

Exploring Information Activities of Swedish Regional Pharmaceutical Committees for Preventing Antibiotic Resistance: Lessons Learned and Areas for Improvement

Granskning av informationsaktiviteter i svenska regionala läkemedelskommittéer för att förebygga antibiotikaresistens: lärdomar och områden för förbättring

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SAMMANFATTNING

Titel: Granskning av informationsaktiviteter i svenska regionala läkemedelskommittéer för att förebygga antibiotikaresistens: lärdomar och områden för förbättring

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Sammanfattning

Introduktion: Världshälsoorganisationen (WHO) har förklarat att antibiotikaresistens är en global folkhälsokris som finns i både låginkomstländer och höginkomstländer. Faktorer som sjukvård, förskrivarnas kunskap om infektionssjukdomar och deras kommunikation påverkar antibiotikaanvändningen och dess förskrivning. Därför metoder som påverkar kommunikationsstrategier för en rationell användning av antibiotika kan vara fördelaktiga i smahället då förökad kunskap kan bidra till bättre användning av antibiotika. **Syfte:** Syftet med denna studie var att granska informationsaktiviteter i svenska regionala läkemedelskommittéer för att förebygga antibiotikaresistens: lärdomar och områden för förbättring. **Metod:** 21 läkemedelskommittéer i Sverige fick 5 frågor via e-post att besvara på gällande antibiotika kommunikation i kommunen. Detta för att sedan analysera svaren med hjälp av kvalitativ tematisk analys. **Resultat:** 18 läkemedelskommittéer besvarade på frågorna därav tre teman och ett undertema identifierades; Nationell reglering och övervakningsverktyg är viktiga för länen, undertema, frekvens av informationsutbyte om antibiotikaförskrivning, Covid-19-pandemins påverkan på informationsaktivitet och Patienternas medvetenhet – ett område att fokusera på. **Slutsats:** I Sverige har länen en viktig roll att förmedla information, uppdateringar av riktlinjer och följa upp antibiotikaförskrivningar på förskrivarnivå. Covid-19 pandemin har ökat kunskapen om att fysiska möten är mer effektiva för att förmedla information. Det finns även ett behov av att utbilda allmänheten även om regionerna är fokuserade på denna aspekt, de flesta län måste fortfarande uppmärksamma detta specifika område.

ABSTRACT

Title: Exploring Information Activities of Swedish Regional Pharmaceutical Committees for Preventing Antibiotic Resistance: Lessons Learned and Areas for Improvement

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Abstract

Introduction: The World Health Organization (WHO) has declared that antibiotic resistance is a global public health emergency that exists in both low income countries and high income countries. Factors like healthcare, prescribers' knowledge in infectious diseases and their communication affect antibiotic use and its prescription. Therefore methods that impact communication strategies enhance rational use of antibiotics. **Aim:** The purpose of this study was to explore information activities of Swedish Regional Pharmaceutical Committees for preventing antibiotic resistance. Also we tried to explore if there were certain lessons to be learned regarding effective information activities, and to identify any rooms for improvements. **Methods:** 21 Pharmaceutical committees in Sweden were sent 5 questions via email to answer regarding antibiotic communication in the county. This to then analyze the responses using qualitative thematic analysis. **Results:** 18 counties responded to the questions whereas three themes and one sub-theme were identified; National regulation and surveillance tools are important for counties, subtheme, frequency of information sharing regarding antibiotic prescription, the COVID-19 pandemic's impact on information activity and Patient's awareness – an area to focus on. **Conclusion:** In Sweden, the counties have an important role to relay information, update on guidelines and follow up on antibiotic prescription at prescriber level. The Covid-19 pandemic has increased the knowledge that physical meetings are more effective to convey information. There is also a need to educate the general public though counties are focused on this aspect, majority of counties still need to bring their attention to this particular area.

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1 INTRODUCTION

1.1 Antibiotic Resistance: A Growing Public Health Concern

In the fight against infections, humans have been trying to control and prevent them since the beginning of time. Infections like cholera, syphilis, plague, tuberculosis, and typhoid fever used to be life-threatening before the discovery of antibiotics (Mohr, 2016). Alexander Fleming's breakthrough discovery of Penicillin in 1928 revolutionized the medical industry, leading to the control and prevention of infections and the safe conduct of complicated medical procedures like organ transplantations and open-heart surgeries (Encyclopædia Britannica, 2022; Hutchings *et al.*, 2019). However, the post-antibiotic era saw the emergence of antibiotic resistance, which has spread at an accelerated rate due to the overuse and irrational use of antibiotics in agriculture, animal use, and human consumption (Frieri, 2017; Tan & Tatsumura, 2015). The World Health Organization (WHO) has declared antibiotic resistance a global public health emergency, affecting both low and high-income countries (Brockmann *et al.*, 2007). As per Centre for Disease Control and Prevention (2022), antibiotic resistance kills nearly 1.27 million people globally, and approximately 5 million deaths were associated with antibiotic resistance in 2019. The United States reported 35,000 deaths as a result of antibiotic resistance (CDCP, 2022). The elevated cost within the healthcare system and the suffering of individuals make it imperative to control antibiotic resistance. Rational use of antibiotics, which implies using the correct dosage, duration, and indication of the antibiotic, is one of the primary ways to reduce the risk of antibiotic resistance (Folkhälsomyndigheten, 2022a; Folkhälsomyndigheten, 2022b).

1.2 Antibiotic Resistance

1.2.1 Mechanisms of Antibiotic Resistance

Understanding the mechanism of resistance is crucial for developing effective strategies to combat antibiotic resistance. Antibiotic resistance can occur through various mechanisms. There are two categories of the mechanism of resistance - enzymatic degradation of antibacterial drugs and/or alteration or bypass of the antimicrobial targets. Enzymatic degradation involves bacterial enzymes like β -lactamase that destroy the β -lactam ring of penicillin's active-component. Another way of degrading antibacterