can SSI stabilize the national network of the ICU influenza surveillance system?

How did the network of ICU influenza surveillance become unstable?

Which issues arise from involving the Danish Regions in the ICU surveillance system?

Which initiatives should SSI implement to stabilize the network of ICU influenza surveillance?

1.4 Research approach

The scientific research addresses the above questions through an Actor-Network Theory (ANT) lens, using the theory as a means to understand the social and technological context of our research field. The reason for choosing ANT lies in its fundamental assumptions, which are well suited for our research field. ANT uses the notion of heterogeneity to describe the relationship between the social and the technological part as a continuum and both being equally important (Latour, 1992). Hence, ANT deals with the notion of human actors and non-human actors, representing the social and the technological element, respectively. This interaction is presented in this study and is a focal part of the network of SSI, regions and ICUs.

By applying the ANT terminology, the study aims to identify current issues in the network affecting instability (Callon, 1991). To determine these issues we have split the analysis into three parts. Firstly, the study will outline the formation and establishment of the network in 2009. Further, it will address the nature of the interessement and translation within the research field. The notion presented by

Callon (1986) will aid in analyzing the initial interest of the actors and how the network was established. Secondly, we outline the current actor-network by investigating the actors and their interaction with one another. This will function as an enabler for the final part of our study, in which we identify patterns that indicate the presence of instability in the actor-network. Based on this, we will collate a series of issues. To deal with these issues we will then present three recommendations for SSI to consider.

The main respondents in this study are the actors responsible for reporting and analyzing the data for surveillance use in both SSI and the Danish Regions. In SSI, we narrow our research field to focus exclusively on the epidemiologist researchers in the Department for Infectious Disease Epidemiology. However, we also observe and analyze the non-human actors, which are used in the information system. As for the Danish Regions, we solely engage with the regional contact persons, as they are responsible for the communication with SSI. The primary data consists of semi-structured interviews with these respondents and observations of their work environment and processes. The observations are crucial in this study, as a second source and a validation of how human and non-human actors interact during the daily work. We therefore opted to conduct all interviews at the Regions across Denmark. In addition, the observations are the primary data source when investigating and understanding the non-human actors.
A majority of observations and information interviews were also conducted during our time in the offices of the department for Infectious Disease Epidemiology. Other data sources, such as documents and website descriptions, are included to enhance our understanding of the complex nature of the field as well as the non-human actors.

1.5 Structure of report

Figure 2 provides the reader with a broad overview of the structure of this report.

Chapters 2 and 3 describe ANT theory and elaborate on the designed research method. In chapter 5 we answer the first sub-question; *how did the network of ICU influenza surveillance become unstable?* Chapter 6 and 7 describes the Danish Regions and SSI, to determine the issues leading to instability (second sub-question). In Chapter 8 we answer the final sub-question by giving recommendation for SSI to stabilize the network.

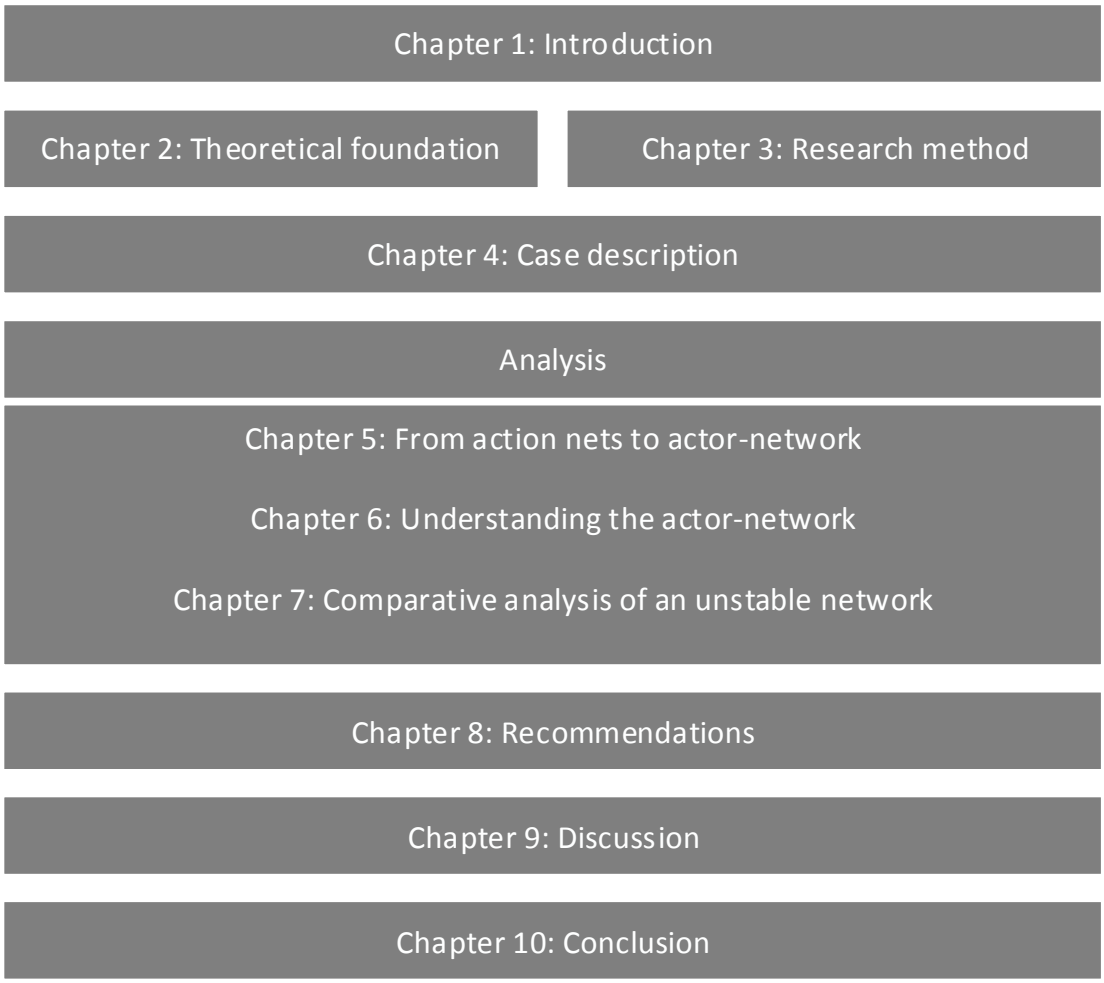


Figure 2: Report structure

2. Theoretical foundation

This chapter dives into the theoretical foundation used in this study of influenza surveillance network of ICUs. The selected theoretical concepts will be introduced together with an analysis strategy outlining how the concepts will be applied on the case. Additionally, the justification of applying ANT in this study is outlined in a literature review.

2.1 Literature Review

In this literature review, we will not cover the literature on ANT within the epidemiological domain, but rather justify our selection of ANT as the theoretical foundation of this study. We will discuss different scientific theories and see how they apply to our case. Furthermore, we will identify limitations of technological determinism and social construction of technology and present ANT as the appropriate theoretical 'key' for this organizational lock.

2.1.1 Technology shapes the social world

If we conducted a study based on technological determinism, the focus would be on the interaction between the technology and the social (Winner, 1980). We would then display how the technology influences the social context of SSI. Our focus should be on the technological factors and identify how they can determine success or failure. The study could investigate how the technology is conceived, developed and implemented. In this sense, the technology is viewed in a neutral fashion, uninfluenced by the society's use of it. This flexibility is worth studying, as its consequences for the society must be understood. Similar to the surrounding environmental factors which shaped Edison's behavior in Hughes' *Electrification of Americas* (1979), an in-depth study in SSI could investigate the flexibility of the technology and how the social context is affected.

In relation to the ICU influenza surveillance system in SSI, the employees deal with several information systems that connect them to the Danish Regions. These

systems define the interconnection of the actors by dictating and limiting the actors' actions in the social context and technological attributions that determine the efficiency of the system. If this study was conducted, a research question can then be posed as follows:

How are the information systems of the ICU surveillance affecting the interaction between SSI and the Danish Regions?

In technological determinism, we neglect the social context and perceive the human factor as a passive observer to the dominance of the technology. It is important to investigate the causes of the technological change that are affecting the social context (MacKenzie & Wajcman, 1985), which the next section challenges.

2.1.2 Social world shapes the technology

The influence of the social context cannot be ignored. The same technology can have quite different effects in different contexts. In social construction of technology (SCOT), the focus is on the interaction between the society and technology, but unlike technological determinism, the society influences and shapes the technology (MacKenzie & Wajcman, 1985). Technology is no longer just an artifact, but also a practice (the society's use of technology) and knowledge (society's experience gained from the use). Although the success of technology is determined by the society, social groups, such as SSI and the regions, will have different interpretations of technology and different definitions of success (Bijker, 1995). In brief, interpretation is flexible.

Were we to apply SCOT to this case of the ICU surveillance system, the focus would be on studying the social context. This includes identifying the heterogeneous social groups, understanding their interaction with, and interpretation of the technology and then defining the level of interpretative flexibility. The study can be anchored within SSI, making them the focal group and helping them to diminish

the interpretative flexibility. To this end, the following research question could be relevant:

How do the various social groups interact with the ICU surveillance system, and how can SSI achieve closure?

It is obvious that the social aspect is dominant in this theory. Winner (1993) accuses SCOT for neglecting technology by giving the social structure too much attention. He presents several limitations of SCOT. One of his most notable arguments claims that SCOT is more concerned with the origins of technology, rather than the effects of the technological choices made by the social groups. Therefore, we turn to a third research program.

2.1.3 Beyond relativism

We must go beyond the relative comparison of technology and society and create something different. What seems to be social is partly technical and what may appear solely technical is partly social; a socio-technical approach (Latour, 1991). The durability of ANT is facilitated by introducing an actor of human-like characteristics to represent the technological artifact; the non-human actor. The concept of the non-human actor offers to combine societal and technological elements in a durable fashion. (Latour, 1991). Methodically, by introducing the non-human actor to accompany the human one, ANT treats the two archetypes of actors equally.

This approach is suited for studying the ICU surveillance system, as SSI and the regions create, and shape, the technological artifact and are simultaneously affected by the possibilities and limitations that the technology presents. Therefore, this study will apply ANT concepts that are suitable for the case of ICU influenza surveillance.

2.2 Principles of Actor-Network Theory

Actor-network theory (ANT) is a socio-technical perspective regarding interactions between humans and technology that can be described and analyzed (Sarker et al., 2006). Complex networks contain both human and non-human actors, and arises from the associations between these entities (Callon, 1991). ANT does not distinguish between these entities and does not make discriminations based upon the relational position or power of computers, people, animals, processes and other elements. The objective of ANT is defined as follows:

> *Actor-network theory attempts to "open the black box" of science and technology by tracing the complex relationships that exist between governments, technologies, knowledge, texts, money and people.*
>
> (Cressman, 2009)

In this section we aim at introducing the various concepts of ANT that we have selected for this study and will apply in the analysis. Although the concepts we have chosen are quite interconnected, we will define them separately while illustrating their interconnectivity. In section 2.3, we outline the manner in which the concepts are to be applied.

2.2.1 Actors and actor-networks

Before we define the notion of *actor* and *actor-network,* let us take a few steps back to see how these notions came to life and understand their origin.

In Czarniawska and Hernes (2005, p. 18), Porsander explains the emerging of an actor-network. The organizing of activities is seen as the foundation that facilitates the creation of actors and networks. Before this creation, the organizing can be addressed as *action nets.* These action nets deal with collective actions and events rather than people and forms. The entities in the action nets are interconnected, but in a loosely coupled fashion.

We can follow the development of these entities (also referred to as actants) into actors. In the process, the actants acquire an identity. An identity can be defined

by the process of repeatedly performing the same actions and achieving equivalent results (Porsander, 2005).

When an actor is defined, it can take shape within actor-networks as either a *human* and *non-human* actor. Actor-network theory has a symmetric treatment of the human and non-human actor (Czarniawska & Hernes, 2005, p. 10). Therefore, an actor can be a person, a document or a piece of technology (Callon & Latour, 1981). An actor is not simply a node in a network, but is formed in an association of heterogeneous elements themselves, which thereby create a network (Law, 1992). It is for this reason that we have phrased the notion of actor in a neutral manner. In actor-network theory, actors, whether human or not, are treated equally and described by the same terms.
In Johnson (1988) all actors have human characteristics. Yet some actors do not have enough characteristics to be defined as human beings, but simultaneously they are not in-human. Here, the notion of the non-human arises as an indication that an actor acts like a human actor, but is not one by nature. According to Johnson (1988), studying social relationships without the non-human actor is impossible.

These actors co-exist in a network and are related by the association they share. Cressman (2009) defined the importance of the associations:

> *The power of a network is measured by the strength of associations.*
>
> (Cressman, 2009)

As described earlier, an actor-network can be seen as the intended outcome of the organized activities in an action net. As a result, the associations between the actors are created. But this should not be seen as a one-time process, but rather an iterative process in which the heterogeneous associations are fluctuant.
The actor-network can simultaneously be seen as an actor, one that is responsible for networking heterogeneous elements and maintains a network that is able to

constantly transform itself (Callon, 1987), as well as a network. The word networking should be stressed, as it indicates the relational effects that recursively generate and reproduce (Gherardi & Nicolini, 2005).
In the next section, we will introduce the process of translation and the underlying activities that yields the actor-network.

2.2.2 Translation

The process in which the actor-network creates and transforms itself, is referred to as *translation* (Callon, 1986). Before a network is created, this process has to occur. The process defines the nature of the network and establishes a relation between actors that were previously not related. Callon defines translation as a means that contains actions through which an actor identifies other actors and arranges them in relation to each other.
This one actor tries to convince the other actors that this network can create mutual benefits and is worth creating and maintaining. Akrich defines the designer in the translation process:

> *In the translation process, the designer who creates the artifacts intends for them to be used in a certain manner, this is then inscribed into the tool.*
>
> (Akrich M. , 1992)

Therefore, translation can only be understood when it is examined from the viewpoint of one focal actor, because within an organization there are often several actors initiating and engaging in translation, but in most cases with distinct interests and different outcomes (Sarker et al., 2006).

Law (1992) argues that translation focuses on power as an effect and presents some strategies on how the focal actor deliberately identifies and arranges other actors by the use of power. In this manner, the actor strives to overcome the inevitable resistance put up by other actors. The output of a translation analysis is to understand how an actor-network is created, strengthened and weakened

(Tatnall & Gilding, 1999). The aforementioned strategies are specified by a vast number of authors, but we have opted to use some of the earlier proponents of these strategies. Callon (1986) specifies the different strategies as four moments that consist of different phases that in reality might overlap. Empirically, the sequence of the moments can therefore be categorized as a continuum where the boundary from one moment to the next is blurred. For the sake of clarity, they are outlined as individual moments in the following.

Problematization

As the name of this moment indicates, the objective here is to define a specific problem, a goal desired by the focal actor. When the problem is framed, the focal actor initiates the search for actor(s) relevant to the solution of the problem and explores how the problem affects these actors. By doing so, the focal actor gains some knowledge on how to approach and persuade the other actors to adopt his objective (Gherardi & Nicolini, 2005). Persuasion, in this context, includes the focal actor outlining general strategies in which the problem is addressed. Additionally, the focal actor attributes a recognizable interest to every actor, thereby making the focal actor indispensable. Through the process of actors accepting the attributed interests, they pass through a so-called *obligatory passage point (OPP)* and are then part of the network. An OPP is a situation or process defined by the focal actor and shared by the other actors in order to focus on fulfilling the established interests of the network (Sarker, et al. 2006).

Interessement

For our purposes this moment must be understood in a quite delicate way. *Interessement* originates from the word *interesse*, used in Medieval Latin, and means to 'be in between'[1]. When a focal actor identifies the interest of the other actors, it is likely that these actors are implicated in a different problematization engaged by a third-party actor with competitive interest. Thus, the focal actor builds devices to interest other actors: devices which can intersect the third-party

1 Source: Den Danske Ordbog (22-07-2013)

problematization and promote its own (Callon, 1986). The underlying presence of power is evident and eventually the other actors should be convinced that the interest defined by the focal actor is consistent with their own. Hereby the focal actor stabilizes the interest of the other actors and creates an alignment through which their interests harmonize. It is worth emphasizing that, although interests may be aligned, they are not necessarily identical (Sarker, et al. 2006).

Enrolment

In this moment, the creation of the actor-network takes shape. In *enrolment*, each actor is assigned a role to fulfill in the network: a role that must harmonize their interest. Usually, the definition of the role that each actor has to fulfill is done by negotiations in the network (Callon, 1986), often between the focal actor and each of the other actors. They test each other's strength and use their power to protect their interests. The outcome of a successful negotiation is the development of an *inscription*, which is the designer's perception of how the tool ought to be used. This use is often recorded in an artifact (Latour, 1979).

Here, the (usually fleeting) commitment made by the actors is stored in an artifact that functions as a shared memory, reminding the actors of their protected interest (Sarker, et al. 2006). Inscription is then treated as a *program of action* that specifies the activities in the network and the social roles of the actors (Holmström & Robey, 2005). In section 2.2.3, the notion of program will be outlined.

Mobilization

In the final moment of the translation process, the aim is to stabilize the network. Appointing a representative of each actor, referred to as *spokesperson*, achieves this. The spokesperson enables the accurate representation of its constituents by ensuring that their mutual interest is aligned (Callon, 1986).

Eventually, when the network is stabilized, the network will be perceived and act as one unified actor. This stabilization will gradually '*black-box*' the network, rendering its content institutionalized (Holmström & Robey, 2005). Still, whilst stability is something to be aspired to, it may never be fully achieved. (Czarniawska & Hernes, 2005).

Pitfalls of translation – betrayal

During the moments described above, an actor might fail to act as promised by the spokesperson. This occurs especially often during post-enrolment and is referred to as *betrayal* (Sarker, et al. 2006). This moment jeopardizes the process of translation, severing the actor from their definition, and so act in conflict with the previously agreed upon roles.

There are severable helpful explanations to be noted here. One is an actor's attraction to the surrounding network in the socio-technical context: the attraction to competing problematizations. Another is an insufficient process of interessment, where the stated interest of the betrayer is either merely superficial or inscribed in an unclear manner (Law, 1992). A third explanation lies in change of actors (i.e. managers) that take an active part in the translation process and thus are important for the stabilization of the network (Sarker, et al. 2006).

2.2.3 Program of action and anti-programs

As we learned earlier, an inscription includes a program of actions for the users in the network. The inscription defines parts to be fulfilled by every actor. The program is a set of instructions that are materialized or recorded into an artifact. We use the word artifact to underline that it can be almost anything. The artifact is therefore technologically neutral. It can take shape in a paper with words describing a sequence of steps to assemble a bike or a more mechanical kind of program, like a modern seatbelt system in a car (Latour, 1992). The goal of creating a program is to inscribe (or dictate) a certain behavior to the actors in the network, usually the behavior desired by the focal actor.

When an artifact is shaped with the intended program of actions and put into an artifact, it is born as a new actor. This actor then imposes its inscribed program of action onto its users. The creation of this new actor is referred to as *anthropomorphism*, the projection of a human behavior onto a nonhuman actor. Latour describes this (1992) as:

… Cold, technical object, one by nature impervious to any feeling.

(Latour B. , 1992, p. 160)

Anthropomorphism is a joint of two Greek words, *anthropo* and *morphos* that means "being human" and "having the shape of", respectively[2]. For our purposes, an anthropomorphic creature has three different characteristics. First, it is shaped by a human and is a construction of a human actor. Second, the human actor *delegates* a set of action to it, hereby substituting the human who previously performed the actions. Parts of the actions can be delegated to a human, others to a nonhuman. This depends on the nature of the action and the complexity it contains. Last, and most crucially, it shapes human action by *prescribing* a certain behavior in return (Latour, 1992). Prescription can be defined as the reaction by the human actors when interacting with a nonhuman actor. The reaction affects the human actors and can discriminate against some of them.

The inscribed program may not even succeed, as the actual use varies from the intended. Rather than following the artifacts' created program of action, the discriminated user may perform an altered version of the program in an unexpected manner. This deviant actor is said to perform an *anti-program* (Johnson, 1988).

Whether an anti-program occurs or not is primary up to the strength of the inscribed program. Some inscriptions are weak, meaning that the actions in the program are flexible and may be performed differently, whereas others may be strong and leave no room for alternative actions.

Yet this does not mean that one should always aim for a strong inscription, as the flexibility of the inscription varies, depending on the interest the actor pursues. The balance can be found by studying the anti-programs that appear and adapt the inscription to the context by developing a *re-inscription* of the program, which is an answer to the approached anti-program (Hanseth & Monteiro, 1998). Re-

[2] Source: (Dictionary.com) (23-07-2013)

inscription is the same as inscription, but seen as a feedback mechanism to cope with the conflicting demands that are reflected in the anti-programs (Latour, 1992;Akrich & Latour, 1992).

Prior to inscription or re-inscription, the actors that are intended to perform the program must be appropriately *pre-inscribed*. The pre-inscription of the actors should be understood as the skillset and knowledge-base of the actor, prior to being part of the technical script. (Latour, 1992). During *pre-inscription*, users must acquire knowledge of the socio-technical context and certain competencies needed prior to initiation of the program. For example, in Denmark, one must initially acquire a standard driving license prior to an application for the license to drive a truck. Another pertinent example is the fact that, in many parts of the western world, people know how to operate and drive a car, even before having driving lessons. In this way the actors within a network have a foundation on which they share and develop (Latour, 1992).
Regardless of the effort used in outlining the initial inscription, some degree of re-inscription has to occur, as the actors' understanding of the socio-technical context enhances over time. As a consequence, the associations between the actors are affected by change and consequently redefined. This process in which they are redefined is translation, as we have presented earlier (Hanseth & Monteiro, 1998).

Latour offers an especially enlightening exegesis on the terminology described in this section. In Latour's *Technology is society made durable* (1991), the case of European hotels is viewed from the perspective of the hotel management, as they want to ensure that the guests leave their keys at the reception when leaving the hotel for a tour. The management wanted to inscribe what they thought to be the desired behavior into the actor-network. The challenge is then to shape a suitable artifact containing a program of actions.
During the first attempt of a program, the management displayed a note next to the key: "please bring back your key". However, this inscription proved to be weak and there were still some guests who did not return the key, thereby introducing

an anti-program: continued possession of the key. Below, Latour illustrates the translation, which occurred in the actor-network (1991, p. 107); as a result of the guests' anti-programs, the hotel management introduces several programs until the anti-programs diminish.

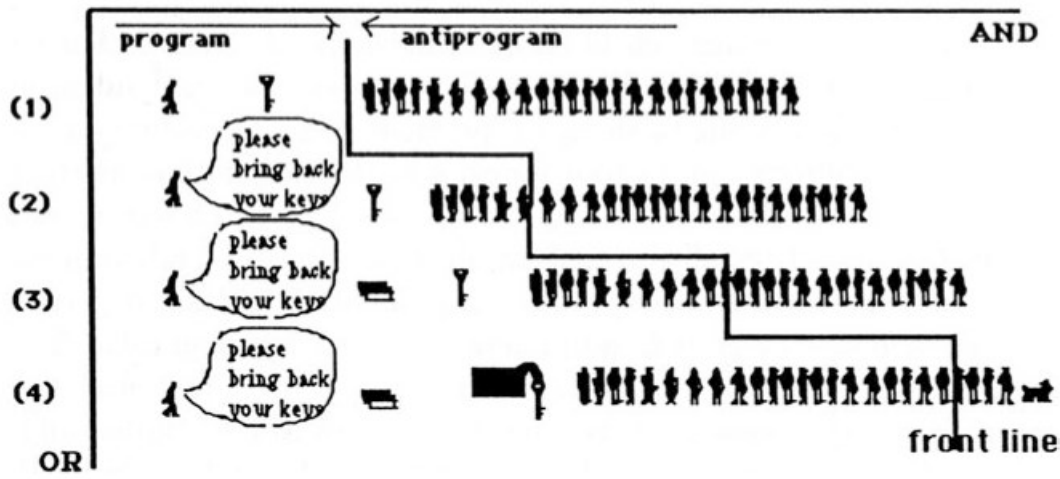


Figure 3: Illustration of the effectiveness of programs and anti-programs, within hotel guests, who are encouraged to leave their room keys when leaving the hotel. [3]

By trying and failing a few times, the management learned more about the socio-technical relationship they were engaging. As a result, they introduced a new artifact in the form of a relatively heavy metal attachment to the key. This proved to be the inscription that fulfilled their interest. The metal piece prescribed the desired behavior that forced almost every hotel guest to return their keys to the reception. In this instance, one could reasonably suggest that the hotel management delegated the action of returning the keys into a nonhuman actor, the metal piece.

2.2.4 Black boxing

Once the translation process has settled in the actor-network, its controversy is no longer noisy. The network is then stabilized leading to a state of "black-boxing".

[3] Source: Latour (1991)

The central premise of a ‘‘black-box’’ is that the content, and so the behavior, of a given technology need not be clear or explained. They may in fact be taken for granted; the only thing one needs to understand with regards to the technology are both the acting input and output of the system. The technology has reached a state where it has become institutionalized in the social context (Holmström & Robey, 2005).
The black-box is not a concept only used by ANT. Its origin is within information science and can be defined as follows:

> *… Opaque the inner complexity of technologies in order to focus on their function, input and outputs, without explaining the inner workings that* stand behind the technology.
>
> (Cressman, 2009)

In ANT, black-boxing is used as a simplification of complex entities. An actor-network can be defined as a network of simplified entities (Callon, 1987). An entity (or actor) can be defined as a member of a network and simultaneously be a network itself. For example a car can be considered a non-human actor in an actor-network and simultaneously be a network in and of itself - a relational interface of non-human actors such as wheels, doors, engine and so forth.
In a network several black-boxes can exist and they are highly dependent on one another for their own durability and their interrelated durability as a whole.

Black-boxing is a desirable state in which the actors no longer need to waste time and energy on deciphering the internal mechanisms of a technology its content, but instead accept it as given and focus solely on the input and output (Tatnall & Gilding, 1999). As Cressman (2009) explains, the objective is to make networks durable:

Opening the black box of technology leads the way to an investigation of the ways in which a variety of social aspects and technical elements are associated and come together as a durable whole, or black box.

(Cressman, 2009)

Eventually, when the network re-defines itself by delegating actions to a non-human actor or displacing an actor of the network, an urge for opening the black-box in order to understand and reconsider the content becomes present (Tatnall & Gilding, 1999). Networks always exist in a socio-technical environment, where competing networks try to enforce their interest. Maintaining black-boxes or simplifications then becomes important to ensure the continuing existence of the network, in one shape or another, which yields an iteration of the translation process.

2.3 Analysis strategy

In this study we want to investigate the actor-network of ICU influenza surveillance and analyze the network with the ANT terminology we have presented throughout this chapter. From an ANT perspective, our analysis answers the research question in a three-step analysis. The manner, in which the three analyses will be performed, is outlined in the following.

To understand how the actor-network in this study is created, the first part of the analysis will focus on the translation process that took place when SSI initiated the surveillance system. The process describes SSI as the focal actor as they are responsible for the influenza surveillance system in Denmark.
Initially, the first part of the analysis identifies the original group of actors and describes the four moments of translation that transformed the action nets into the current actor-network. The manner in which SSI framed their problem, aligned interest, enrolled actors and mobilized the network, will be outlined in this part. Following the four moments, we will further describe the changes that occurred in the network, and conclude with a discussion of instability as the

eventual outcome. To ease the description of the translation process, the actors within a network are simplified, for example; instead of describing how each actor in SSI contributed to the translation process, we simply refer to them in unified terms by using 'SSI'. We justify this act, by assuming that interests within the organization are aligned. In this way, we can use 'SSI' as a representative of the organization. The same method is applied for the Danish Regions.

In the second part of our analysis we study the networks of SSI and four of the five Danish Regions (Midtjylland did not participate). Analysis of these five networks provide an understanding of how the program is inscribed in each network. This includes the study of the non-human actors and the actions delegated to them. Further, we analyze the prescription of the non-human actors and observe whether this is performed as agreed upon in the translation process. The study of prescription yields an understanding of how the Danish Regions are affected by the responsibilities delegated to them and evaluates the strength of the inscription. This provides insights regarding any anti-programs that may occur amongst the selected regions and which issues derive from the anti-programs' presence. Finally, we search for the presence of black-boxes in the network and how these affect stability.

In the third analysis we draw some patterns from the first and second analysis and formulate some characteristics identified across the regions and SSI. These common characteristics are then formulated into issues that must be managed in order to stabilize the network.

We illustrates in Figure 4 in which parts the ANT concepts have been applied in this study:

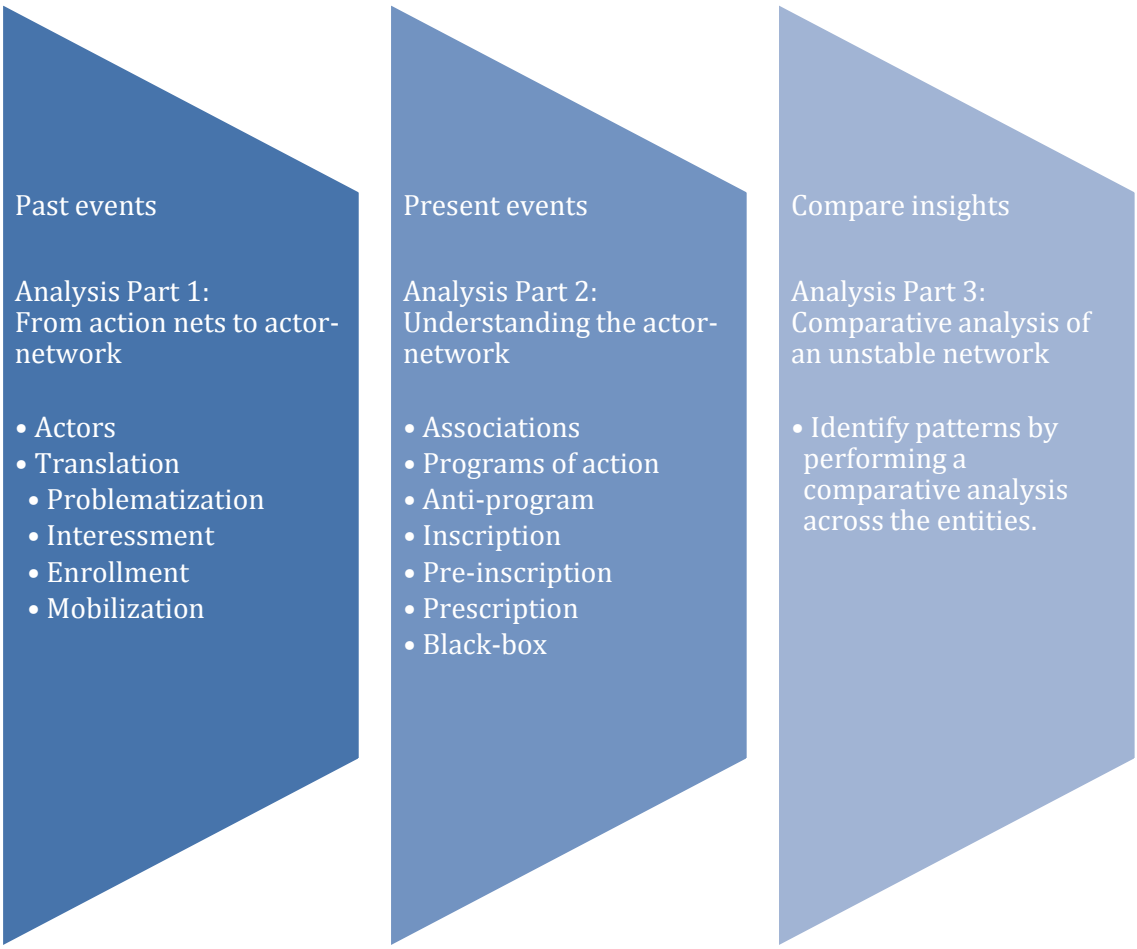


Figure 4: The application of ANT concepts in this thesis.

3. Research method

In this section, we illustrate our empirical approach in this study of the ICU influenza surveillance network.

Our designed research method can be divided into three phases. The first phase was to conduct brief exploratory research to determine the appropriate scope of our study. We present the elements of the data collection process (second phase) and how we gained access to SSI, exploring the scope and boundaries of the network and opening the black boxes of the regions. During this study we have had the opportunity to observe the employees within the department of infectious disease epidemiology within SSI. After completing the data collection, the third phase consisted of data coding. A matrix was developed, illustrated graphically, grouped by ANT concepts, which yielded five identifiable category systems.

3.1 Scientific discipline

The scientific discipline is vital for a study, as it defines a set of methods to apply when interacting with a specific context. The definition of this discipline must be aligned with the research question in order to discern the appropriate tools that will eventually contribute to answering the posed question.

The elements of network that we explore in this study are dominated by the interactions among people and between people and technology (or human and non-human actors in the network). To understand how these interactions are performed, we must orient ourselves with the specific social context in which such interactions can be found. It is in this social context, that the people make sense of each other and the technology by developing assumptions, expectations and ultimately knowledge. The developed perception of the technology is conceptualized by Orlikowski and Gash (1994) as *frames.* It is these frames, along with the understanding of the social world, which we want to study and understand.

In order to study and understand these frames, Orlikowski and Gash (1994) argue that they can only be described, and their significance appreciated, in the social

context in which the users and their use of technology can be found. This means that we must observe the users within SSI and the regions interacting with the technology and inquire into their frames and social world.

This can be facilitated by the use of interpretive social science as the scientific discipline in this study. Interpretive research focuses on how people interact and get along with each other as a means to create and maintain the social world (Neuman, 2006). The interpretive approach means that the applied data collection methods will consist of idiographic methods, as these will allow us to grasp the subjective perception of the people in SSI and the regions.
Here, we wish to question the people in SSI and the regions in order to learn about their social world and gain enough knowledge to give a detailed and illustrative representation of it (Neuman, 2006). Additionally, we choose to conduct detailed observations of the relevant people and their interaction with the technological artifacts.

3.2 Design of the research method

This section outlines the combination of methods we apply in our study. The ultimate objective of the methods used is to facilitate an answer to the primary and secondary questions entailed by our research. Before addressing these questions, it is of great importance to understand the context of the ICU influenza surveillance. For this reason, we performed exploratory research, which in turn decided the scope of the study.
A second phase of our research method consists of collecting sufficient data for the analysis, before moving to the last phase where we code the collected data and create a data foundation from which the research question is answered.

The below figure below illustrates the design of our research method. We now go through each of the phases and describe the decisions made and the structure of the method.

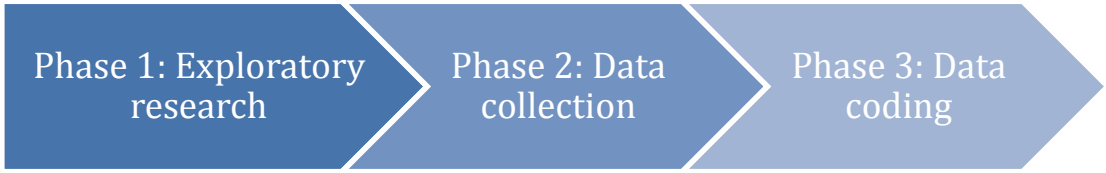


Figure 5: The three phases of the research method used to analyze the ICU influenza surveillance system.

The research method combines methodologies to triangulate the study with the subject of ICU influenza surveillance (Jick, 1979, p. 602). By mixing the methodologies, our study aims to generate greater confidence in its findings (Jick, 1979, p. 608).

3.2.1 Phase 1: Exploratory study

In the initial phase of this study, the overall focus was to establish a profound understanding of the organization, its objectives and the current challenges in relation to the ICU influenza surveillance. Preliminary exploratory research was used to help define the problem by engaging with the problem area in order to narrow down the research question.

Prior to any initial contact to SSI, we performed a minor study, using web sources, to identify problem domains which we found academically interesting, whilst simultaneously appealing to SSI's agenda. A part of this study was to determine the theoretical approach, as described in section 2.1, Literature Review. During this process our perception of SSI and their context was solely based on web-site descriptions, research publications and our own interpretations. This could lead to researcher bias, where our perception of the challenges could be based on a premature and invalid conclusion; hence, this must be managed.

In order to avoid being biased, we conducted two early meetings with SSI to identify present challenges. The first meeting was held with a medical superintendent in the department of Infectious Disease Epidemiology and held little in the way of an overriding structure. The choice of keeping the interview unstructured with no interview-guide gave the interviewee the opportunity to freely engage in conversing on topics and challenges that seemed contemporary (see Appendix E). Another positive effect from this approach was to capture the interest of the interviewee, increasing the involvement and commitment of the informant to continue with the project.

During our initial discussions with SSI, we learned the complexities of epidemic surveillance from a macro-level perspective. This contributed to the surveillance description found in section 4.4. The presentation ignited a discussion on the challenges of the surveillance system. Particular attention was paid to the fact that the surveillance of patients with influenza on ICUs involved processes across multiple organizations and systems.
SSI knew the information system was problematic and was therefore planning improvement initiatives. The ICU surveillance system is quite comprehensive and complicated, so we needed to explore the problem area to determine our research question and scope, which set the direction for the remainder of the research.

After our initial meeting we developed a project description, based on our understanding of our findings.[4] Along with the project description was a brief description of our focus and research approach. We needed SSI to verify that our understanding of the problem area was in fact valid, before we could continue. Furthermore, we wanted to ensure that we could interview participants of the influenza surveillance system. After getting the project approved by SSI, we arranged our next interview.

[4] See Appendix C

The second interview was conducted with an epidemiology researcher, also from the department of Infectious Disease Epidemiology. Our purpose for this interview was to validate our perceived understanding, which we gained from the first interview. Without presenting the challenges mentioned in the first interview, and with the purpose of remaining objective, we held a meeting with the interviewee on present challenges in the ICU influenza surveillance system. The interviewee presented a similar understanding by pointing out the same challenges that we had observed at the first meeting.

In this fashion, we did not solely focus on eliminating a potential researcher bias, but outlined additional challenges that are shared by at least two different actors in SSI, validating the collected data on a minor scale. As we held the following interviews it soon became evident that the entire department as a whole shared views on the identified challenges.

The exploratory research played a defining role in choosing the theory for the study. Our understanding of the context grew after each meeting and was evaluated in relation to our academic field. Choosing a socio-technical approach was based on the interconnection of the people and the technology in the workplaces, as well as the presence of multiple black boxes in the network.

3.2.2 Phase 2: Data Collection

During our exploratory research we realized the nature of this study and choose to use idiographic methods for our primary data collection. Idiographic methods such as interviews, observations and informal conversations gave us the opportunity to interact with both subject and stakeholders. For this purpose we conducted a series of semi-structured interviews, supplemented by other qualitative data collection methods.

In the following section, we describe how data for this study was collected using idiographic methods. The approach reflects our initial exploratory research and our subsequent immersion in the problem area

Access to the problem domain

The research scope of this field study yields the need for accessing both SSI and the Danish Regions. This is mainly due to the interoperability between the two organizations, found in the current influenza surveillance of ICU patients.

We utilized our contacts at SSI to communicate with the regional contacts. We prepared an e-mail, which described our research scope and why we needed their input.[5] Our expectation was to get a stronger commitment by the regional contacts, because a SSI contact introduced us.

The e-mail which the SSI contact forwarded contained a brief introduction of our academic background and a short questionnaire. There were two designed objectives of the questionnaire: to gather information on the background of the regional contacts and to focus on the problem of the ICU influenza surveillance. From our initial meetings with SSI, we had learned that the regional contacts had expressed minor dissatisfaction with the current ICU surveillance system. We put focus on the problem, by asking questions about the process of the system. Their responses were somewhat valuable, but our objective was for the respondent to acknowledge the problem area, so that they would participate in an interview.

After our initial inquiry, we did not receive an answer from three of the five regions. SSI decided to escalate the inquiry resulting in a senior employee an additional attempt to get the regions to enter into dialogue. Hereafter the regions responded one by one, except for Region Midtjylland. We discussed this with SSI and, based on their lack of interest, decided to conduct the study without Region Midtjylland.

Interviews

After determining on the research focus we wanted to gain a deeper understanding of the system and the interconnection between the actors, not only

[5] See Appendix D

in SSI but also across the Danish Regions. We wanted to open the black-boxes in the actor-network.

A second, semi-structured interview with the epidemiology researcher was conducted, the aim of the interview was to get detailed descriptions of the current network and verify our interpretation of the network at that time. Therefore, prior to the meeting, we prepared an illustration, outlining our initial perception of the network, for the epidemiologist to review. We used this illustration to develop our understanding of the actor-network and evolved it throughout the data collection phase.

Additionally, we wanted to be introduced to the non-human actors such as IT systems, workbooks, spreadsheets, web pages etc. However, for this study we needed more than just an introduction to the non-human actors. Hence, we observed the researcher while she used the systems in order to capture the interaction between the human and the non-human actors. During our observations, we questioned the scientist whenever an action seemed to be implicit or not fully intelligible from our perspective.

With the aid of the SSI, we arranged a meeting with the four participating regions in the study. We chose to conduct an interview, as this method gives the opportunity for posing clarifying questions when needed (Andersen, 2008). This contributes to our understanding of the social context these regions operate in. Being two researchers, we were both present in the interviews and contributed to the dialog. We conducted all the interviews on location with the interviewee to be able to make complementary observations of their environment. The short questionnaire used in the introduction mail to the regional contacts had given us some information on each of the interviewee[6]. We discussed whether to develop questions for the interview script based on the respondents' answers. However, we decided to apply identical interview guides for all four interviews to ensure the comparability of answers in the data-coding process[7].

[6] See Appendix D

[7] See Appendix E

Each interview started with the interviewee explaining the background of their position. Thereafter they were asked to describe their internal process in detail and what other systems or persons that may have been included. In two regions we had the opportunity to observe while the regional contact conducted the ICU influenza reporting.

Besides the introductory questions, the interview guide was based on the theoretical concepts of ANT used in this study. The interview guide must operationalize these concepts and facilitate the transformation of these concepts into empirical evident data. In the case of ANT, the concepts are abstract and must be operationalized delicately. Below, we present a few examples of the concepts concealed in questions that must be intelligible for individuals not familiar to ANT. For illustrative purposes, we will present how the notions of program and anti-program were operationalized:

Which guidelines have been predefined by SSI in relation to the reporting of data?

The above question is posed to address the notion of program in ANT. Here we ask the informant whether she or he knows about a predefined program by SSI.

How do you use these guidelines? In 'practical' terms.

This question is defined very broadly and will initiate a dialog where the performance of the program can be described by the informant. This will reveal how the regions carry out the task of gathering the data from the ICUs

At some point, did you have the need to overrule the guidelines?

This last example will indicate whether the region performs any anti-programs.

We must stress, that these questions are intentionally broad, formulated with the aim of giving us the benefit of doing deep into a subject as the dialog advances. The full interview guide can be seen in Appendix E. The questions in the interview

guide structured in various section to provide an overview throughout the interview.

Observations

Besides carrying out observation while visiting the regions, we spent the last two months of the study at SSI's premises, where we had an office at the department of Infectious Disease Epidemiology. Having an office on location allowed us to carry out continuous observations and clarify details as we analyzed the collected data. We became involved with the organization and attended various meetings and presentations. Not all of these observations were used directly in this study, however these meetings supplemented our understanding of how the department operates. We specifically used qualitative observations that were conducted in the field, as this provides the most accurate and pure understanding of the context (Andersen, 2008).

We were introduced to the department at a weekly meeting, attended by all the employees of the department. Here we shortly presented our academic background and the reason for our presence. The following week we conducted a longer presentation, where we presented our preliminary findings and theoretical perspective. We decided to briefly present Actor-network theory and then continue to present an updated illustration of our interpretations of the network. This was validated and discussed by all of the attendees and this helped us to correct any misinterpretations.

Informal conversations at the coffee machine or in the hallways were also valuable, as the employees were asking about our research and suggesting articles to include and persons to contact. We had many of these conversations, and whenever we had a longer discussion, we made an effort to write notes of that conversation (see Appendix B)

After the conclusion of the project, we have arranged to do a final presentation for the department on our analysis, findings and recommendations.

During our data collection within the Danish Regions, we were invited to an internal meeting, where future improvements of the ICU influenza surveillance system were discussed. The attendees were two epidemiologists and a medical superintendent. The focus was on how to include other systems and databases to optimize the ICU influenza surveillance. Relevant health care information systems were considered and whether integrating these would increase the value or decrease the workload.

We were primarily observers at the meeting, however we were interested in learning their reasons for changing the current system. Greater knowledge of the health care information systems and registers also helped provide appropriate recommendations in chapter 8. As observers, we kept an ANT perspective of SSI's discussions on delegating non-human actors in ICU influenza surveillance network. This led us to investigating the potential systems to use in a future arrangement of the network. However, we acknowledged that these were SSI's ideas, so we focused on completing the data coding and analysis without being biased by SSI's ambitions.

Secondary data

To study the subject of ICU influenza surveillance, we had to understand the design of global and national epidemic surveillance. Reports by WHO, SSI and Danish Emergency Management Agency provided a holistic overview of how pandemic contingency plans were managed and prioritized by these organization units. From these reports, we could describe how information systems and databases combine to in the surveillance of pandemics.

Studies published by researchers at the department for Infectious Disease Epidemiology specified in detail how the ICU influenza surveillance was operated and how it had been improved over time. Although the concentration of the studies were on epidemical results, then we focused on the system descriptions, which were valuable in assessing the non-human actors of the actor-network.

Secondary data was also used to supplement the primary data and observations. Here, we used observations, interviews and documents to triangulate our understanding of the program.
The document describing the standard operating procedures of the epidemiologist at SSI was used to accurately describe how she interacted with the non-human actors (see Appendix A). Again, this was also confirmed by our observations during an interview, however the document revealed certain considerations which we otherwise would not have observed.

Finally, we had access to the Excel worksheet and the weekly ICU report: two focal non-human actors in the actor-network of this study. Taking a closer look at these actors was very important, as we could study them in their purest form, without any interpretation of respondents describing them (Dahler-Larsen, 2002). We primary used these to documents to understand their contents and the degree of their complexity. This understanding was also beneficial when the respondents commented on these document. Here, we could relate much better to their opinions.

3.2.3 Phase 3: Coding collected data

The coding phase can be divided into several activities. The first were transcribing the interviews and structuring the statements from our primary data collection into a matrix and an illustration (Andersen, 2008). These displays provide a systematic overview of the dataset (Dahler-Larsen, 2002). Later, the displays were analyzed for patterns across these statements.

Dahler-Larsen has defined three rules, in which to follow to increase the validity of qualitative data coding (Dahler-Larsen, 2002). The authenticity, inclusion and transparency rules have all been taken into consideration, when coding the collected qualitative data.
After the conclusion of our primary data collection, we initiated the data coding. All of the interviews were recorded, so that we could transcribe the dialogue very accurately. Statements were directly used from the interview transcription in the

coding to fulfill the requirement of the authenticity rule (Dahler-Larsen, 2002). We decided not to translate the statements before coding, to emphasize on working with the data in its purest form.

The transcriptions were reviewed for statements that were associated with the operationalized theory. These statements highlighted and later copied into a matrix spreadsheet, which is illustrated below.

	A	B	C	D	E	F
1		**Statens Serum Institut**	**Region Hovedstaden**	**Region Sjælland**	**Region Syddanmark**	**Region Nordjylland**
2	**Programs**	Sophie: Tanken er så at vi bruger det her, i stedet for at kopiere til en anden database. Som i kan se, er der noget galt med min excel fil, men måske det også er fordi der ikke er noget. Men halvdelen inde i sæsonen, kunne jeg ikke bruge dette her længere. Tanken var, at de bruger det her - men det kunne være endnu bedre hvis det blev elektronisk.	Marit: Og så har AMK lægen også den funktion at være den koordinerende læge, så alt hvad der vedrører koordinering mellem os og de øvrige hospitaler på regionsniveau, går via vores AMK funktion. Så vi har ligesom valgt at sige, at det er den måde vi arbejder på. Det gør også at hospitaler, direktioner og afdelinger er klar på den arbejdsdeling vi har. De kender AMK funktionen her, så det gør det mere tydeligt.	MSN: Vi får dem begge, ja. De (red. SSI) sender en gang om ugen, et resume af hvad der er blevet registreret den foregående uge, af influenza tilfælde. Så sender vi det videre til afdelingerne (red. de intensive afdelinger) for orientering.	Martin: Vi er egenlig kommet ind i en rutine. Mandag kl. 12 skriver jeg en rykker til dem(red, intensivafdelinger) som ikke har indberettet endnu, det gør jeg igen tirsdag morgen. Her har de været forholdsvis flinke, den sidste fik jeg 7.34 imorges - det var fordi indberetteren har haft fri igår.	Mette: Under en time. Så skal jeg plotte det ind i arket og sende det via det link til SSI. Det tager ikke lang tid.
3		Sophie: Når intensivafdelingerne indberetter patienter jeg ikke kan finde i miba, så sender jeg en email til mine kontaktpersoner.	Nanna: AMK lægen inde på vagtcentralen sender en mail ud til alle intensivafdelinger og beder dem om at indtaste antal af patienter på afdelingen med influenza og alle de andre informationer der er i skemaet. Så hvis intensivafdelingerne har mulighed eller overskud til det, så giver de svar inden for den tidsramme der er.		Martin: Så sender de ovre fra SSI hver uge en rapport omkring de her status. Når jeg modtager den, så videresender jeg også til min mailliste, så de også får hvordan det ser ud på landsplan. Det jeg sender ud, er kun hvordan det ser ud på regionalplan.	
4		Sophie: Det sker engang imellem at patienter bliver indberettet som jeg ikke kan finde i MiBA eller som ikke har prøvesvar på influenza i MiBA. Så spørger jeg dem.	Nanna: Men ja, AMK lægen får informationerne fra intensivafdelingerne, samler det som sagt i det her skema, rykker intensivafdelingerne som ikke har indleveret information hvis det er nødvendigt. Så sender han det samlede dokument til mig, hvor jeg som sagt, kvalitetssikrer det, ligger det over i det rette skema, hvis det ikke er det i forvejen, og uploader det til Seruminstituttet.			
5		SG: Jeg spørger Jane hver uge om udtræk af data over dødelighed. Så hvis det kan køre mere automatisk?				
6		KM: Det tror jeg bestemt det er. Under pandimien udvekslet regionerne og afdelingerne patienter med hinanden. Og også på fra udlandet. Sverige f.eks. Så				

Figure 6: Matrix of statements from semi-structured interviews using the collaborative tool Google Spreadsheets.

The y-axis of the matrix described the theoretical concepts applied in this study (as described in section 2.2 Principles of Actor-Network Theory) and the x-axis distinguished between the different respondents. In the matrix, we see some empty space that indicated some respondents have referred to a subject relatively more than other respondents. This tendency of missing or overlapping comments of certain subject characterizes the more open interviews (Andersen, 2008).

The matrix provided the structure in the data coding process, which was the foundation for mapping the statements graphically in boxes (as shown in Figure 8), each box contains a statement, which is color coded for Region. Notice that the full illustration of the data coding is located in the attached CD (see Appendix A).

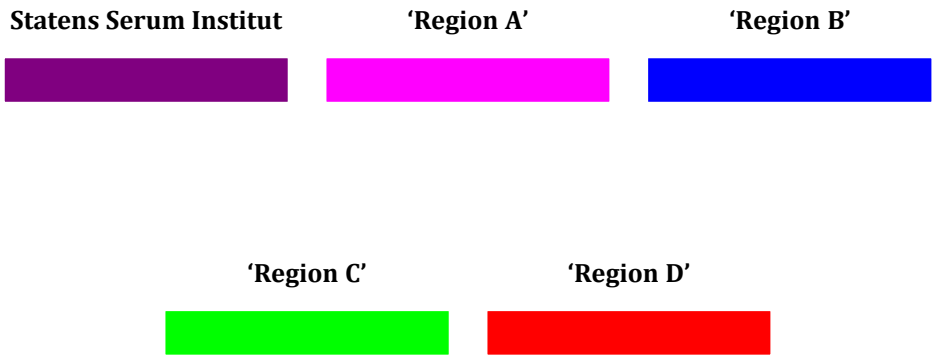


Figure 7: Legend of colors used in illustrating the coded primary data

All statement boxes were organized by theoretical concept identical to the matrix display. The first version (Figure 8) of the illustration is a graphical representation of the matrix, where the x-axis was substituted for colors and y-axis was abandoned.

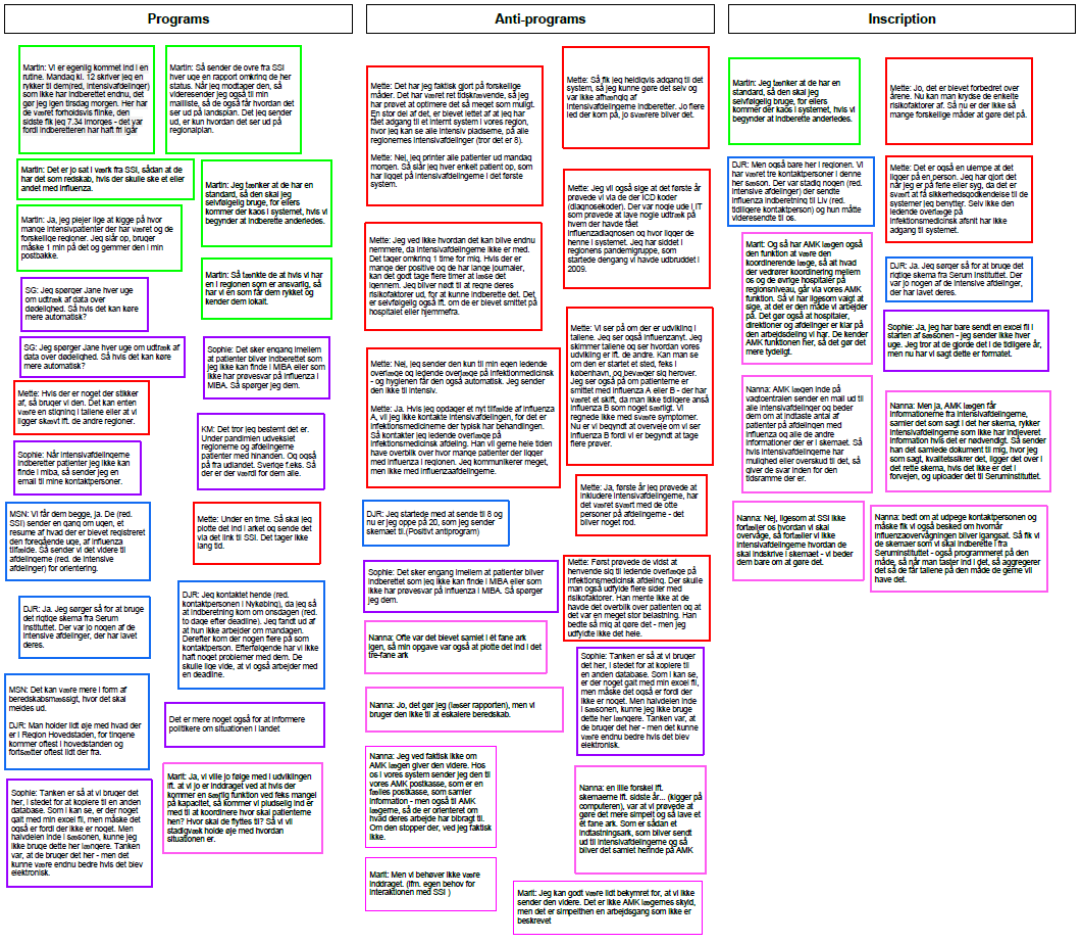


Figure 8: Results of preliminary data coding organized by ANT terminology (the full illustration in Appendix A)

Figure 8 shows how the statements were placed and organized by theoretical concept. The concepts are not mutually exclusive in the graphical representation, so a few of the statements were placed in more than on column.[8]

With all the statements fairly structured, then we started analyzing for category systems by grouping statements together. The objective of the first overview was to create a better overview and validate statements within each category system. It resulted in seven category systems, which were later combined into five and they were all given a working title. A few statements did not fit into any theme and were not taken into consideration.

[8] Example: when a statement describes both a black box and an anti-program.

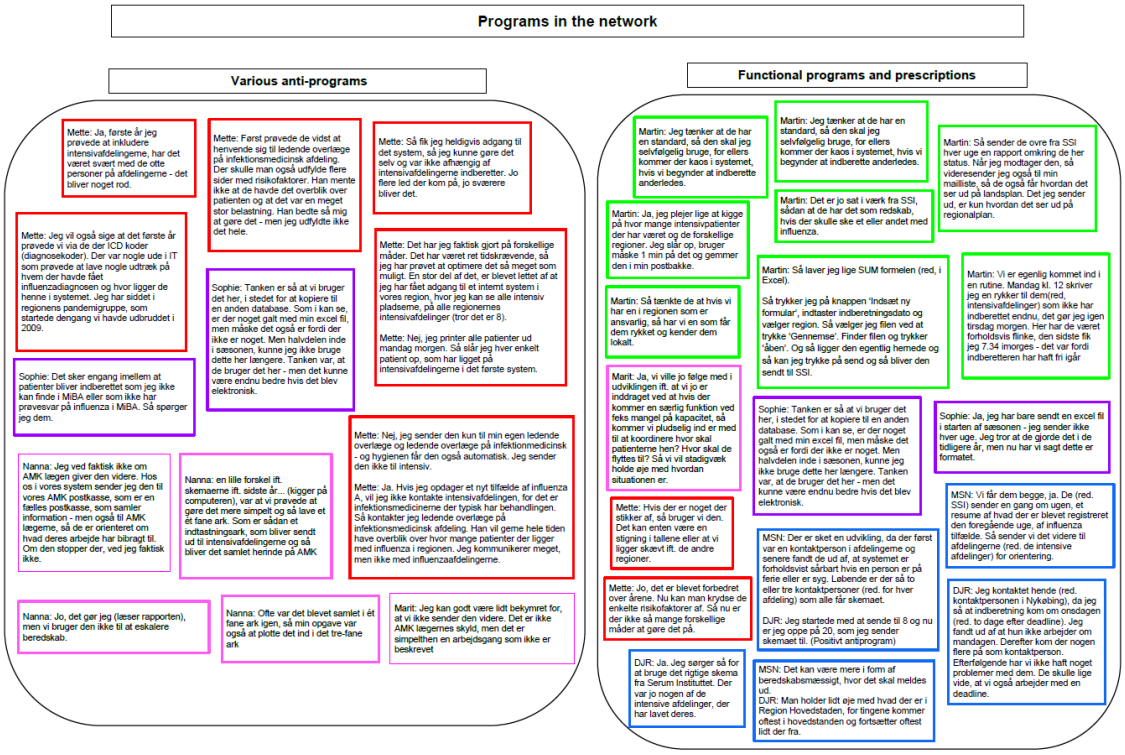


Figure 9: Grouping sub-category systems within each category system

The same approach in grouping was then used again, but this time scoped within each of the identified category system. We grouped the statements with similar meaning or theme, to illustrate the different aspects shown by the comments.

Figure 10 illustrates a sub-category system, where there statements from different regions grouped together. In this segment, besides two boxes from SSI, we only see red and pink boxes which indicate that only two regions have statements within this sub-category. Grouping of the statements are based on the occurrence of anti-programs within the program of gathering ICU data from the regions. All statements from the two interviews, which concern this aspect, are included in this sub-category.

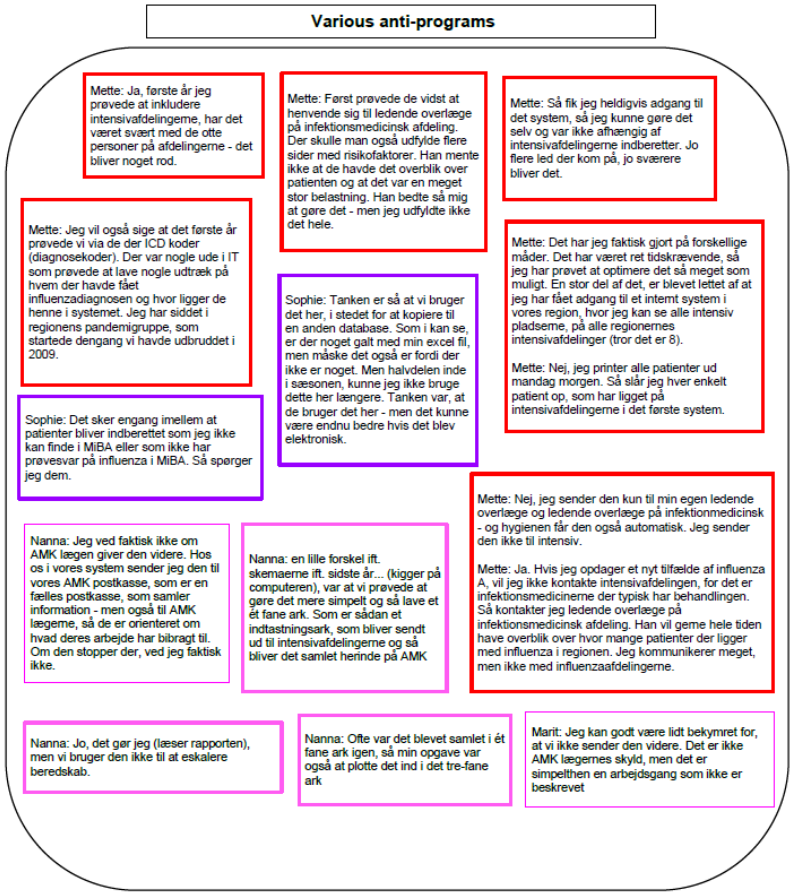


Figure 10: Example of color-coded statements that show which regions that had statements within this sub-category system.

We now give an example of two statements from these interviews, to justify their inclusion.

Fortunately, I was granted access to the system [a regional system], so I could do it myself and was no longer dependent on the reports from the ICUs. The more links present, there more complex it becomes.

Molecular biologist, 'Region D'

A slight difference in relation to the forms from last year was that we tried to make it simpler in a one-pane sheet. It is a form, which is sent to intensive care units, and so it all comes together here at AMK.

Emergency response consultant, 'Region A'

While both statements do not describe an identical behavior, they concern a developed anti-program of the region in their process of gathering data.

Our observations and informal discussions we had when working at SSI' office are not included in the display. These data were collected after finishing the data coding process, but we have used the subsequent data collection to clarify and supplement these statements. We have documented our notes from the observations in Appendix B.

By describing the method in coding the collected data, we strive to comply with the transparency rule in describing the sorting and processing of the displays (Dahler-Larsen, 2002).

4. Case description

SSI is one of the largest research institutions in the Danish health care sector. It is a public enterprise under the Danish Ministry of Health, whose main task is to secure preparedness towards infectious diseases and congenital disorders.

An area of infectious disease preparedness is the surveillance of epidemic outbreaks (Statens Serum Institut, 2012). Epidemic outbreaks take different forms and have different effects on the population. Smaller outbreaks within a small number of persons can happen from food poisoning or water pollution. SSI carries out an investigation of the source of the outbreak, in order to limit the number of people that contract an infection. Recurrent epidemic outbreaks, such as the influenza virus, are monitored and its severity is carefully analyzed. Whenever an influenza outbreak occurs, SSI is required to give advice to the general public, healthcare professionals, politicians and other stakeholders regarding the severity of the epidemic, as well as the potential and realistic threats it poses (Statens Serum Institut, 2012). The objective of epidemic surveillance and preparedness is for SSI to reduce the social and human costs of epidemics (Sundhedsstyrelsen, 2013).

The department for infectious disease epidemiology carries out the surveillance of infectious diseases. As epidemics occur, the department provides counseling for physicians and the Danish health care system (Statens Serum Institut, 2013). SSI administers the information system to provide valuable data on hospitalizations and registered incidents by medical on-call service and general practitioners. In addition to the counseling of health care professionals, the department does research on the development of epidemics and determines the effectiveness of vaccinations (Bragstad, et al., 2013), report on surveillance information systems (Gubbels, et al., 2013) and the burden of the influenza pandemics (Mølbak, et al., 2011).

4.1 Prevention and control cycle

The SSI's control of infectious diseases is organized in a cycle, where outbreaks are continuously being closely monitored and fought against. Figure 11 illustrates the cycle.

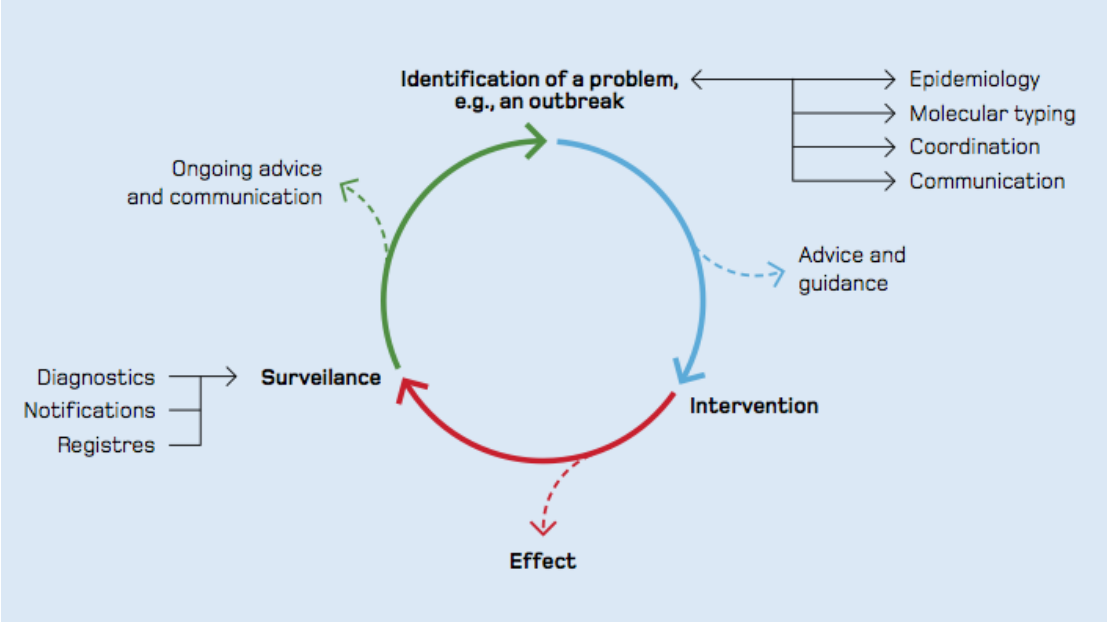


Figure 11: Control and prevention cycle organized by SSI. [9]

As outbreaks are being identified, SSI is responsible for providing advice and guidance for the general public, the public press and the Danish health care system. This is intended to lead to an intervention, which should match the severity of the outbreak. Effects of the intervention are measured by the surveillance activity within the cycle.

The following three sections describe each phase of the cycle in detail. The surveillance cycle is a general methodology used in epidemiology by SSI and is similarly used within multiple areas of surveillance. The scope of this study, is the influenza surveillance of patients hospitalized at ICUs, therefore the following description is limited to fall within this scope.

[9] Source: Statens Serum Institut, 2012 (31-07-2013)

4.2 Identification of a problem

An outbreak can be identified via different channels within the department for infectious disease epidemiology of SSI. The most important source of identification is the national surveillance network, which consists of several information systems which create a holistic overview for SSI. Once the threat has been identified in Denmark, then contingency programs can be executed either regionally or nationally. In addition to national identification, SSI collaborates with other countries to prepare for any potential pandemics or outbreaks.

Globalization has changed how epidemics are treated, as people, goods and items cross borders often, enabling infectious diseases to spread rapidly. The World Health Organization (WHO) administers the Global Influenza Programme, which provides strategic guidance and coordination of epidemics on a global scale.[10] This program relies on the willing participation of countries to report on their influenza surveillance data and findings. In return, the member countries gain access to data and guidance on vaccinations and global influenza trends, to allow for better preparation for upcoming epidemics.

[10] Source: World Health Organization (02-08-2013)

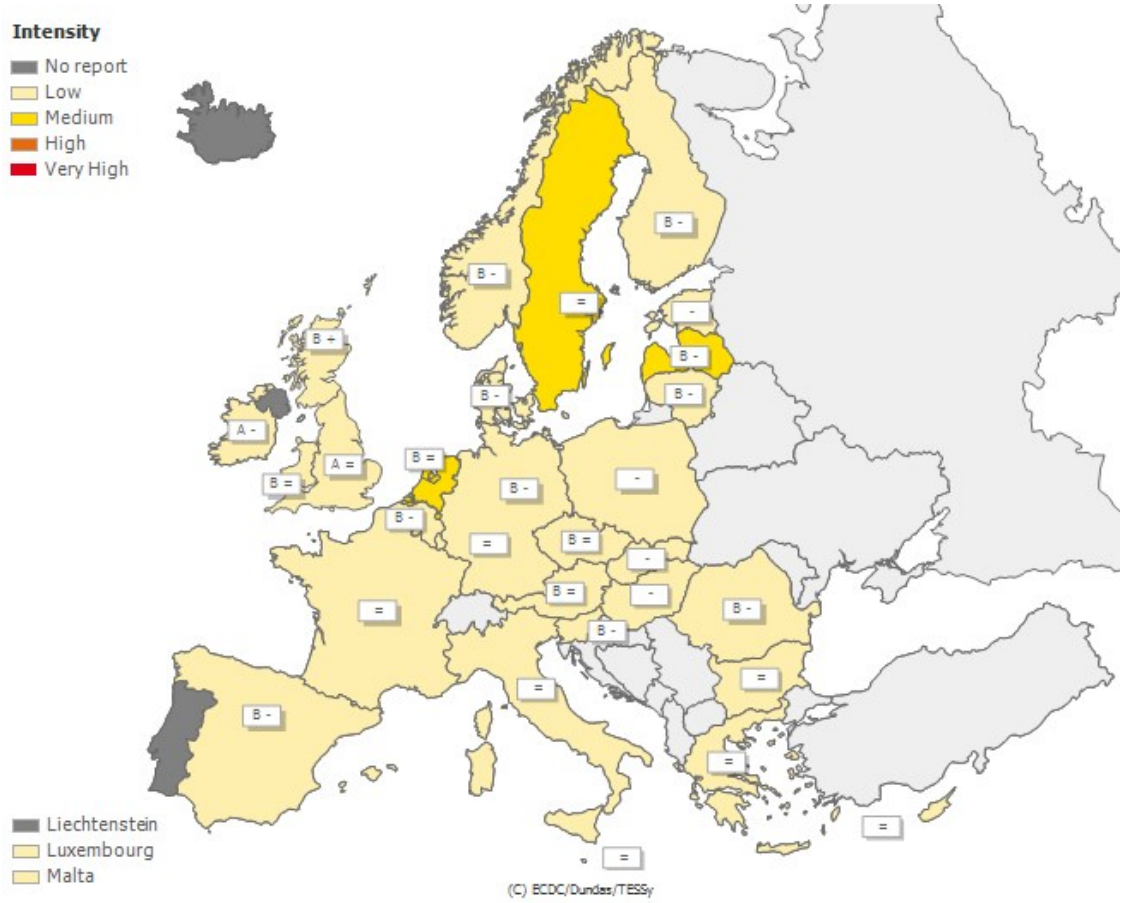


Figure 12: Map of Europe which illustrates the intensity of influenza in European countries, who are members of ECDC

The European Centre for Disease Prevention and Control (ECDC) is similar to the Global Influenza Program, but focuses on influenza surveillance in the European Union[11]. Data from the member countries is collected through the European Surveillance System, which is then analyzed on a weekly basis by the ECDC. The result of the analysis is published in the WISO report[12] and provides an opportunity to better assess the severity of influenza throughout Europe. One example of the result of their analysis is illustrated in Figure 12, where a higher amount of identified influenza cases results in an increased intensity. For SSI, this will give an overview of the severity in neighboring countries, however,

[11] Source: The European Centre of Disease Prevention and Control (27-07-2013)

[12] Source: The European Centre of Disease Prevention and Control (31-07-2013)

differences in reporting methods in the countries makes the assessment of the severity troublesome.

4.3 Intervention

Interventions during influenza epidemics are the precautionary vaccinations of persons within specific risk groups and the ongoing communication between the public and health care professionals. During pandemics it is important to assess the vaccine effectiveness (Sundhedsstyrelsen, 2013).

Vaccinations may seem like a cheap and efficient intervention, however, a recent study by SSI has shown lower vaccine effectiveness than expected in the 2012/2013 season (Bragstad, et al., 2013, pp. 15-16). Many countries had similar reports of low effectiveness of influenza vaccines in the population. [13]

Vaccinating the population is also not without risks. In Sweden, Finland and Iceland, there have been issues with vaccinations of H1N1, which have had an unexpected side effect on some children. A four times greater risk of narcolepsy was reported for vaccinated children (World Health Organization, 2011). Persons in high-risk groups are offered free vaccinations in Denmark, as severe cases of influenza can be dangerous for persons in these groups. As the virus constantly changes, the contents of the yearly vaccination needs to change from year to year, therefore these persons need to get a new vaccination every year (Danske Lægers Vaccinations Service, n.d.).

The intervention through communication is two-fold as there are two major target-groups which need information on the current state of influenza. The public is one target group, which receives information through the media and the *Influenza-nyt* newsletter.

[13] Appendix B - Notes from observations

The aim is not only to measure trends and patterns of illness, but also to control rumors and to reassure the population and decision makers that the society can deal with the epidemic with an acceptable level of harm. Indeed, information sharing is one of the important key concepts in crisis management.

(Mølbak, et al., 2011, p. B67)

Medical professionals and the Danish Regions, which are responsible for hospitals, also need to receive detailed information on the current spread of influenza. An influenza epidemic puts pressure on general practitioners, medical on-call doctors and hospitals, so therefore they need to be informed about the severity and risk factors associated with this year's influenza mutation (Sundhedsstyrelsen, 2006).

Statens Serum Institut responded to the 2009/2010 influenza pandemic with an enhancement of the surveillance system, which was in accordance with the Danish pandemic plan (Mølbak, et al., 2011). A part of this plan was to begin ICU influenza surveillance. Determining planning assumptions for interventions prior to pandemics is difficult, so countries often do extra interventions to be on the safe side. SSI's assumptions concerning the 2009/2010 influenza pandemic did not match the estimated impact on the population (Mølbak, et al., 2011). An example of the discrepancy is the expected clinical attack rate, which was assumed to be up to 30% of the population. This would be equivalent to 1.65 million people, however the actual clinical attack rate was only 5%, which means that only 274,000 were infected (Mølbak, et al., 2011). An evaluation carried out by The Worlds Health Organization (WHO) confirms that other countries had similar difficulties determining the impact and risk potential of epidemics (World Health Organization, 2012).

4.4 Surveillance

The department of infectious disease epidemiology uses multiple information systems for their surveillance of influenza. Each system provides different scope

and detail on the current state of the virus in the population. The entire system can be illustrated as a pyramid, as seen below.

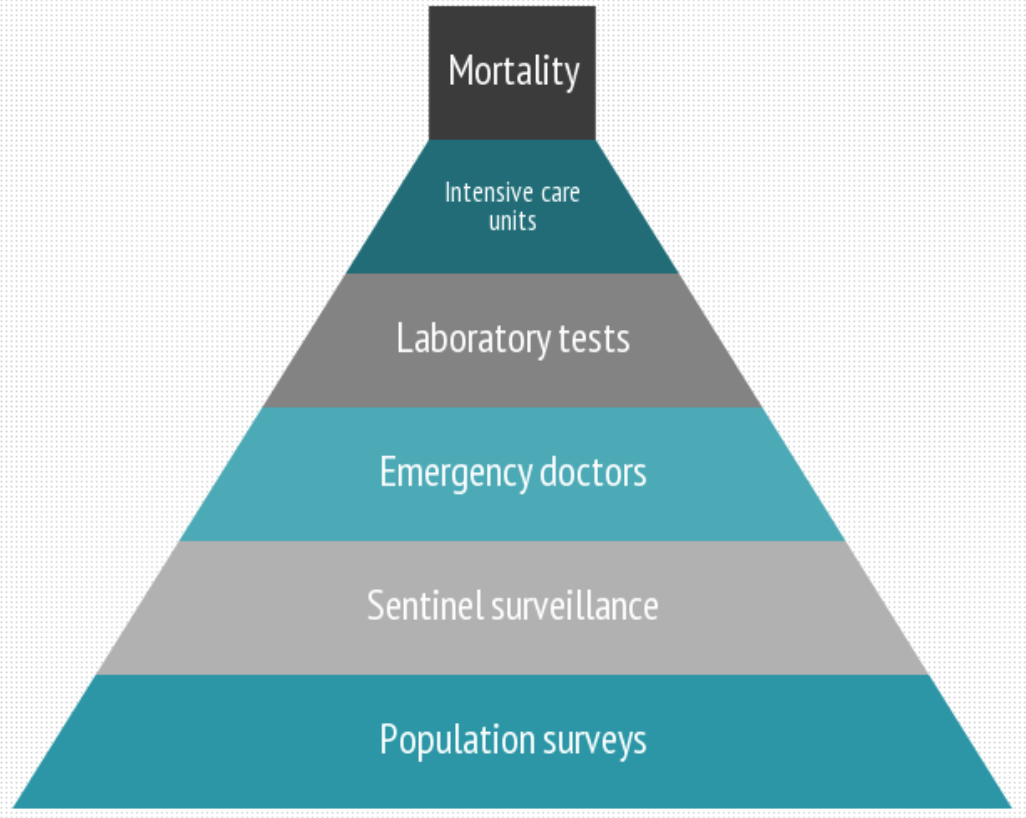


Figure 13: Overview of levels of infection surveillance used by Statens Serum Institut. [14]

Starting from the top of the pyramid, the number of persons included within each level increases in lower levels. In contrast, the specificity and details of the influenza cases decrease with lower levels. In the levels below "Laboratory tests", SSI monitors influenza-like symptoms, so cases are not laboratory confirmed cases.

SSI cannot consider only one level in isolation, to accurately assess the current burden of influenza. All levels of the pyramid add their aspect to the complete picture of the spread, burden and severity of an epidemic.

[14] Source: Sundhedsstyrelsen (2013)

The following sections expand on the levels of the pyramid and details the systems are in use to provide data on each level.

4.4.1 Level 1: Mortality

The top surveillance level tracks the mortality of the population, as the mortality rise during influenza epidemics. SSI continuously monitors fatality developments and whether they exceed the expected fatality rate (Sundhedsstyrelsen, 2013). The all-cause mortality as well as influenza-like illness attributable mortality is monitored on a weekly basis (Nielsen et al., 2011). SSI also coordinates the mortality monitoring for Europe (Mazick, et al., 2012).

Data from the Danish Central Personal Register (CPR) is used in assessing the development on mortality for the entire population and with the possibility of filtering for specific age segments. Future developments of CPR will allow for researchers and epidemiologists to see the determined cause of death for persons who die at a hospital.

4.4.2 Level 2: Intensive care units

Intensive care units (ICU) are responsible for treating patients with most severe and life-threatening illnesses or injuries. The surveillance of these patients is to determine severe cases of influenza and what risk factors are associated with these cases.

Since 2009, the ICUs have reported the number of patients hospitalized in an ICU with a laboratory confirmed influenza infection every week. For every patient the ICU reports case based details on the details of the treatment given. This report has numerous details, such as the date of hospitalization, CPR number and whether the patient has other risk factors or diseases and influenza type (Sundhedsstyrelsen, 2013).

Each Danish region has an assigned contact person, who is responsible of collecting the reports from the ICUs in their respective regions, combine the reports and send the aggregated report to SSI.

After the contact person receives the reports from the ICUs, the contents of those reports need to be transformed into a specific format, defined by SSI in the beginning of the reporting season. It is a manual process, where the contact person receives the Excel reports on e-mail, opens each report and copies or types the contents to a master Excel file. As this master file contains CPR numbers, it is not allowed for the regional contact to e-mail the file. Instead, after all contents have been copied, the file is uploaded through an online tool called Capevo.

Upon receipt by the SSI the data is manually collated and linked to other registers for additional information (vaccination register for the vaccination status, CPR register for the vital status and the Danish microbiology database (MiBA) for additional details on the laboratory tests).

4.4.3 Level 3: Laboratory tests

The Danish microbiology database (MiBA) is a result of engagement from SSI and the Danish microbiological laboratories in a project aimed to structure the distribution of test results by digitalizing and creating a national database for all microbiological test results.

To determine whether a patient has been infected with the influenza virus, SSI uses MiBA. A sample from the patient is sent to one of the 13 clinical microbiology laboratories in Denmark. The results are then sent to the practitioner or hospital requesting the sample and a copy is sent to MiBA. It is required for all of the Danish microbiology laboratories to report their results to MiBA.

Figure 14: Screenshot for MiBA database website. [15]

MiBa benefits from more valid and faster data, which gives a better basis for research and statistic reporting. The metadata in MiBA is not created for the purpose of influenza surveillance, but is focused towards the clinical professionals. The lack of a unified taxonomy or structure when describing the test results creates complexity for SSI. Influenza test results are reported in a text string, which makes it harder for use aggregated statistical analyzes.

SSI has initiated a project, called EPI-MiBa, to improve the output from MiBA. The system dissects the relevant fields, which are used for epidemic studies. SSI analysts are developing and refining the software to standardize the data fields. The data from EPI-MiBa is updated on a weekly basis and is used to identify patients with laboratory confirmed influenza A or B.

4.4.4 Level 4: Medical on-call service

The Danish medical on-call service (DMOS) is responsible for carrying out telephone consultations outside the opening hours of general (Harder, et al., 2011).

[15] Source: Statens Serum Institut (2012)

After each consultation, the contact is registered in the patient' electronic health record.

In 2006 SSI established the surveillance of influenza-like illness identified via DMOS and by 2008 it covered the entire country (Harder, et al., 2011). The implementation was made directly in the electronic journal system, for this specific purpose. The duty officer simply marks a checkbox, if the patient has influenza like symptoms, thereby reporting the case to SSI. It is quick and accessible and allows SSI to get an electronic real-time indication of the number of persons with influenza-like symptoms segmented by age group or geographical areas. This segmentation was used on a daily basis, during the 2009/2010 pandemic and is now currently being included in the weekly assessment of influenza in the *Influenza-nyt* newsletter.

4.4.5 Level 5: Sentinel surveillance

Since 1994 a number of general practitioners have reported their weekly number of patients, with influenza like symptoms to SSI (Gubbels, et al., 2013). They register each incident on a specific physical form, which requires the doctor or nurse to specify the age segment of the patient. The form is sent to SSI every week. The general practitioner can either choose to send the registrations electronically via a web-system or the actual forms by mail.

4.4.6 Level 6: Population surveys

The previous five levels only capture those infected persons who are in contact with the Danish health care system. Depending on the mutation of the influenza, many people might not even need to visit the doctor. To assess the severity of seasonal or pandemic influenzas, SSI has experimented with population surveys.

During autumn of 2009, SSI carried out an online survey, in collaboration with Danmarks Radio and netdoktor.dk (Mølbak, et al., 2011). Visitors were asked to fill out a short survey which covered any influenza-like illness symptoms over the past seven days and stated whether or not medical assistance was actually sought.

The data from the survey provided SSI an indication of the symptoms in the population and which health-care facilities were then contacted.

4.5 Economic burden of influenza epidemics

Influenza surveillance has an economic cost, however from a macroeconomic perspective, the interventions for limiting the spread of influenza can be beneficial. Some studies have tried to estimate the economic burden and costs of influenza on the society. These include not simply the direct costs for health care and vaccines, but also the indirect costs of lost labor due to illness. An analysis of the economic burden of a pandemic in Singapore estimated between 3.8 and 6.2 days of hospitalization per infected (Lee, et al., 2006). The researchers' conclusion was that vaccines as an intervention improved both economic and treatment benefits.

An American study, the objective of which was to measure the economic burden of annual seasonal influenza in the US, projected a total cost of $87.1 billion using statistics from 2003 (Molinari et al., 2007). The annual burden per capita was $92, when only considering lost earnings and $299, when also including lost lives. The impact on the GDP is between 0.24% and 0.79%, depending on the calculation used. A similar study estimated the cost of a pandemic to be between $71.3 to $166.5 billion USD (Meltzer et al., 1999).

Although there are no similar economic Danish estimates, the closest equivalent is a SSI report on the burden of illness of the 2009 pandemic (Mølbak, et al., 2011). The authors carried out a public questionnaire on influenza-like illness of visitors of two major Danish websites.[16] There were questions on the history of influenza-like illness in the past 7 days of the respondent. SSI collected 18,000 responds,

[16] *Danmarks Radio* (www.dr.dk), the Danish public service broadcasting corporation and www.netdoktor.dk, a health-care information website.

which showed that for every person in contact with a general practitioner, an average of 6.8 people in the population had an influenza-like illness.[17] The result was a clinical attack rate of 5%, or 274,000 persons, which were infected during the pandemic. A rough estimate using 2003 numbers, estimated by Molinari, et al., has the Danish cost of the 2009 pandemic to be $25,208,000 USD, when not considering lost lives.[18]

The above studies show that epidemics have economic costs for the society. Reducing the impact on the spread in the populations would also limit the direct impact of hospital admissions and indirect costs of less GDP because of lost labor.

4.6 Danish Regions governs health care

The case in this study is scoped to be of influenza surveillance of ICUs (level 2), which covers all five Danish Regions. The Danish Regions main task is to govern the Danish health care, which is financed through the state and 98 municipalities.

[17] Similar for the Danish medical on-call service, then for each ILI-case, there were 17.8 people in the population with ILI. SSI describes the sentinel surveillance of GP as being the most precise, therefore only this number is used.

[18] Calculation: $92 USD x 274,000 infected persons = $25,208,000.

Figure 15: Geographical illustration of the Danish Regions (Danske Regioner, 2012). [19]

The national pandemic plan describes the framework for contingency programs, which are developed and administered by the regions (Sundhedsstyrelsen, 2013, p. 7). The influenza surveillance of ICUs is a segment of the pandemic contingency, in which the regions play a central role in gathering data. Each region has developed contingency plans, which rely on national assessments and reports. SSI feeds one of these reports on the basis of the ICU influenza surveillance. In the following chapter we will analyze how the ICU influenza surveillance system was established and how the network went from stabilization to becoming unstable.

[19] Source: Danske Regioner (2012)

5. From action nets to actor-network

Before examining the establishment and development of the influenza surveillance network, it is worth looking at the sequence of actions leading to the current network, as this will provide an understanding on the rationale behind the formation of the network. These actions are a result of ongoing connections between the entities in the early stages of the ICU influenza surveillance. These early connections can be categorized as *action nets*, a set of organizing activities that eventually lead to the establishment of the *network* and *actors* within. Hence, in order to evaluate the success of a network this transformation must be examined (Czarniawska & Hernes, 2005). For this we must study the history to discover the translation process of the network.

The following network analysis deals with a simplification of the actors within the network. SSI, the Danish Regions and the ICUs will be used as a representative for the different actors within these organizations. Due to the inherent complexity of the networks, the translation process must necessarily be simplified in order to minimize the confusion that would inevitably arise if so many actors were to retain their complexity in our discussion.

Furthermore, as the four moments of translation (problematization, interessment, enrolment and mobilization) tend to overlap in reality (Callon, 1986), the following analysis will treat these moments as a continuum, where the progression from moment to moment is rather blurred. We aim to outline the translation process as it happens, rather than modify it to fit the four moments. The analysis will focus on SSI as the actor from whose viewpoint we see the process of translation.

5.1 Establishment of the network – the early stages

ICU influenza surveillance was first used during the 2009/2010 influenza pandemic, which was a result of a preliminary translation process. The following section describes how SSI and a professor at a Danish hospital, Rigshospitalet,

created an alliance, which were the first steps towards establishment of the actor-network.

5.1.1 Defining problematization and managing different interests

The Danish Health and Medicines Authority published a national pandemic influenza plan in 2006 (Sundhedsstyrelsen, 2006) that contained both guidelines on which protocols the public health institutes should initiate in the event of a pandemic influenza outbreak and examples on how these protocols could be performed. Most importantly, the plan included the need for surveillance during the outbreak and how this can be managed appropriately. The plan emphasized the need for receiving patient-related data from the Danish ICUs. A doctor in the department elaborates:

> *It [the possibility of receiving data from the ICUs] was pretty much down to the plan. I contributed to the writing of the report in 2006. Some others and I emphasized the need of retrieving data from the intensive care units. So it was as a consequence of that. Eventually, we would sooner or later have requested for the data regardless of the plan. It is obvious that we must monitor the serious spectrum of the influenza disease.*
>
> Superintendent , SSI

As a direct result of this plan, SSI started to directly contact the 44 ICUs located across the country, asking for a weekly status report during the influenza season (Gubbels, et al., 2013, p. 768). In addition, it is worth mentioning that SSI is a member in the Danish pandemic influenza preparedness advisory group alongside other leading figures in other relevant public organizations such as the Danish Regions, a representative of the hospitals and the Danish municipality union. SSI played an active role in influencing the decision to initiate the surveillance of the ICUs by creating an alliance with the professor from Rigshospitalet (a Danish hospital in Copenhagen) with whom they found a mutual interest:

He was very interested in getting the data from 'Region A' and was later appointed as a coordinator [in 2006]. We have met in several occasions regarding the surveillance […].

Superintendent, SSI

Considering the preceding actions from an actor-network theory perspective, there are clearly some translation processes being initiated by SSI, as the focal actor. First, the professor at Rigshospitalet and SSI both needed data from the ICUs. SSI's interest is based on using the data for research and documentation purposes and follows the guidelines presented by ECDC:

There are recommendations from ECDC to perform the so-called SARI surveillance. So [with this initiative] we wanted to fulfill the SARI surveillance as well.

Superintendent, SSI

In addition, SSI is responsible for informing the society and politicians about the influenza severity; Rigshospitalet maintains a similar interest, as the hospital uses the data for research purposes. Hence, the two actors create an alliance that uses its power to influence the agenda of the advisory group and eventually introducing the pandemic plan into the network as a non-human actor.
Secondly, the 2006 pandemic plan aids the process of aligning the interests of the actors of the network with the ICUs, as it is the ICUs which are obliged to submit weekly patient data. By using the pandemic plan to dictate the program to the ICUs, the alliance has created a system which they can define as the OPP. The associations created in the problematization are illustrated below.

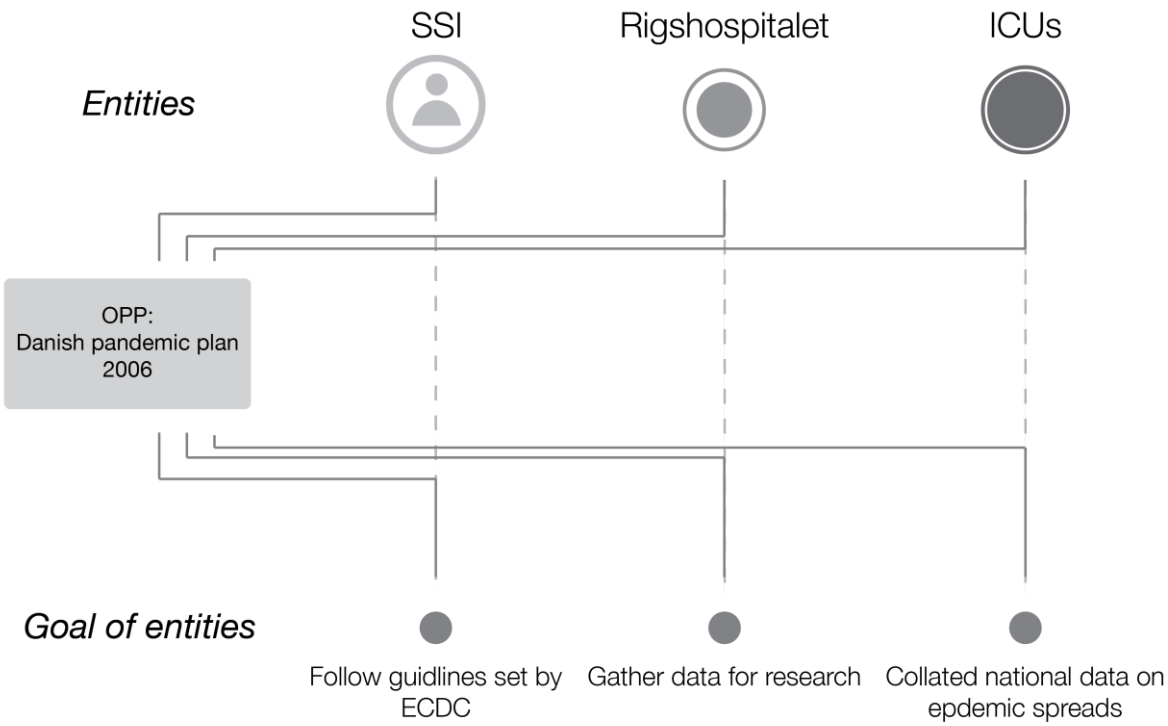


Figure 16: The system of association within the network

Glancing at the above illustration, one could ask the following: *why are the ICUs not parts of the alliance?* It lies in the difference between the actors and their interest. The aforementioned interests of SSI and Rigshospitalet contradict with the general interest of ICUs. The latter is known to have a heavy workload, where patient treatment and monitoring dominates the agenda, relegating any other activities that are not directly related to this to secondary objectives.

They have much to do at the ICUs. This is indeed a form of reporting, among many. All reports are made with a good purpose, but it takes the time from their work, for those who gather the data.

Administrator, 'Region C'

This creates a challenge for the alliance, as it must manage the contradictory interest of the ICUs created by patients and other actors in their network. The contradictory interest must be managed, interposed to be more precise, as it might

threaten the identity stabilization that the alliance is trying to create through the problematization (Callon, 1987). But how can interessment include the ICUs?
This challenge was managed by the alliance through a meeting, held in early autumn of 2009, at which SSI and Rigshospitalet designed a solution together. This solution was a device to aid their purpose. Negotiations took place between the two actors, but they had the same perception: 'if you want the ICUs to report data on a weekly basis, you must give them something in return'. After a discussion, the two actors decided to delegate a new actor in the shape of a weekly report based on the collected data from the ICUs, as we learned through our observations at SSI:

We [SSI and the professor in Rigshospitalet] talked about how to build this report and which content it should have. We took the regions' general need of information in consideration.

Superintendent, SSI

This report would contain information on influenza at the ICU level of the surveillance pyramid. The contents of the report would consist of statistics of patient risk factors and treatment methods. The intention of the alliance is to make this artifact appealing to the ICUs, by giving them access to this information. Yet the ICUs did not participate in this meeting. Instead, Rigshospitalet has knowledge of the area and the utility of the ICUs. Their absence is greatly influenced by the vast number of ICUs across the country and their diverse structuring.

5.1.2 Light enrolment before mobilizing

Even though the enrolment process occurred, it was limited to include the alliance and not the ICUs. Within the alliance, the enrolment seemed to be successful, but from the perspective of the ICUs, this was not the case. The enrollment did not include the ICUs, as they did not accept the interest defined by the alliance. The alliance informed the ICUs about the initiative and asked them to appoint a spokesperson with the responsibility to send the data of patients with influenza

to SSI. It is fair to state that the alliance consolidated their power to force the program of surveillance on the ICUs. Yet this initiated an accelerated mobilization process and within a few weeks associations between the actors were in place, making the network stable. An epidemiologist in SSI explains the events that led to the stabilization:

The pace in which the setup was done impressed me. In a few weeks we [SSI] held a meeting with Rigshospitalet, pointed out contact persons and got the system up and running.

Doctor and epidemiologist, SSI

SSI received the very first data from the ICUs in late October 2009. The data was reported directly from all 44 ICUs to SSI. This generated a large amount of data that had to be managed, analyzed, compiled and eventually reported to the other actors in the network every week. However, the process was time consuming and the work turned out to be too much of a burden for the epidemiologist:

We found out that much work was involved in receiving the data directly from each unit […].

Superintendent, SSI

The epidemiologist, whose responsibility was to gather the data, expressed a similar view:

It [the direct interaction] created too much chaos.

Doctor and epidemiologist, SSI

The epidemiologist described how they initially handed out an Excel worksheet, in which the ICUs were to register the data manually. Soon it appeared that the inscribed program was weak, as the ICUs reported the data using varying

structure, and some units even changed the formatting of the original Excel worksheet. This showed a clear presence of disruptive anti-programs. However, the direct contact with the ICUs continued throughout the influenza season up until spring of 2010. Reorganizing the network was associated with some complexities and time factors; it is for this reason that any changes were postponed until the conclusion of the influenza season. For the following season, it was certain that the stability of the network was threatened as SSI echoed the necessity for a different structure.

5.2 Redefining the actor-network

Until now the first iteration of the translation process of the surveillance system has been explained. The reason behind using the term 'iteration' originates from the perception of the nature of network translation; one must recognize that the outcome of the translation process is "actor-networking". This means that associations between the entities of the network are loosely coupled and they recursively generate and reproduce themselves – an effect caused by the actions and strategies performed in the translation process (Latour, 1999). In this section the actor-networking process will be outlined and we discover how SSI deals with the chaotic interaction mentioned above.

5.2.1 Displacement of the regional contact person

Learning that the newly stabilized network proved to be disadvantageous, SSI recognized the need to find an alternative method of organizing the influenza surveillance. When the influenza season of 2009/2010 was over, SSI explored any alternative ways by which the ICU data could be collected. In this process, SSI consulted several actors outside the network, particularly among the Danish Regions. Most significantly, SSI discovered that a department within 'Region A' had direct contact with several ICUs in the region and collected patient related data manually by phone conversations. An epidemiologist explains:

I believe it was because we discovered that 'Region A' had a system by which they called every intensive care unit each day during the pandemic. So we thought if they had such a system, they could easily send the data to us. Then the intensive care units would not have to report their data multiple times […].

Doctor and epidemiologist, SSI

The head of the department for Infectious Disease Epidemiology elaborates further:

In several regions the units [ICUs] reported to their regional coordinator and us [SSI]. So we might as well get the data from the regional coordinator. This way a reorganizing would make it easier for all parties.

Superintendent, SSI

The regional coordinator in the Regional Hovedstaden was, and still is, responsible for collecting the data from the ICUs. The informant described that 'Region A' focused on attaining an overview of patients with infectious deceases (including influenza) in the ICUs within the region (see the below comment). The regions use the data for monitoring and control activities in case of an infectious outbreak.

Eventually, it was clear to SSI that if they wanted data from 'Region A', the region must be displaced in the network and this action yields a change of the network (Latour, 1988). In other words another iteration of the earlier translation process will be performed.

In this second translation process, the problematization moment is revised. From the perspective of SSI, the problem remains the same; *how can the relevant data from the ICUs be collected?* However, the answer has changed and is now represented in the shape of 'Region A'. SSI must now convince the new actor, the region, to accept the proposal of collecting the ICU patient data. They arranged a meeting with the responsible management, in order to form a collaboration. SSI

tried to persuade the region with arguments as to how the output of the system would reduce the workload of the ICUs. In addition, SSI emphasized on how the device, developed for the ICUs (the weekly report in section 5.1.1), would aid the purpose and helps them during pandemic outbreaks. SSI also argued that the same device could benefit the five regions as well. Providing them with relevant statistics and charts, SSI would add a nation-wide perspective on influenza infections, giving information that otherwise would not be available.

Using this reasoning, SSI and Rigshospitalet (the alliance) defined the interaction with 'Region A' as the OPP and tried to make it indispensable by offering its device: the weekly report. Furthermore, the actions defined in the problematization help impose the identity of the region and hereby allowing the alignment of interest to be achieved. The superintendent in the department clarifies:

> *[…] There has been a special attention on it [a surveillance system in the ICUs] in 'Region A' that was not present in the other regions. The autonomy of the region is complex with more ICUs and bigger capacity than other parts of the country.*
>
> Superintendent, SSI

The above comment shows an equal interest from 'Region A' to acquire data on influenza patients on ICUs. Mutual benefit between the alliance and 'Region A' arise as the actors can exchange information of an area of mutual interest. But can we conclude that a successful interessment is accomplished? As we will cover next (in section 5.3), some controversies arise and created *betrayal*, a moment defined by Callon (Sarker et al., 2006).

5.2.2 Negotiations and appointing the spokesperson

With the interests aligned, the next step for SSI was to enroll 'Region A' into the network. In order for this to occur, SSI negotiated and agreed on a program in which the data is sent to SSI.

SSI held an internal meeting where some doctors and epidemiologists discussed a program that would suit their needs and simultaneously be accepted by 'Region A'. The challenge was to use a user-friendly format and not to ask for too detailed data. The region told SSI that they would not allow using much time on this task. Therefore, the program of actions must be simple to avoid overburdening the ICUs and 'Region A'. The result was an Excel worksheet (see Figure 20).

In actor-network terminology, the Excel worksheet represents the artifact created by SSI in the inscription of the program. In most cases, the inscription occurs as part of the enrollment process (Sarker et al., 2006). In section 6.2 the content of the inscription is outlined using rich descriptions of the regions.

For the mobilization moment, the process of appointing a spokesperson to represent each actor cannot be isolated within a single event. The spokesperson of SSI, the epidemiologist, was already defined in the first iteration and is currently still representing SSI. As for the spokesperson of 'Region A', the region thought that the regional contact, with whom the ICUs have a direct contact, is the most likely candidate to represent the region in this network. Appointing a spokesperson is a mean to achieve stabilization in the network. In the process of interessment and enrolment, only a minor number of actors are involved actively. Hence, these actors are the ones who understand the value of the network and were engaged in aligning interests (Callon, 1986). Therefore, the presence of these actors stabilizes the network. The next relevant question to ask becomes; what happens if one actor (or more) leaves the network and is replaced by a different actor? It might be incomprehensible to merely perceive the actors as roles, which can be performed by any member of a unit, but we will outline the consequences of treating them this way in section 5.3. Before

answering this question, it is important to analyze how the other Danish Regions were introduced to the network.

5.2.3 Including the remaining regions

SSI needed to delegate the same program to the remaining Danish Regions in order to achieve a national ICU influenza surveillance. The challenge was that the alliance was already forged. SSI therefore had to initiate actions similar to those we have seen before, in order for the introduction of the regions to succeed.
During a weekly meeting in the department of Infectious Disease Epidemiology in SSI, a Medical superintendent involved in the process explained that:

> *When we first contacted the region [the remaining regions], we wanted to arrange a meeting where we could hear them out and discuss how the surveillance should be carried on.*
>
> Medical superintendent, SSI

SSI contacted 'Region A' hoping to initiate a translation process. However, the meeting never took place, as the regions did not want to participate. From there on the prospect of a successful translation became problematic and with the four other regions not willing to align interest SSI had one last option - to demand the data from the regions by referring to the pandemic plan of 2006, in which SSI was given authority to acquire this data. An epidemiologist at SSI elaborates:

> *[…] We asked the region whom they wanted to appoint as a contact person. Apparently they have decided to perform the task differently. How they want to organize, is a decision that lies within each region.*
>
> Doctor and epidemiologist, SSI

Eventually the Excel worksheet was delegated to each region (including 'Region A'), where a regional contact person is responsible for delivering data to SSI. This structure was initiated in the influenza season of 2010/2011. Four more actors

joined the network, although their association with SSI is weaker compared to 'Region A'. Figure 17 illustrates the associations of the network after the displacement of the remaining regions.

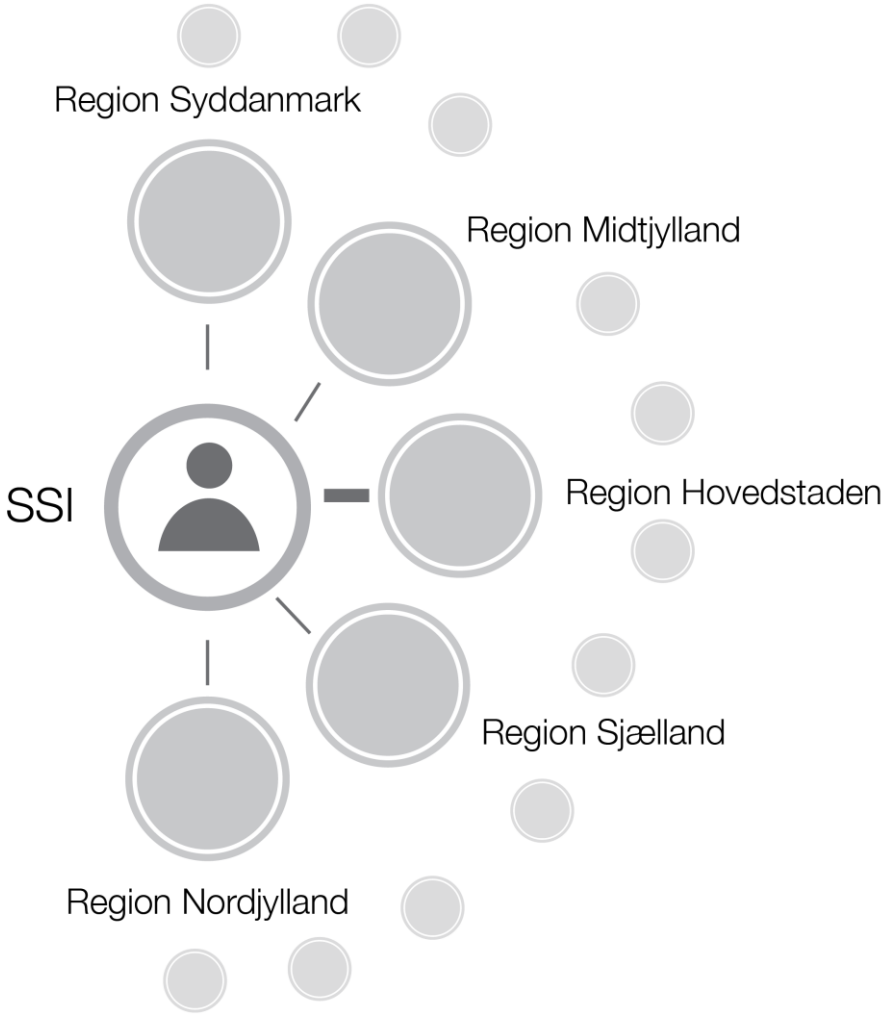


Figure 17: The associations between SSI and the regions. Association with 'Region A' is stronger than the remaining regions.

5.3 Controversies leading to instability

At this point the network has been established and stabilized and black-boxes has been successfully created. Since the 2010/2011 season the program developed by SSI has been in use by all five regions. However, it has definitely not been a smooth collaboration.

Now it is time to answer the questions raised in section 5.2.1 and 5.2.2. In section 5.2.1 it was indicated that a potential of betrayal in the network is present due to interessment differences. In section 5.2.2 the importance of the spokespersons to maintain the stabilization was raised.

In relation to betrayal, this moment of translation did occur in the seasons that followed 2010/2011. In the initial planning, the actors (especially SSI and 'Region A') did not fully discuss the duration of time in which the program was to be performed. Consequently, two different definitions of the manner in which the program should be performed were present, eventually creating controversies between SSI and the regions. SSI wanted the regions to fill out the Excel worksheet from week 40 in one year to week 20 in the following year. This was the definition used by SSI. On the other hand, the regions were mostly interested in information on the very peak of the influenza season, in which they could monitor the development and manage the health care resources to deal with the influenza. A superintendent in the department explains his learning:

Seen from the perspective of the regions, their contingency plan, the most important time [of the influenza season] is the peak of the season, where you should move patients, expand capacity. Seen from an epidemic view, it is important to cover the whole season.

Superintendent, SSI

And adding another comment:

The time where they cannot see the benefit of the system is the beginning and the end of each season. Here, the motivation [of the regions] is quite low.

Superintendent, SSI

Thus, from the regions point of view, the attention on ICU surveillance system is not present throughout the influenza season. This perception is found in all four regions that took part in the study. To conclude this finding, it is important to deal with the interessment thoroughly to avoid neglecting the interest of any actors. Additionally, the focal actor must put an effort into pre-inscribing the other actors, so they acquire the sufficient knowledge before entering the network.

In relation to the importance of the spokespersons to the network, Callon (1986) mentions that in the translation process, for the most part, only a few individuals (or representatives) take an active role in the process. Therefore, their presence is vital for the stabilization of the network. The current contact person in 'Region A' has been responsible for the data report for the past two years. When asked of her view on the influenza surveillance system, she replied:

Generally, I think that SSI has an issue with propagation. Because I do not know why it is relevant to have this surveillance and I have been a contact person for two year. That is a revelation.

Emergency response consultant, 'Region A'

This comment confirms that she was not a part of the translation process that took place earlier, as another individual had the responsibility back in 2010/2011. She can therefore not eye the value of the established network and eventually creating instability in the network. This does not mean that a change of a spokesperson must not occur, but that when it does, some knowledge transfer of actions or use of devices must take place.

6. Understanding the actor-networks

In this chapter we describe and analyze the actor-networks that are involved in the Danish ICU influenza surveillance. The two major networks are that of SSI and the Danish Regions. Although these two networks are interconnected, it is possible to describe them separately as we do in this chapter.

The presentation of the network of SSI will describe the Danish Region simplified as actors (Callon, 1991). In section 6.2 we will elaborate on each of the distinct networks of the Danish Regions. When describing these networks, we simplify the network of SSI, which is then perceived as a singular actor (Callon, 1991). The findings in this section are based on interviews and supplemented by observations made during our visits at the regions.

Although some actors has been mentioned earlier, they have not been fully described. Whenever new actors are introduced in the descriptions, they are marked in *italics*.

6.1 Outlining the actor-network of SSI

In SSI, the responsibility of the ICU influenza surveillance systems lies within an actor whom we name the *epidemiologist*. This actor has the direct interaction to the *regional contact persons* during the influenza season, as described earlier in chapter 5.

The work of an epidemiologist in the influenza surveillance is depended on the collaboration of the Danish Regions. The epidemiologist depends on the data provided by the regions, as a result of an inscription made by SSI. In return, the regions receive weekly ICU reports on the tendencies of the spread of influenza infections across ICUs in the Danish Regions. The network of the epidemiologist is illustrated below and will be explained in this section.

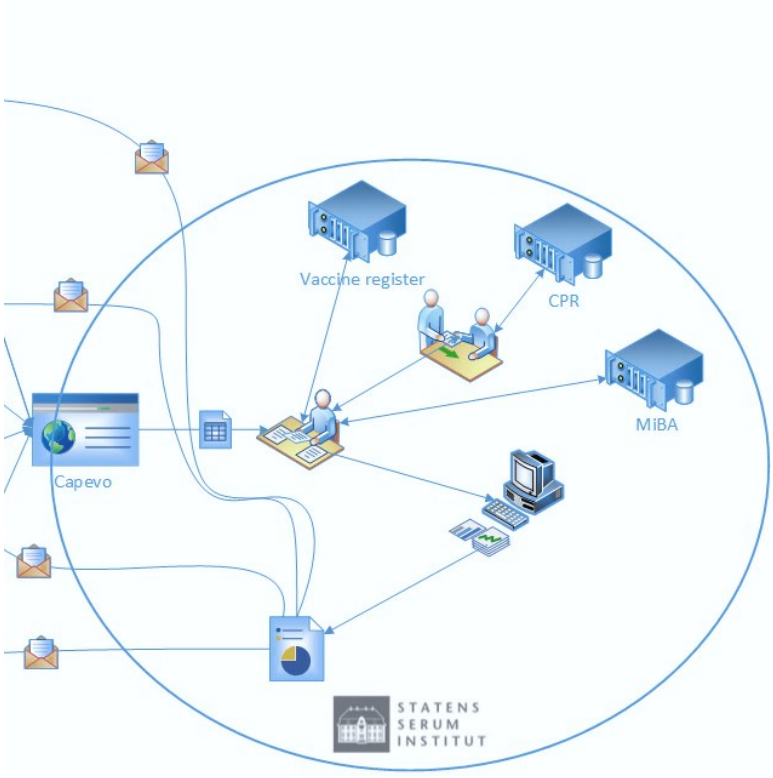


Figure 18: The actor-network of the epidemiologist at SSI

As previously described, SSI organized the process so that a regional contact is responsible for collecting data from the ICUs within their respective region. This responsibility was previously placed with SSI, which then had direct contact with the ICUs. The regional contact was delegated this task and the process has since become a black-box for SSI.

Before the epidemiologist is to initiate any analytical work on the influenza surveillance, she must receive the data from the regions. The regional contact person sends the ICU data, no later than Monday afternoon, which is a deadline inscribed by SSI. The epidemiologist has some knowledge about the structure of the regions, but less about their practices of collecting the data from the ICUs. This indicates the presence of a black-box (Cressman, 2009), which is supported by the following statement by the epidemiologist:

It is true that I do not have knowledge of what the regions are doing [when collecting data]. I know for example that in 'Region A', it is the emergency call center that does it [the reporting]. Up until the middle of this season, they have called every ICU, to hear whether they have any influenza patients - as I understand it.

Doctor and epidemiologist, SSI

In order to access the influenza surveillance data sent from each regional contact, the epidemiologist interacts with *Capevo*; a web-based system. The epidemiologist has the ability to download the weekly reported data. This non-human actor is positioned between the epidemiologist and the regional contacts, as Danish law forbids CPR numbers to be sent by e-mail.[20] Before the introduction of Capevo, the regional contacts in the network were required to break up CPR numbers into two separate e-mails, which the epidemiologist then combined upon reception. Capevo was not developed for ICU influenza surveillance; still, it inscribes a simpler program of action for the regional contact and epidemiologist.

[20] Source: Datatilsynet (2012) (02-08-2013)

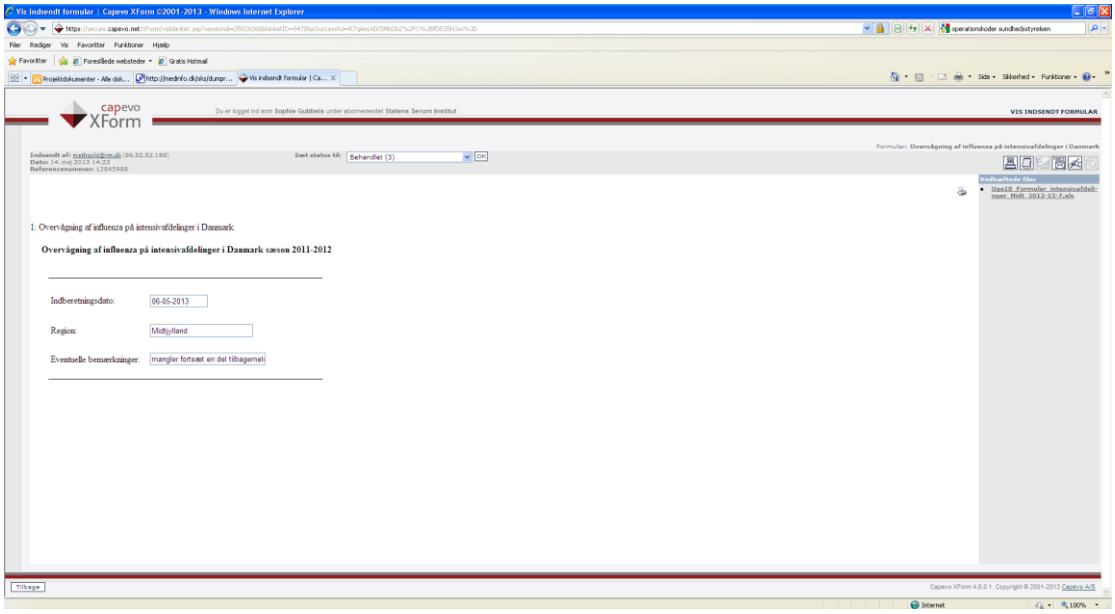
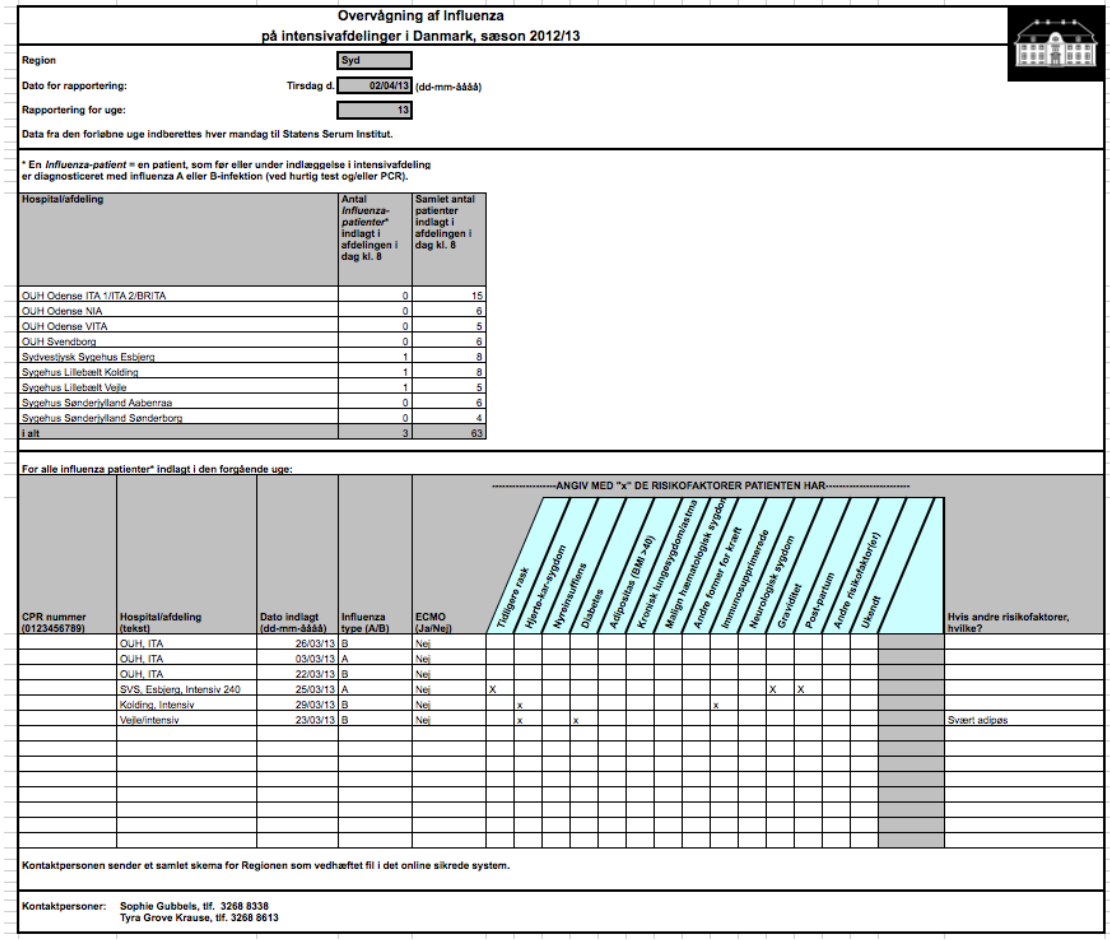


Figure 19: Screenshot of Capevo.

The program of action inscribed by Capevo provides access using a personalized login via a webpage. A form on the webpage prescribes the use by the actors, as it ensures that data meets specific criteria. The regional contact person uploads the data in Excel format before submitting it in a form with an optional attached message to SSI. Designed inscription of Capevo disallows submission of the form without attaching an Excel file. The ICU influenza data is structured in a standardized *Excel worksheet*, one for each region. The epidemiologist downloads all of these Excel worksheets and reads any messages from the regional contacts.



Overvågning af Influenza
på intensivafdelinger i Danmark, sæson 2012/13

Region: Syd

Dato for rapportering: Tirsdag d. 02/04/13 (dd-mm-åååå)

Rapportering for uge: 13

Data fra den forløbne uge indberettes hver mandag til Statens Serum Institut.

* En *Influenza-patient* = en patient, som før eller under indlæggelse i intensivafdeling er diagnosticeret med influenza A eller B-infektion (ved hurtig test og/eller PCR).

Hospital/afdeling	Antal *Influenza-patienter** indlagt i afdelingen i dag kl. 8	Samlet antal patienter indlagt i afdelingen i dag kl. 8
OUH Odense ITA 1/ITA 2/BRITA	0	15
OUH Odense NIA	0	6
OUH Odense VITA	0	5
OUH Svendborg	0	6
Sydvestjysk Sygehus Esbjerg	1	8
Sygehus Lillebælt Kolding	1	8
Sygehus Lillebælt Vejle	1	5
Sygehus Sønderjylland Aabenraa	0	6
Sygehus Sønderjylland Sønderborg	0	4
I alt	3	63

For alle influenza patienter* indlagt i den forgående uge:

CPR nummer (0123456789)	Hospital/afdeling (tekst)	Dato indlagt (dd-mm-åååå)	Influenza type (A/B)	ECMO (Ja/Nej)	ANGIV MED "x" DE RISIKOFAKTORER PATIENTEN HAR: Tidligere rask	Hjerte-kar-sygdom	Nyreinsufficiens	Diabetes	Adipositas (BMI >40)	Kronisk lungesygdom/astma	Malign hæmatologisk sygdom	Andre former for kræft	Immunosuppression/nedsat	Neurologisk sygdom	Graviditet	Post-partum	Andre risikofaktor(er)	Ukendt	Hvis andre risikofaktorer, hvilke?
	OUH, ITA	26/03/13	B	Nej															
	OUH, ITA	03/03/13	A	Nej															
	OUH, ITA	22/03/13	B	Nej															
	SVS, Esbjerg, Intensiv 240	25/03/13	A	Nej	X										X	X			
	Kolding, Intensiv	29/03/13	B	Nej		x							x						
	Vejle/intensiv	23/03/13	B	Nej		x		x											Svært adipøs

Kontaktpersonen sender et samlet skema for Regionen som vedhæftet fil i det online sikrede system.

Kontaktpersoner: Sophie Gubbels, tlf. 3268 8338
Tyra Grove Krause, tlf. 3268 8613

Figure 20: Excel worksheet used to collect data from ICUs (see Appendix A).

The scheme of the Excel worksheet, displayed above, is the result of an inscription designed by SSI to standardize the input of the ICUs. The scheme structures and describes two types of data, unit aggregated and case based, which the regional contacts are to provide.[21] The Excel worksheet and Capevo both prescribe a program of action for the regional contacts and ICUs, which is designed to result in structured valid data for SSI.

[21] Aggregated data includes the number of patients hospitalized on the ICUs and the number of those that are diagnosed with influenza. Case based data details the diagnosis and treatment of the patient. These details include CPR number, location, hospitalization date, influenza type, whether ECMO treatment has been and diagnosed risk factors.

After downloading the worksheets, the epidemiologist checks whether they are complete and then copies all rows from each Excel worksheet to a *collected list*. The collected list contains all influenza patients on the ICUs in the current season.

The received dataset is a weekly status of identified influenza patients from the previous week at the ICUs. These datasets could include duplicates of hospitalized patients, forcing the epidemiologist to validate the data manually and remove any duplicates. Other data cleaning activities are performed by the epidemiologist to ensure the data quality, which includes verifying the patients' gender and age by making calculations based on the CPR number. Furthermore, the data is manually corresponded with sample results from the laboratories, which is stored in the *Microbiological Database (MiBA)*. The epidemiologist from SSI explains the need for this action:

> *Normally the reported data [from the regions] is all right, but sometimes it is odd. At times, I have more information on MiBA than from the received reports.*
>
> Doctor and epidemiologist, SSI

Patient specific information on laboratory confirmed influenza from within MiBA is added to the collected list to enrich the existing information. In the case of any contradictory information, the epidemiologist overrules the received reports with the information found in MiBA. Information from MiBA is considered more accurate since it is based on laboratory results and the data is updated often.

To further enrich the data, the epidemiologist checks whether the persons on the collected list have been

Det Danske Vaccinationsregister
DDV is an electronic track record system that contains information about the vaccine history of the Danish citizens. It covers government-funded vaccines, with the purpose of creating a transparent vaccine system. Each Danish citizen can view his or her own vaccination track record.

vaccinated for the influenza virus. This piece of information is available in the national vaccine register *Det Danske Vaccinationsregister (DDV)* (see the fact box).

Although the information on influenza vaccines is updated on a monthly basis, there is a delay of up to three months, from the time the vaccine has been given, to the time information is available in the register. This delay affects the accuracy of the data and therefore the validity of the analysis itself.

Besides the individually based data, the cases of mortality from influenza infections are summed and added to the analysis. For this task, the epidemiologist delegates the work to a co-worker who matches the patients in the finalized collected list to an extract of the *CPR register* to identify the patient's vital status. The CPR register is a database with the main objective of administering the unique personal number of all Danish citizens. The co-worker uses this data source to monitor changes in the mortality of patients carrying influenza during flu seasons. The process is to manually look up the CPR numbers from the collected list every week, and checking the person's vital status: i.e. whether the person is dead or alive. The access to the CPR register database allows SSI to only update the data once every 30 days. Therefore, the collected list of patients must be checked once more in the register in order to get a comprehensive overview of the influenza mortality incidents. If this is not done, then there is a risk of lacking an entire month of mortality data.

To recap, the epidemiologist now has the following sources, which she uses in producing the weekly analysis of influenza virus in Denmark:

- **Patient data from regional ICUs**
- **Laboratory confirmed influenza tests from MiBA**
- **Vaccination data from DDV**
- **Vital status from CPR**

On Wednesday morning the epidemiologist, delegate a series of actions using the statistical application *STATA*. The epidemiologist used STATA to calculate several

calculations and produces charts based on the patient information from the collected list.

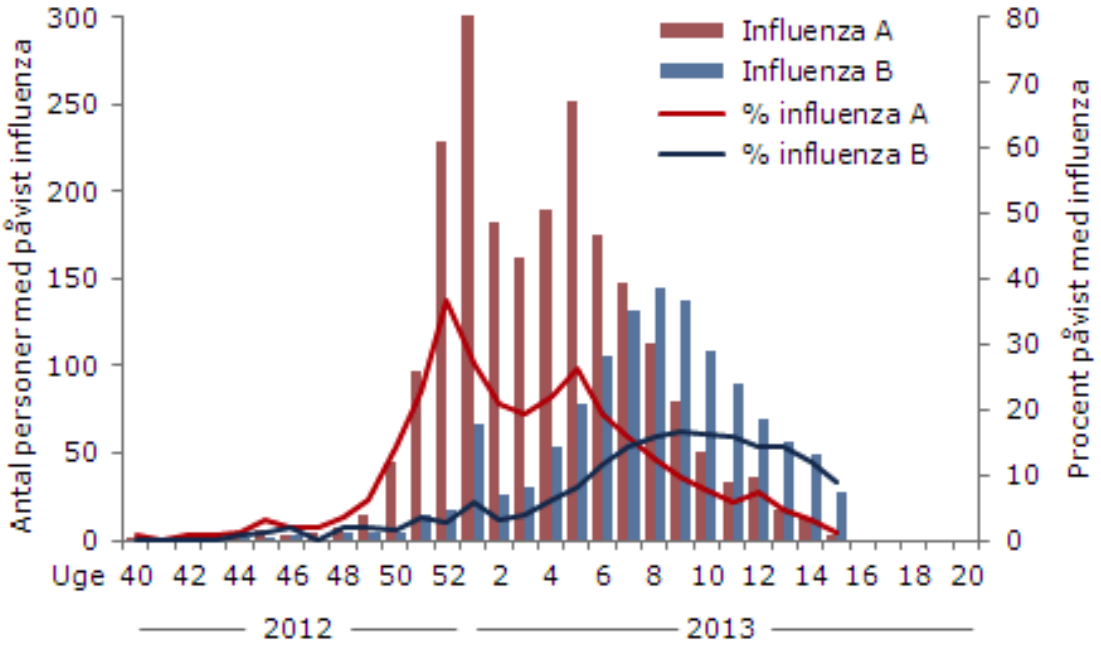


Figure 21: Laboratory confirmed influenza A and B, and percentage of tested persons identified with influenza (Statens Serum Institut, 2013)

These calculations are updated weekly, as the regions report new patients with influenza, and are then revised with the latest data from MiBA, DDV and the CPR register. Figure 21 shows an example of the visualization, which the epidemiologist generates through STATA. Other statistics describe elements such as number of patients per week per region, gender of the patients, age groups, number of received vaccines, total amount of mortality cases, risk factors and types of treatment received by the patients.

Using this information the epidemiologist produces two different weekly reports that show the development of influenza infections; a newsletter and an ICU report. The newsletter, *Influenza-nyt*, which consists of text describing the current state of the influenza infection throughout the population. SSI incorporates data from the other influenza surveillance system as input for the newsletter. The newsletter does not contain case based details and no information on the risks factors

associated with the yearly influenza mutation. Instead, this newsletter aims to inform the public, politicians and journalists about influenza infections in Denmark.

The second weekly report (*ICU report*) is focused on the regions and the influenza infected patients on ICUs. The report includes the statistics and charts described previously as well as specific case based information on patients hospitalized on ICUs. One reason behind the difference in the level of information in each report type lies in protecting the privacy of the patients. An epidemiologist explains:

> *Occasionally a patient might be pregnant, in one Region, and then it might be easy to track down that exact person. If it is to be published in "Influenza-nyt" we consider it being too sensitive information. That is why we distribute it directly and privately to the contact persons.*
>
> Doctor and epidemiologist, SSI

As explained in chapter 5, during the establishment of the ICU surveillance system, the ICU report was used by the SSI alliance to persuade the regions and ICUs to participate in ICU surveillance, which is another reason why the epidemiologist produces this specific report.

The intended program of this report is to give the ICUs and regions an indication on the influenza infections and for them to use this to support decisions related to managing bed and personnel capacity. A medical superintendent elaborates below:

A couple of days ago I attended a meeting with CEO of Emergency Medical Services in 'Region A'. He told us how much he benefited from our surveillance of the intensive care units and encourages us to maintain our surveillance of this level.

Medical superintendent, SSI

SSI uses the result of the ICU surveillance to create the two reports, however, they also use the data for epidemical studies. The actor-network of SSI includes several human- and non-human actors, which the epidemiologist interacts with when producing the reports. The fundamental data is provided by the ICUs, through the regional contacts. SSI has designed inscriptions to make the regional contacts follow a specific program. This program has been improved over time, as SSI has enrolled the Excel worksheet and enrolled Capevo in the actor-network. The strong associations between the epidemiologist and STATA, MiBA, DDV and CPR are used to further enrich the data, which is later used to create the reports.

6.2 Outlining the networks of the Danish Regions

From the perspective of SSI, each region is simplified as an actor within their network; however, each region can be observed as an individual sub-network (Callon, 1987). In this section, we open the black box of each region and elaborate on the reporting process and actor-network of each region.

During this study, we interviewed the regional contacts and observed their work-practices when doing the surveillance reporting. We observed an array of different methods, processes and systems, used to gather the data from the ICUs.

The following sections describe each regional contact and their actor-network, which they depend on to collect the data for SSI.

6.2.1 'Region A'

The responsibility of gathering data from the ICUs has been placed in an administrative unit, which supports the regional emergency dispatch center. One function of this unit is to receive emergency calls from the public and provide coordination of the emergency response. Everything is carried out from a call-center, where consultants in addition to receiving calls, also monitor threats and disease outbreaks.

An *emergency response consultant* is the actor responsible for reporting ICUs to SSI. In the beginning of the influenza season, she receives the Excel worksheet from SSI, which she then distributes to the ICUs. The Excel worksheet is designed to be forwarded to the ICUs and therefore includes descriptions on how to fill out the forms and fields. However, before sending the Excel worksheet, she alters it to increase the simplicity of reporting for the ICUs. This alteration removes the designed logic of the worksheet, but makes it easier and faster for the ICUs to enter the patient data. It is evident in that 'Region A' has put an effort into reducing the workload of the ICU reporters.

> *A minor difference in relation to the worksheets was, that we tried to simplify [the process] and create a one-pane worksheet. It is like an input worksheet, which is sent to the intensive care units and is afterwards combined at the AMK emergency dispatch center and quality assured by me.*
>
> Emergency response consultant, 'Region A'

The reason for this change is clear from her statement; to simplify the process and worksheet for the ICU reporters. She is aware of the burden of reporting for the ICUs and tries to improve the situation by altering the Excel worksheet. This indicates the presence of an anti-program caused by the prescription of the excel worksheet. The prescription of the Excel worksheet places additional workload on the emergency response consultant, who now has to verify the data and later reapply the worksheet logic.

The emergency response consultant is not allowed to contact the ICUs directly, as the organizational structure in 'Region A' does not allow her to do so. She must instead retrieve the information of the ICUs through the *AMK emergency doctor* actor. The AMK emergency doctor is also responsible for any communications to and from the regional dispatch center to these hospitals. The below comment indicates that the AMK doctor has strong associations with the ICUs in the region:

> *The AMK emergency doctor has the task of being the coordinating doctor, so everything regarding coordination between us and the other hospitals on regional level goes through our AMK function. We have decided that this is the way we work. It also gives hospitals, directors and departments an understanding our work processes. They know the AMK position here, so that makes it transparent.*
>
> Head of department, 'Region A'

Several doctors operate this position, so an *AMK emergency doctor mailbox* has been set up, where all communications are stored. To initiate the ICU influenza reporting, the emergency response consultant sends the altered Excel worksheet to the AMK emergency doctor mailbox. The AMK emergency doctor on duty then distributes this worksheet to designated reporters at the ICUs. These actors may be secretaries or department mailboxes as the ICUs' structures are different, making it harder for the emergency response department to control the process. The head of the department states:

[…] ICUs are structured differently as to how they work with it [influenza reporting] and how they receive it. Or to whom we are sending the influenza-reporting worksheet. There is really a big difference whether we submit to an intensive care unit mailbox, which is continuously monitored or if we send to doctor "PH Hansen". In the last case, we can be uncertain whether the mail is seen that day.

Head of department, 'Region A'

In the actor-network of 'Region A', the AMK emergency doctor mailbox and AMK emergency doctor operate as obligatory passage points between the emergency response consultant and the ICUs.
The AMK emergency doctor position has been assigned great power within the actor-network of 'Region A'. This power forces other actors to use the obligatory passage point, the AMK emergency mailbox and AMK emergency doctor, in their communications with the ICUs.

On Monday morning of each week during the influenza season, the ICUs should return the completed worksheet to the AMK emergency doctor mailbox. The AMK emergency doctor on duty forwards the responses to the emergency response consultant. As she receives the responses she begins a routine, where she combines the results to comply with the structure of the original Excel worksheet from SSI. She opens each ICU report, copies the corresponding rows and fields to a master file. In the master file the initial program, which was lost due to the initial alteration of the Excel worksheet, is re-applied. She validates the quality of the patient data, as she copies the fields to the master file, because the ICUs occasionally mistype fields or incorrectly format their responses.

When the emergency response consultant has finished the routine of combining all ICU reports, she uses her personalized access to log in to Capevo, and uploads the master Excel worksheet to the server.

The emergency response consultant is unable to validate all of the fields, before uploading the master file to Capevo, so some fields potentially have invalid values. The CPR number is the most common field that has an invalid value. Either the number is mistyped, and therefore no person can be found with that CPR number, or the CPR number is valid, but SSI cannot validate that the person has been tested for influenza.
Once an error has been identified, the epidemiologist at SSI sends an email, where she requests the corrected information from the emergency response consultant. This forces the consultant to initiate the entire set of interactions mentioned earlier, but only with regards to the relevant ICU.

Once the epidemiologist at SSI has completed the weekly ICU report, she sends it to the emergency response consultant, who forwards the report to the AMK emergency doctor mailbox. From here, our respondents are not clear whether this report is distributed to the ICUs or is archived by the AMK emergency doctor. The Head of Department describes that she does not think it is distributed, as there is no workflow inscribing whether the AMK emergency doctor should distribute the weekly ICU report to the *ICUs*.

I am a little worried that we do not distribute it [the ICU report]. The AMK doctor is not to blame; it is simply a workflow that is not described. It is clear that this is influencing the lack of understanding by the intensive care units, of the necessity of this reporting. Why do we have to carry out this task, when we have tasks that are more pressing? How do we benefit from this task? How do others benefit from this task?

Head of department, 'Region A'

To conclude the state of 'Region A', it becomes clear that the region has developed some anti-programs as they have changed the form of the Excel worksheet. The lack of pre-inscription of the regional contact person (emergency response consultant) increases the risks of anti-programs.

Additionally, the region is structured in quite a complex way, with the AMK emergency doctor positioned as the obligatory passage point actor.

6.2.2 'Region B'

In 'Region B', the ICU reporting is placed within a quality and development team, which is responsible for ensuring quality within patient security, clinical databases and implementations from different councils. There are multiple quality assurance teams in 'Region B', all with different tasks and responsibilities. One *quality and development consultant* carries out the coordination of the ICU surveillance and two other consultants observe the process.

Every Friday during the influenza season, the quality and development consultant sends an e-mail to the ICU contact persons to remind them of the upcoming reporting deadline. She attaches the Excel worksheet, which she had received from SSI. The e-mail has a description of how the Excel worksheet should be completed with specific patient information. The deadline of the response is also described in the e-mail, because without this, then the ICUs will not prioritize the task, as described by the quality and development consultant:

> *If this information [the deadline] is not present, then I will not get a response.*
>
> Quality and development consultant, 'Region B'

The quality and development consultant recognizes in her actions and the above statement that she needs to enforce the inscriptions for the ICUs to follow the intended program designed by SSI.

On Monday the ICUs begin to send their responses to the regional contact. If they have not yet reported at 12.00, then the quality and development consultant sends out an e-mail reminder to the respective ICUs. A second e-mail reminder, flagged as high importance, is sent if the quality and development consultant has not received the data when she leaves work on Monday evening. This is a clear sign of

anti-programs from the ICUs, as they have to be reminded by the consultant. This anti-program affects the interaction between the region and SSI, as delays in the responses from the ICUs affects the timing of the consultant's response to SSI. If an ICU does not respond within the deadline inscribed by the quality and development consultant, this ultimately results in incomplete data.

In 'Region B' they have learned that specific persons at the ICUs were important for the process to properly function. If one person at an ICU was absent, then the process would halt and no data for that ICU would be submitted to SSI. To overcome this vulnerability then, they have decided to involve more contact persons at the ICUs.

> *There has been a development. First there was one contact person at each unit [ICU]. Later we learned that the system was fairly vulnerable, if this person is on vacation or is sick. Currently, two or three contact persons [for each ICU] all get the form.*
>
> Quality and development consultant, 'Region B'

She continues to describe the development:

> *I started out by sending to eight persons and now I have reached twenty recipients for the form.*
>
> Quality and development consultant, 'Region B'

The consequence of this development is that more actors are involved in the program of gathering data from the ICUs. Enrolling more actors in the actor-network strengthens the associations between the consultant and the ICUs, which reduces the identified vulnerability.

Once the quality and development consultant has received all the responses, or the deadline for the ICUs has been met, then she begins combining the Excel worksheets into one master worksheet. Previously, there was no program inscribed for the ICU reporters, so each unit created their own worksheets. Now all use the standardized Excel worksheet from SSI. When uploading the master Excel worksheet to SSI through Capevo, the quality and development consultant notes if they have not received information from specific departments within the region.

On Wednesday, the quality and development consultant receives the specific ICU report from SSI. After reading the report, she composes an e-mail, where she describes the location of cases in the region. She also attaches the original report from SSI, as she forwards the e-mail to each ICU mailbox of the region.

Once a week, they [SSI] send a resume of the registrations from the past week of influenza cases. Then we forward these to the units [ICU] for orientation.

Quality and development consultant, 'Region B'

During the establishment of ICU influenza surveillance, the designed program was for the regional contacts to distribute the ICU report to regional managers. However, the quality and development consultant fails to fulfill this program, as her anti-program includes only sending the ICU reports to the ICUs.

The quality and development consultant recognizes that the ICUs are very busy and that this reporting task has a low priority in their work routine. Some of the ICUs within the region do value the reports and see the importance of such a system. The quality and development consultant states about whether the ICUs recognizes the value of the ICU report:

I do not think they do [read the ICU report]. One time, when I missed the reporting deadline, we did not get 'Region B' numbers in the weekly report. I would believe that if they read it [ICU report], then I would have heard from them.

Quality and development consultant, 'Region B'

The above statement implies that ICUs do not read the weekly ICU report, however we learned from the interview that the quality and development consultants screen the ICU reports. They use this information for emergency preparedness. In particular, numbers from 'Region A' are analyzed as influenza usually spreads from this region.

In 'Region B', the quality and development consultant has strong associations with the human actors of the ICUs, which has been enforced by an enrollment of more ICU contacts. By enrolling more actors, then the actor-network has been stabilized, as the quality and development consultant is no longer dependent on any singular actor. In the region, we have identified an anti-program of the quality and development consultant as the ICU report is not distributed to the regional management. However, the quality and development team uses the report for emergency preparedness.

6.2.3 'Region C'

The regional contact person in 'Region C' is an *administrator*. Apart from doing the ICU influenza reporting, he is also involved with emergency preparations, where he arranges first-aid schemes and pre-hospital activities for patients.

The administrator has a structured routine which he goes through every week during influenza season. Each Monday at 12 he sends a reminder to the ICUs of the region, which has not yet sent their influenza report. If there are still reports missing on Tuesday, then yet another reminder is sent. For the first couple of weeks in the beginning of the influenza season, the administrator needs to send more reminders, as the ICU reporters get used to the habit of sending in their

weekly influenza cases each Monday morning. In sending reminders, he strengthens the inscriptions of the program for the ICU reporters. The administrator states:

If you as a coordinator do not really put enough pressure on them [the ICUs] or prioritizes other tasks higher, because you do not really want to do this [influenza reporting], then it will not go well.

Administrator, 'Region C'

The administrator continues to follow the expected program from SSI in his routine and reminders are sent in a timely fashion. He recognizes the importance of using the standard Excel worksheet, as unstructured reporting would have bad results. He states:

I believe that they [SSI] have a standard, so I will of course need to follow that or else there would be chaos, if we started to report differently.

Administrator, 'Region C'

This statement indicates a strong prescription in the form of the Excel worksheet, which has led to the administrator following the intended program designed by SSI. The background and skills of the administrator influence his understanding that following the standard of the Excel worksheet is important. In his job in emergency preparedness, he needs to monitor and evaluate regional threats, such as terrorism or diseases. Pandemic influenza is listed as one of these threats; therefore, he is interested in any developments (Beredskabsstyrelsen, 2013). The pre-inscription of the administrator, being involved in emergency preparedness, has him following the technical script and understanding the necessity of ICU influenza reporting.

He prints out the SSI Excel worksheet when all the ICUs have sent their influenza reports, and, with a pen, types the numbers from the ICU reports to a piece of paper. While going through all the ICU reports, he types these numbers into a combined Excel worksheet. Once complete, he interacts with a non-human actor, as he archives it electronically on a 'Region C' *file management system*.

The combined Excel worksheet is uploaded to SSI through Capevo with a personalized login. Afterwards, the administrator distributes this file internally to the organization and to the ICUs. He distributes on Mondays as a preliminary orientation to these persons of the influenza situation at the ICUs. On Wednesday, he distributes the ICU report from SSI.

The delegated task of being a coordinator is understood, however the administrator sees both advantages and disadvantages of the current structure compared to the former.

I know the department management of the intensive care units and they know who I am. The same applies to the reporters, who are often the same from year to year – they know me too. That makes a commitment.

Administrator, 'Region C'

The above statements by the administrator, recognizes that the associations of the network are stronger between regional coordinators and the ICUs, than between SSI and the ICUs. He describes it as an advantage of the current network of ICU reporting, because of the local knowledge. However, it has a cost and for the disadvantages, the administrator states:

There are advantages and disadvantages of it [regional coordinators], because errors can be made, when I am filling out or fetching it [the Excel worksheets]. It also does take extra time. Conversely, the current structure is probably because some [ICUs] would not send [their influenza reports].

Administrator, 'Region C'

The actor-network of 'Region C' relies on strong associations between the administrator and the ICUs. Although the administrator enforces the inscriptions early in the influenza season, his good relationship with the ICU managers and reporters is the foundation of the strong associations. Pre-inscription of the administrator influences his understanding of why ICU surveillance was established. This fact, combined with his strong associations with the ICUs, means that he follows the designed program of action.

6.2.4 'Region D'

The responsibility of ICU influenza reporting in 'Region D' is maintained by a *molecular biologist*, whose primary focus is to carry out molecular analysis.

In 'Region D', the molecular biologist has developed an anti-program, as the ICUs do not play an active role in the influenza surveillance. The molecular biologist instead has access to systems, where she can look up patients hospitalized on either of the regions eight ICUs. As a molecular biologist, she has strong associations with non-human actors, which have been enrolled in the actor-network. She has access to *MiBA*, which was previously described as an actor within the network of SSI. However, these non-human actors were not a part of the network, when it was established in 'Region D'. Initially the actor-network included the ICUs, but as the following statement shows, then association between the molecular biologist and ICUs was weak:

I believe that I tried to put it out to the contact persons [at the ICUs] to report to me, if the patients had an influenza diagnosis. It was very inconvenient, as they forgot to report, one was sick or was on vacation. It was all built on goodwill. There were eight contact persons every week, one from each unit, so it became rather confusing.

Molecular biologist, 'Region D'

The molecular biologist observed instability in the network and therefore substituted the human actors, ICUs, with non-human actors. The stronger associations between the molecular biologist and the non-human actors forge greater stability of the network. By interacting with multiple non-human actors, the molecular biologist can fulfill the reporting duties of the entire region, without involving the ICUs.

Fortunately, I was granted access to the system [a regional system], so I could do it myself and was no longer dependent on the reports from the ICUs. The more links present, there more complex it becomes.

Molecular biologist, 'Region D'

We have observed an anti-program when gathering the patient data, as the ICUs are not evident in the network and prescription of the Excel worksheet on the ICUs is therefore never upheld. While the molecular biologist does not follow the designed program when collecting the data, she still puts in effort to respect the standard of the Excel worksheet. This indicates a strong inscription within the Excel worksheet artifact.

The molecular biologist looks up all patients hospitalized on ICUs in a *regional system*. Afterwards, she looks up these patients in a journal system called *KMA-websvar*, which also has a link to laboratory tests in MiBA. She has to ensure that patients already reported in previous weeks are left out, as she must only report a patient once each influenza season.

I also need to follow the patients, so those who were positive last week, will not be counted again. This season there have not been so many patients, but if there are many influenza patients lying on intensive care for several weeks in a row, then it becomes unmanageable very quickly. Therefore, I have to be sure, not to count them several times.

Molecular biologist, 'Region D'

Once she has the unique list of patients, she needs to look up a detailed case-based diagnosis from the patient's journal. To do this, she accesses a fourth system, *AD Bact*, where she goes through the entire journal of the patient. If there are many positive influenza patients with long journals, then this task may be very complex and time-consuming. The molecular biologist needs to determine the diagnosed risk factors of the patient and whether the patient had the influenza infection prior to hospitalization (as prescribed by the Excel worksheet).

A disadvantage of the anti-programs is that the colleagues of the molecular biologist do not have the same strong associations with these non-human actors and therefore does not have the credentials to access these systems. Therefore, during vacations or illness, *the* molecular biologist has no way of letting a substitute do the task. She states:

It is also a disadvantage, that it is placed on one person. I have done it while I was on vacation or sick, as it is hard to get security clearance for those systems I am using. Even the lead doctor on the infectious diseases department, does not have access to the system.

Molecular biologist, 'Region D'

As the actor-network does not include the ICUs, then the molecular biologist is unable to distribute the ICU report to these units. She is therefore forced to develop an anti-program, where she only distributes the ICU report to the regional management.

In the network of 'Region D', the molecular biologist takes on the tasks of the ICUs, thereby developing an anti-program. The burden shifts from the ICUs to the molecular biologist, which has to read full patient journals to complete the Excel worksheet. The associations of the molecular biologist influence the formation of the actor-network in 'Region D'. Stronger associations with non-human actors, relative to the human actors, has resulted in an actor-network dominated by information systems. Although the formation was greatly influenced by the molecular biologist, it has led to the emergence of anti-programs.

6.3 State of the regional actor-networks

The above description and analysis of the regions and SSI has showed some instability in the networks. The network of ICU surveillance utilizes the stronger associations between the regional contacts and ICUs, which were to forge a more consistent standard of reporting on the influenza patients of these units.

The architecture of the network is, however, complex, as the regions are structured differently. SSI may delegate the data collection task to the region, but does not influence where in the organization the task is placed. It is the difference of the regions limits SSI's ability to do so. Consequently, the structures of the actor-networks differ. Through analyzing the regions, three patterns have emerged, which are described in the following chapter.

7. Comparative analysis of an unstable network

The descriptions of the formation and current state of the actor-networks has provided an understanding of each entity. The rich descriptions of the network of SSI and each of the Danish Regions will provide the basis for a comparative analysis of the actors.

Through the Actor-network theory lens, we have analyzed the networks across the regions and SSI, and described the dynamics of the networks. This following comparative analysis shows how four patterns are evident in the network.[22]

7.1 Patterns of actor-network

Regional contact position was established as an obligatory passage point in the network during the redefinition of the actor-network. This has delegated a great deal of responsibility to this actor as the collection of ICU data and distribution of the weekly ICU report is now a task for the regional contacts.

SSI has black-boxed the Danish Regions and relies on the inscription of technological artifacts, such as the Excel worksheet and Capevo, to prescribe a program of action for the regional contacts. However, when opening the black-boxes, subsequent patterns have emerged, which influence the destabilization of the network.

The following four patterns are evident in the network.

[22] A detailed description of this process and the formation of patterns is found in 3.2.3 Phase 3: Coding collected data.

Associations between actors
Diverse pre-inscription of actors
Anti-programs develop depending on context
Utility of ICU report

Table 1: Patterns identified in the analysis of the actor-networks

7.1.1 Associations between actors

Regional contacts were enrolled in the network because their associations with the ICUs where much stronger compared to those with SSI. This enrollment creates a more stable and persistent network.

The analysis shows that human and non-human associations of the regional contacts influence the formation of the regional actor-networks. Most regional contacts utilize their strong associations with human actors, the ICUs, to ensure stability of their network. To maintain these associations, the regional contacts perform various extra activities; even though the burden of work increases for the regional contact, the associations with the ICUs are strengthened.

In 'Region D', the regional contact's associations with the non-human actors are stronger, which has led to a network dominated by non-human actors. Previous formation of this network included human actors (ICU contacts) however shifts in the regional contacts associations with the non-human actors ignited a translation process within this actor network.

SSI has shown similar behavior in regards to forging strong associations with the regional contacts. SSI managed the weakening associations towards the regional contacts, following the 2009/2010 pandemic, by enrolling non-human actors,

such as Capevo and the Excel worksheet, in the actor-network. Again, this enrollment stabilized the network.

This pattern describes how actor-networks are formed based on the associations of the focal actors. To further strengthen associations in the network, then actors are willing to take on tasks, which were previously undertaken by other actors. However, these associations play a large part in the formation and retention of alliances. The Danish Regions have different structures and therefore the task of collecting ICU data is placed within different organizational units. The associations of the regional contact, with either human or non-human actors, changes with the context, in which the ICU surveillance is placed.

7.1.2 Diverse pre-inscription of actors

The background and skills of the regional contacts has demonstratively influenced the way in which regional contacts understand the task of influenza reporting. The task of ICU surveillance is located in different units throughout the Danish Regions, which affects the necessary background of the regional actor. Because of the different backgrounds, skills and knowledge of the regional actors, the pre-inscription differs.

The regional contacts that are more involved in emergency preparedness have shown to have a better understanding of the reason for having ICU influenza surveillance. Their knowledge of emergency contingency plans and involvement in pandemic outbreaks align their pre-inscription with that of SSI. Two of the Danish Regions, 'Region C' and 'Region B', follow the designed program of SSI very closely, which can be attributed to their pre-inscription. Both regional contacts work with emergency preparedness, which benefits their approach. In these regions we have observed fewer anti-programs in relation to both ICU data gathering and ICU report distribution.

The various pre-inscriptions of the actor-network increase the complexity for SSI to design strong inscriptions. The regional contacts who have a pre-inscription

similar to that of SSI have shown to develop less anti-programs, unfortunately not all actors have identical pre-inscriptions. Increased diversity in the pre-inscriptions in the network cause the complexity of inscriptions to increase, as SSI has to consider all the pre-inscriptions.

7.1.3 Anti-programs develop depending on context

SSI has some knowledge of how the regions organize the process of collecting the data from the ICUs, however as the regions are black-boxed, this is not transparent. SSI has designed the Excel worksheet artifact and Capevo system to prescribe a program of action, where the regional contacts involve the ICUs to report the weekly influenza cases of the region.

Regional contact has two major activities in their process. First activity is to gather the data from the ICUs and send it to SSI and second activity is to distribute the ICU report to regional management and ICUs. We have observed anti-programs within both of these activities performed by the regional contacts.

In relation to the first, prescriptions of Capevo and the Excel worksheet perform as intended, as all regional contacts report through Capevo and follow the Excel worksheet. SSI has inscribed a program in the Excel worksheet for it to be distributed directly among the ICUs. However, anti-programs were developed, as the regional contacts altered the use of the technological artifact to be suitable in their context.

Anti-programs related to the distribution of the ICU report cause instability in the network. Because of the ICU report, SSI was positioned as indispensable in the network for the regions and ICUs. When the regional contact does not distribute the ICU report, then they fail to fulfill their obligation within the network. As the regional management or ICUs does not receive the ICU report, then SSI may lose its indispensable status. SSI does not influence how the regional contact distributes the ICU report, therefore the inscription must be considered weak or nonexistent.

The organizational diversity of the regions makes it difficult for SSI to design a universal program of action, which would consider all regional differences, especially given that the actor-networks of the regions may also change over time. In some cases, like Capevo, the prescribed use of the artifact is followed. However, weaker inscriptions of the Excel worksheet and ICU report, shows how anti-programs emerge.

The case shows that perceptions of technological artifacts change with the context. Technological artifacts used in ICU influenza reporting are exposed to multiple contexts and, as our analysis shows, are changed or bended to fit different socio-technical structures. It is complex for the designer of a technical artifact to consider all these contexts in one universal artifact.

7.1.4 Utility of ICU report

When comparing SSI and the regions, the information utility of the ICU surveillance system becomes evident. SSI, as a research institution, demands the "complete picture" of the severity of influenza across the entire season, for use in epidemiology studies and informing the Danish public. This involves maintaining the system during the very beginning and the very end of the season, where few or no influenza patients are reported from the ICUs.
The Danish Regions, including the ICUs, benefit most from the ICU report during epidemic peaks or outbreaks. Most regional contacts do not value the report and are unsure about the need to maintain the ICU surveillance outside the seasonal peaks. Nevertheless, they still fulfill their reporting obligations to SSI.

Contradicting information utility between actors causes instability in the network. Establishment of the network occurred after a global pandemic, when a vast amount of contingency protocols were initiated. The reason for establishing the ICU influenza surveillance system was evident following a large pandemic, however this motivation has faded over time.

Different actors in the ICU surveillance network have different motivations in their participation in the actor-network. During the establishment of the ICU surveillance, the regions were persuaded to ally with SSI, because they would benefit from the ICU reports. However, as described in this pattern, there is a fundamental difference between the information utility of SSI and the regions, which causes instability in the network. If not managed, then eventually the alliance between SSI and the regions may disintegrate.

7.2 Identified issues within the patterns

The four patterns describe how instability develops the complex actor-network of ICU surveillance. SSI, as the focal actor, must consider the destabilizing features of these patterns, in order to regain stability in the network. As a conclusion of the analysis, we formulate issues within each of the patterns, which cause instability of the network. The issues are derived directly from the patterns; hence describing them would be a repetition of the former. The below table presents these issues:

Pattern	Issue
Associations between actors	Issue 1: Weak association between SSI and regional contact persons affects the collaboration negatively. Issue 2: Weak association between SSI and regional contact persons are enablers for anti-program.
Diverse pre-inscription of actors	Issue 3: Regional contact persons with dissimilar pre-inscriptions than SSI develop anti-programs. Issue 4: Difficult to develop a universal solution to appeal to different background.
Anti-programs develop depending on context	Issue 5: Weak inscription of Excel worksheet allows regional contacts to gather data differently. Issue 6: Weak inscription in the ICU report reduces the distribution to stakeholders.
Utility of ICU report	Issue 7: Different information utility of regional contacts and SSI.

Table 2: Overview of the issues within the identified patterns

SSI should initiate activities to remove or reduce the effect of these issues. The following chapter presents three recommendations, in which we will tackle the instability caused by these issues.

8. Recommendations

After focusing on the causes of instability in the actor-network of ICU influenza surveillance, we shift the perspective, as we look towards the initiatives that should be implemented by SSI to stabilize the network once again. We present five recommendations for SSI that addresses the issues listed in chapter 7.

The recommendations can be implemented separately and are not interdependent; SSI can choose to implement one or more recommendation to restore stabilization.

Table 3 presents how the issues identified in the analysis is connected to the recommendations. A list of the addressed issues will be at the introduction of every recommendation description.

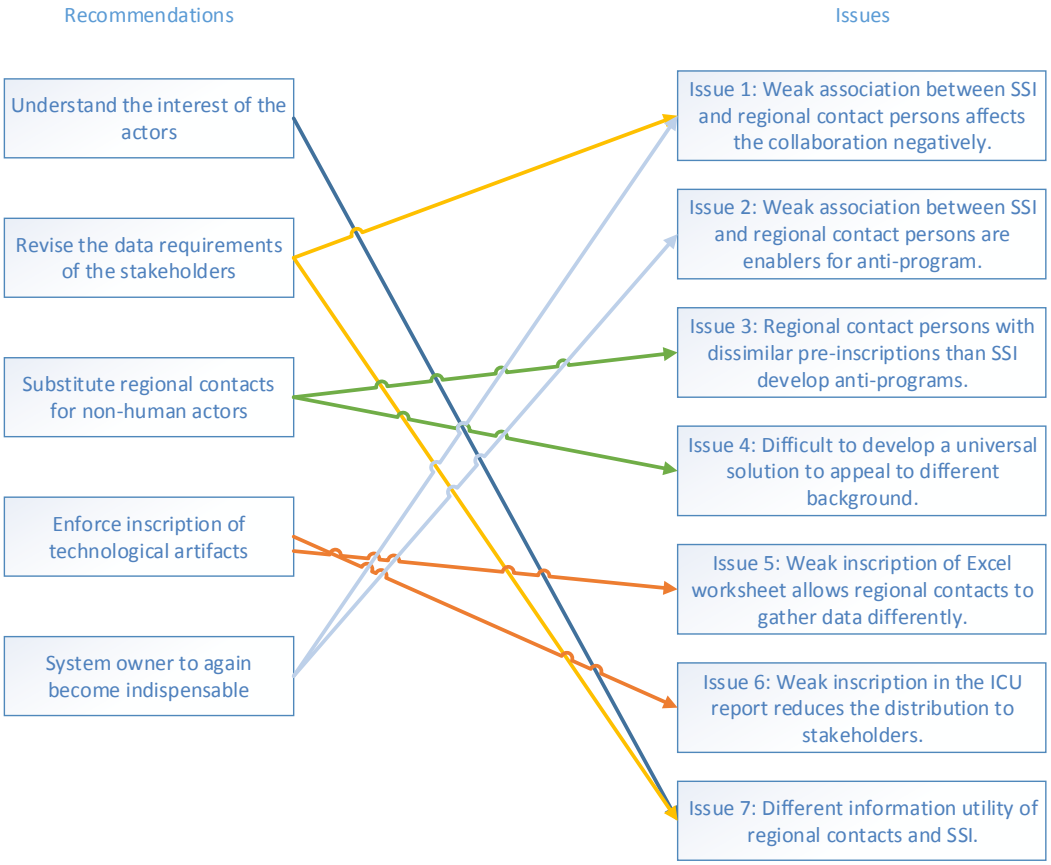


Table 3: Mapping of recommendations and issues identified in the analysis

8.1 Understand the interest of the actors

Issue addressed:

Issue 7: Different information utility of regional contacts and SSI.

This study has shown that, when bridging several organizations in an actor-network, the contexts of the actors need to be considered. SSI has black-boxed the regional contacts during the translation process.
However, this has foreclosed disruptive anti-programs. As our study shows, the ICU report produced by SSI is not distributed accordingly. The ICU report was a central element in persuading the regions to participate actively in the ICU surveillance.

Communication from SSI regarding the purpose of the system has shown to be insufficient; the stakeholders involved in the ICU surveillance system need to understand why there is a necessity for influenza surveillance, also outside epidemic peaks. Yet SSI must also recognize the fundamental differences in the information utility between actors to be able to create and strengthen the alliance.

Even though SSI has the political power, they must still forge alliances with key actors and mediate mutually compatible translations (Horowitz, 2012). SSI balances many associations with numerous actors, which further complicates their management of associations within the network.

SSI must encourage dialogue with the black-boxed regions to further understand these actor-networks. After the investigation, SSI must review the contents of the ICU report, to ensure that it is still relevant for the recipients. Keeping the ICU report relevant will ensure that the alliance between the regions, ICUs and SSI remains stable.

8.2 Revise the data requirements of the stakeholders

Issues addressed:

Issue 1: Weak association between SSI and regional contact persons affects the collaboration negatively.

Issue 7: Different information utility of regional contacts and SSI.

During epidemics, the Danish ICUs and regional contacts understand why it is important to report patient data, as there is often a massive demand for information from within the health care system and the Danish public. However, during low severity influenza seasons, the regional contact does not see the utility of the influenza surveillance. SSI's interests and utility from the ICU surveillance are different because they benefit from the information to use in epidemic research.

WHO recommends the countries to be more appropriate in their initiatives, so they are better equipped to match the severity of the influenza in the population (World Health Organization, 2012). SSI knows that they can escalate the influenza surveillance of ICUs, like they did during the 2009/2010 influenza pandemic, however their regular surveillance may be too extensive.

In our study we learned that SSI was continuously aware of improving the ICU surveillance system. SSI tries to follow the WHO and ECDC recommendations and guidelines, whilst continuing to optimize the process for ICUs and regional contacts. One potential improvement, which was presented by SSI, was the ability to de-escalate the current surveillance system during periods with less influenza in the population. Incorporating this ability could lessen the reporting period or reduce the necessary information details from the ICUs.
In shortening the reporting period, then the risk of epidemics outside the defined season increases. From an actor-network perspective, it would require the actor-network to swiftly substitute actors as epidemics occur. The ability should be

embedded in the actor-network, which can shift form following an organized translation process (Mähring , Holmström , Keil, & Montealegre, 2004).

SSI must compromise their data requirements from ICUs to improve this relationship. Shorter reporting seasons or less data requirements are not in the interest of SSI, which previously utilized the same method when they reduced the patient details from the ICUs. At that time, it led to network stabilization.
Yet, the reduction of influenza reporting will improve the stability of the alliance between SSI and the regional contacts, as the interest of the regional contact is considered (i.e. less reporting during low influenza spread). The effect for SSI is that the association with the regional actor is strengthened and therefore stability is restored. Although not an ideal situation for SSI, this recommendation can be considered easy to implement with immediate results.

8.3 Substitute regional contacts for non-human actors

Issues addressed:

Issue 3: Regional contact persons with dissimilar pre-inscriptions than SSI develop anti-programs.

Issue 4: Difficult to develop a universal solution to appeal to different background.

Issue 5: Weak inscription of Excel worksheet allows regional contacts to gather data differently.

The study has shown that human actors have a will and will use the actor-networks, in which they operate, to fulfill their obligations. Regional actors structure their work routines around the program outlined by SSI and the associations with human and non-human actors.

SSI must also consider their associations with the remaining actors and utilize strong associations to stabilize the network. SSI has strong associations with non-human actors and utilizes these in working with the data from the ICUs. Substituting the regional contacts allows SSI to alliance with other actors to stabilize the network. SSI previously used a similar approach to enroll non-human actors to strengthen associations and create stability.

One challenge of substituting the regional contacts for a non-human actor, is that the standardized information on patient diagnostics and hospital units are still new and not fully equipped to realize this objective.

SSI has access to two registers that can substitute the collection of patient data from the regional contacts and ICUs. Enrolling the LPR register (see right) would provide data on which units any patient in Denmark is hospitalized. LPR, in combination with MiBA, which store all laboratory tests in Denmark, enables SSI to determine whether the patients on ICUs have influenza.

Landspatientregisteret (LPR)

LPR is a database administered by the Danish Health and Medicines Authority. All contact points of any patient with the Danish health care system are registered in the database. It is registered as a record in LPR, when a patient is hospitalized or discharged from the hospital. This database can provide access for researchers to a very large dataset of patient treatments.

SSI must be aware that if displacing the regional contact from the network, then the task of distributing the weekly report is lost. Delegating the distribution to the SSI epidemiologist would risk the earlier communication problems of the network, as the association between SSI and the ICUs will be weakened as a consequence. In addition, the distribution to stakeholders within the regions would be a complex task, as SSI would need to be enrolled in these networks. We recommend keeping the regional contacts in the network, to ensure distribution of the ICU report.

Substituting the regional contact with a non-human actor would counter some of the anti-programs of the regional contacts (Czarniawska & Hernes, 2005, p. 8). Non-human actors are easier to discipline; therefore, the risk of anti-programs developing in the actor-network would decrease. Furthermore, this will deal with the complexity of designing technical artifacts to function in all of the regions, as the Excel worksheet and Capevo becomes irrelevant without the presence of the regional contacts.

8.4 Enforce inscription of technological artifacts

Issues addressed:

Issue 5: Weak inscription of Excel worksheet allows regional contacts to gather data differently.

Issue 6: Weak inscription in the ICU report reduces the distribution to stakeholders.

The analysis shows that the inscriptions provided by the Excel worksheet and ICU report are not strong enough, as some regional contacts fail to follow the intended program. Inscriptions of these technological artifacts are complex, as SSI needs to consider the prescription of the technological artifact in many contexts. Furthermore, these are region specific contexts which have been black-boxed, and which therefore their inner complexities are hidden. Further complications arise from the diversity in the regional structures, which SSI does not influence.

Different data collection methods and failure to distribute ICU report destabilizes the network. Half of the Regions which participated in this study alter the artifacts and programs to co-exist with the actor-network of the regions, however in doing so they develop anti-programs. Yet in some regions the inscription works as the program of action is followed.

Nevertheless, the enrolment of Capevo has been successful, as we have not observed any anti-programs involved with this technological artifact. The combination of strong inscriptions and the Danish privacy law prescribes a program, which all the regional contacts follow, independent of context.

SSI must revise the inscriptions of the Excel worksheet and ICU report to reduce the development of anti-programs.
For the Excel worksheet, SSI should consider whether to re-inscribe or design a new technological artifact. We recommend SSI to take inspiration from features of Capevo, when revising the Excel worksheet.
Ensuring that the ICU report is distributed to stakeholders is important, as the information in this report was one of the reasons for establishing the ICU influenza surveillance in the first instance. SSI can decide to undertake the distribution themselves or delegate this to a non-human actor. This could take form of a newsletter, such as *Influenza-nyt*, or mailing list. The regional contact would in this situation only be concerned with gathering data from the ICUs.

8.5 System owner to again become indispensable

Issues addressed:

Issue 1: Weak association between SSI and regional contact persons affects the collaboration negatively.

Issue 2: Weak association between SSI and regional contact persons are enablers for anti-program.

Weak associations between SSI and the regional contacts enable anti-programs and harm the collaboration between these actors. Due to the weakening of these associations, SSI's indispensable position in the network is threatened. SSI needs to strengthen these associations to once again become a necessity for the ICUs and regional contacts.

SSI must initiate another translation process to encourage the alignment of interests between the actors.

The interest of the ICUs, regional management and regional contacts in the ICU surveillance system, is the information communicated in the form of the ICU report. Increasing the quality and quantity of information can appeal to these stakeholders and thereby persuade them to join in an alliance. SSI should utilize their participation in other networks, namely WHO and ECDC, which provides them with data on a larger scale. Incorporating data from other countries, in helping them make operational capacity decisions, can also add more value to the ICU report for regional management and ICUs.

Increasing the value of the ICU report is a means for SSI to strengthen their associations in the actor-network, and thereby again become indispensable in the ICU surveillance system.

9. Discussion

In this chapter, we discuss the analysis result of this study, its theoretical foundation and our research method approach. Additionally, we discuss the recommendation given to SSI. These recommendations are tailored for SSI, but their application is also relevant for similar actor-network constellations.

9.1 Discussion of analysis results

Working with the analysis, issues and recommendations, we have evaluated the current ICU influenza surveillance system and have recommended new initiatives to improve the system. We have taken the perspective of SSI, as it is the organization responsible for maintaining the information system and thus have the authority to change it.

9.1.1 Review of the analysis outcome

When a qualitative study is conducted, it is important to address the trustworthiness of its outcome. Lincoln and Guba (1985) present four factors (or criteria) that the study must be compliant with. We apply these criteria to evaluate this study.

Credibility

Prior to initiating any data collection, we conducted early preliminary meetings with SSI to discuss the potential for collaboration, defining a scope for a study and establishing a trustworthy relationship. This "prolonged engagement" provided us with an understanding of SSI as well as a holistic outline of the influenza surveillance system. Having the opportunity to be present physically at SSI has reinforced our relationships with the participants.

We conversed with the participants often, which gave us the opportunity to review our perception and test our arguments. The department of Infectious Disease Epidemiology concerns a very different field than that of ours. Our

background and perspective was always respected and our approach was met with great interest from everyone we spoke with during our time at SSI.

A second activity that strengthened our credibility is the data triangulation. We used different methods such as interviews, observations and study of secondary data (technological artifacts, internal documents etc.). Using different data sources allowed us to build our arguments on different methods and hereby validate them.
We also conducted a debriefing session with SSI, where we presented our preliminary findings and the insights from our collected data. The feedback given by SSI employees provided further insight into, and explanation of, the problem domain.

We utilized the fact that we were two investigators, as we continuously reviewed each other's work and provided feedback to strengthen our arguments and descriptions. Participants from SSI reviewed sections of our study in order to validate our understanding; this was the case with chapter 4, Case description, and the scope of our study.

Finally, we did not succeed in involving Region Midtjylland in this study, as explained earlier. Their absence has a relatively large implication with regards to the data collection, as there are only five Danish Regions. SSI has to include this region in the actor-network; not being able to analyze this actor, their behavior has a decreasing effect of the validity of the recommendations.

Transferability

Throughout our analysis, particularly in chapter 5 and 6 we described our approach of using rich descriptions of actors to analyze the organizational context and give the reader a proper understanding of the actor-network. In Lincoln and Guba (1985), this is referred to as *thick descriptions*. This concept can ensure transferability, as other practitioners can determine whether their organizational context is comparable with the one presented in this study, although this

comparison would primarily be on a conceptual level, as influenza surveillance of this kind is relatively unique.

Dependability

There are two primary reasons for why the criterion of dependability is difficult to achieve in this study. The first reason is that the timing of the study has a great impact on the respondents' responses. We collected the data towards the end of the season. Hence collecting data from the ICUs and reporting to SSI throughout the influenza season has fatigued the regional respondents. Therefore the bias of 'recency' is very likely to affect their response. If a similar study with comparable results is to be performed, it must be conducted within a similar time frame.

The second reason is the fluctuations in the influenza seasons. The severity of an epidemic might be low and the workload of the regions decreases as a result. Therefore, the severity of the influenza season plays a large role in the dependability of this study.

Confirmability

We have strived to create transparency in our research approach by creating detailed descriptions of the applied methodology, although this could have been further reinforced by outlining an "audit trail" that describes and illustrates the development of data: i.e. from raw audio samples into collected data (Lincoln & Guba, 1985). We have illustrated the process to some extent in interview transcriptions and audio files that add to the confirmability (see Appendix A).

9.1.2 Further research

The objective of this study was to analyze the ICU surveillance network and determine the initiatives which would improve the unstable actor-network. We approached the problem from an operational perspective, as we analyzed the work processes of each of the involved human actors. Their statements, descriptions and networks were analyzed and combined with their descriptions of the non-human actors. This allowed us to present the entire actor-network of human actors, non-human actors and artifacts, as well as their interactions in carrying out the ICU surveillance.

During our presentation of the preliminary results for SSI, we learned that the middle management of many hospitals found the ICU influenza report very valuable. They received the ICU influenza report when the regional contact distributed it to within their organization. The strategic perspective is not within the scope of this study, but should be considered when initiating translation of the network. All of the interviewees of this study were involved with the operation of the ICU influenza surveillance and did not understand the purpose of the system, nor did the majority use the information that was extracted and communicated through the ICU reports. Expanding the scope to include the strategic perspective would determine whether or not other entities used the information in their decisions of emergency preparedness or hospital capacity.

9.1.3 Implications of the results on SSI

Depending on which recommendations SSI chooses to implement, the implications will vary. Even if they choose not to follow any of the presented recommendations, our analysis opens the black-box of the Danish Regions and describes how these actor-networks are structured. The outlined information on the contexts of the Regions can provide other alternative initiatives that we have not covered in this report.

If SSI chooses to implement recommendation 8.3, and substitutes the regional contact actor for a non-human actor, then the immediate practical implication, is that it would remove some of the trivial coordination tasks by the epidemiologist. Less coordination in the network would probably also enhance the relationship between SSI and the Danish Regions, as the workload of the regional contact would decrease.

Substituting the actors of the network enables new opportunities within surveillance of infectious diseases. Integration with other systems and registers can introduce new layers of the surveillance pyramid. Automatizing the influenza surveillance system would enable SSI to monitor not only influenza patients on

ICUs, but also integrate closer with other systems, such as DDV, CPR and MiBA. In doing so, SSI opens up for a wider research and information on the severity of influenzas, which would also benefit the Danish Regions and ICUs.

SSI can verify the validity of the results created by new non-human actors by comparing the data. If the historic patient data is present in the health care databases, then it could be used to simulate earlier epidemic data from the non-human actor and to make comparison with the data of the current actor-network. If there is no historic data, then a method called 'capture-recapture' can be used to estimate the completeness of registers, as we learned from our observations at SSI (Tilling, 2001). Putting an effort in validating the data of any new system is important, as this will ensure complete substitution of any non-human actors.

SSI can also benefit from the general findings of this study, which they can apply in other contexts. We learned that SSI owns, or is a part of, many information systems which balance the interests of many stakeholders. In any information system, opening the black-boxes occasionally will ensure the functioning and stability of the actor-network. Furthermore, recognizing that technological artifacts are complex to design and may not be perceived identically in different contexts, can help SSI generate an explanation of why other networks may not function as intended.

9.2 Theory discussion

Using ANT as a lens for the analysis of these organizations have proven beneficial for describing the social context and its interaction with the technological artifacts and vice versa.

However it is important to discuss some of the challenges and downfalls in applying ANT for this study, as this will affect the value of this study.

9.2.1 Early theory considerations and the use of Actor-network theory

Our early considerations included theory on decision support systems, which would help SSI in estimating the burden and spread of influenza. We were inspired by the Google Flu Trends project, which used search statistics to detect influenza before other traditional systems (Ginsberg, et al., 2009).[23] The ambition was to use big data to determine patterns, which would be an early warning that influenza was spreading. Earlier interventions would be more effective and result in a lower severity of the influenza infection. However, in our first interview we learned that emergency preparedness is not planned for specific incidents, but rather is adaptable to be applied in a variety of situations. SSI is piloting a small project, called *Influenzameter*, which would provide a similar warning system to Google Flu Trends, but in a much smaller scale.

We decided to use Actor-network theory after our exploratory meetings with SSI, where they described the influenza surveillance system of ICUs. Deciding to use Actor-network theory early in this study allowed us to adapt our mindset to the concepts of ANT and detecting these concepts during the exploratory phase of the research.

9.2.2 Theoretical implications

The insights gained from section 7.1 (Patterns of actor-network) reveals how certain concepts of ANT affect one another as we have identified how the notions of association and pre-inscription are closely interconnected with that of anti-programs. These implications are causal relationships, where one variable cause a change in another variable. First, *we demonstrate that the strength of association between the focal actor and other actors in the network, affects the development of anti-programs*. Strong associations between the actors indicate that a successful

[23] Discussions on the reliability of the Google Flu Trends project are ongoing, as subsequent results have shown that the results are over-estimating the actual influenza spread. Source (Butler, 2013)

translation process had occurred, and that the focal actor has become indispensable in the network. On the other hand, weak associations indicate that the focal actor is dispensable, and that hence the translation process had failed and the interests of the actors were not aligned. As a consequence, the focal actor will experience anti-programs developed by the other actors.

Secondly, the pre-inscription of the actors in the network affects how they perceive the program introduced by the focal actor. If the pre-inscription of each actor is assimilated, designing one universal program will be quite manageable in diminishing anti-programs that might arise. On the other hand, if the pre-inscription of each actor is diverse, it will be very challenging to design one universal program to take all the pre-inscriptions into consideration, leading to the creation of anti-programs. The focal actor must strive to assimilate the pre-inscription of the actors if possible.

Finally, it must be stressed that these causalities are derived from our limited collected data and must be challenged before they can be confirmed.

9.2.3 Critique of Actor-network theory

Although ANT has provided some useful tools for describing the ICU influenza surveillance system, it has been a complex theory to apply.

ANT does not provide any methodology or suggestions on how to scope the study. The researcher is left unaided to scope and define the boundaries of the actor-network to study. This was challenging, as we used lot of time and energy in scoping the actor-network and constantly reminding ourselves not to cross its boundaries.

Furthermore, the rich descriptions are fundamental in the ANT analysis. In chapter 5 and 6 we utilized rich descriptions of actors to provide an understanding of the network from an ANT perspective. However, several times we were worried whether our analysis would remain purely descriptive. This was a substantial challenge that we managed by repeatedly being critical of the insights that these two chapters outline.

Finally, as ANT requires the study of the non-human actor, our interaction with the technological artifact and systems are primarily based on observations. This becomes a challenge, as the non-human actors cannot be interrogated and the appreciation of their true value is highly connected to the professional background of the specialist in the context (such as doctors, epidemiologist, and researchers). As an example; we experienced situations where we asked the human actors for explanations of the non-human actor, which could affect our understanding of the latter. In these situations we lacked the knowledge associated with the professional background of SSI. To avoid basing our understanding on a single informant, we approached several human actors to validate our understanding of the non-human actors. The challenge of operating in a context alien to our academic background resembles the one Latour experienced in *Laboratory Life* when doing field work at the Salk Institute (Collins & Steven, 1992).

9.2.4 Alternative theory application

The socio-technical nature of this study can be viewed from different perspectives. An alternative perspective could present a complementary view on this research; we present three alternatives theories.

Our first alternative is to change management theory. This theory can not only be applied to describe the changes resulting from the introduction of the regional contact persons to the network, but also to analyze the events that occurred and explain how these events have affected the social context. Based on an analysis, the recommendations can be presented to address the consequences of the events.

A second alternative is to study the power concentrations in the context and analyze whether the structure of power has affected the decisions made throughout the change process. Although to conduct this research, one must gain access to respondents that engaged in the initial process of establishing the ICU influenza surveillance system.

The final theoretical alternative, Sensemaking Theory, can be applied to study how the different contact persons in the regions give meaning to the surveillance

system. Additionally, this theory can be combined with Institutional Theory. These two perspectives can contribute to one another as shown in Jensen, Kjærgaard and Svejvig (Jensen, Kjærgaard, & Svejvig, 2009). Here, the authors apply Institutional Theory to explain how the introduction of new information systems is affected by political pressure, institutional constraints, and professional traditions. Sensemaking Theory is then applied to describe how individuals in the organizational context respond to the institutional pressure.

9.3 Method discussion

The data collection methods used in this study facilitated a comprehensive empirical study. We elaborated on the advantages and disadvantages of these methods.

9.3.1 Interviews

The conducted interviews with SSI and the regional contacts have been our primary empirical source of data in this study. Besides providing data for the coding process, the preliminary open interview gave us an understanding of the context of the problem area. The following interviews with the regions and SSI were semi-structured, enabling us to apply the theoretical concepts in the empirical context and ask in-depth questions during the interview.

The construction of semi-structured interviews with the regions was affected by the responses received from a brief questionnaire (see Appendix E). The responses gave us inspiration for the additional questions for the respondents. Asking these additional questions gave us a comprehensive understanding of the individuals' motives and behavior.

It is worth mentioning that the interviews with 'Region A' and 'Region B' had two respondents each. The presence of two individuals in an interview can affect the answers from the respondents, if there is a dependency between the individuals (Andersen, 2008). Dependency can be between an employer and employee, or giving biased answers to avoid embarrassment in front of coworkers. Although we

cannot confirm the presence of these issues, we can state that the fact that we did not conduct two interviews for each of these regions, poses this risk.

We discussed whether to conduct interviews with the ICUs or not, as their opinion has not been addressed in this study.
Initially we wanted to interview a few ICU reporters to determine if their participation was relevant; however, being allowed to conduct interviews with the ICU reporters proved to be challenging. We tried utilizing the regional contacts, which we already interviewed, to introduce us to the ICUs since they already had frequent contact with them. Even though we sent reminders to the regional contacts, we did not receive a reply.

9.3.2 Observations and secondary data

Conducting observations gave us the opportunity to understand the non-human actors. During our observations we watched how the respondents engaged with the technological artifacts and systems in the respondents' context. This interaction provided insights into the associations between the human and non-human actors and, as a result, we were able to evaluate the strength of the observed associations.
A disadvantage of the observations is the probable change of behavior when the respondents know that they are being observed (Andersen, 2008). We were aware of the fact that this behavior could arise, but, due to the timing of the study (following the surveillance season), this issue could not be managed, although this change of behavior can be managed by conducting "hidden observation" (Andersen, 2008).

The methodological effect of our presence in SSI provided several informal conversations that contributed to our understanding and gave us the opportunity to confirm our observations. Additionally, during the short stay at the department of Infectious Disease Epidemiology, we developed a relationship with the employees that gave a behind-the-scenes view of the ICU influenza surveillance system.

The secondary data contributed to our analysis of the non-human actor. By closely studying the documents, such as the Excel worksheet and ICU report, we developed some level of understanding of the nature of these artifacts' documents. To really appreciate the value and effect of the documents, we had to query the epidemiologist, as she had the appropriate knowledge and attitude base to interpret these documents. By attitude, we mean that she was of the correct professional disposition to utilize these documents. Additionally, a document containing the standard operating procedures of the epidemiologist complemented and verified the observations of this position (see Appendix A).

10. Conclusion

In this study, we have investigated; *how SSI can stabilize the national network of the ICU influenza surveillance system?* To set the scope of the study, three sub-questions were stated and answered.

The first question was; *how did the network of ICU influenza surveillance become unstable?* To define how the network became unstable, we revisited the transformation that occurred when the network was established. Since the 2009/2010 pandemic, SSI has been administering a national surveillance system of influenza patients on ICUs. Initially SSI collected patient information directly from the ICUs. However, because of weak associations, SSI required the regions to assign a contact person who collects the patient data from the ICUs. Continuous changes of actors, both humans and non-humans, and difference in interest have created instability in the network, threatening its existence.

The second question was; *which issues arise from involving the Danish Regions in the ICU surveillance system?* An analysis of the regional actors of the network resulted in rich descriptions of their actor-networks. The analysis shows the complexity of managing the associations in an actor-network. Actors have different interests, backgrounds and associations, which, when black-boxed, go unnoticed by SSI.
A comparative analysis across these actors and SSI revealed three patterns evident in the network. We analyzed the patterns and isolated following seven issues, which affected the instability of the network:

Issue 1: Weak association between SSI and regional contact persons affects the collaboration negatively.

Issue 2: Weak association between SSI and regional contact persons are enablers for anti-program.

Issue 3: Regional contact persons with dissimilar pre-inscriptions than SSI develop anti-programs.

Issue 4: Difficult to develop a universal solution to appeal to different background.

Issue 5: Weak inscription of Excel worksheet allows regional contacts to gather data differently.

Issue 6: Weak inscription in the ICU report reduces the distribution to stakeholders.

Issue 7: Different information utility of regional contacts and SSI.

The third question stated was; *which initiatives should SSI implement to stabilize the network of ICU influenza surveillance?* To manage the identified issues, we have proposed five recommendations for SSI to consider in order to stabilize the network.

Our first recommendation for SSI is to recognize the fundamental differences in information utility between the actors in the network. The actor-network was formed after a pandemic influenza, where the purpose is very evident, however, the commitment of the actors have since decreased. Encouraging dialogue and reviewing the ICU reports will strengthen the associations in the network.

Our second recommendation considers the different information utility of the actors in the network. Health care personnel require data during epidemics peaks, while SSI researchers study the development of influenza and need the complete picture. SSI should compromise their data requirements from the ICUs to follow WHO recommendations. Less reporting in the beginning and the end of the

influenza season is in the interest of the regional contact, so by aligning their interests, then the association is strengthened.

Our third recommendation is to displace the regional contact from the network with a non-human actor. SSI must utilize their strong associations with non-human actors and enroll these in the ICU surveillance network. This substitution will stabilize some of the operational instabilities caused by the different interests of the regional contact actors. A non-human actor can be disciplined to follow a specific program and thereby the network would be stabilized.

Our fourth recommendation deals with the weak inscription of the technological artifacts designed by SSI. Anti-programs are developed, both in data gathering from ICUs and when distributing the ICU report, because of the current inscription. Although our analysis has shown the complexity of designing technological artifacts for use in multiple contexts, SSI must design stronger inscriptions of the technological artifacts.

Our fifth recommendation is to encourage a new translation process in the network. SSI must strengthen their position as an indispensable part in the network, by making the ICU report more relevant for the stakeholders.

This study has shown how actor-networks are established and maintained by the associations of the actors. Furthermore, how technical artifacts are perceived differently in distinctive contexts, which makes designing the artifacts complex. Although SSI may succeed in stabilizing the network, they should still regularly open black-boxes to ensure stability, as the associations between actors, human and non-human, shifts over time.

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Appendix report

Stabilizing the Danish ICU influenza surveillance network

– An Actor-network theory perspective

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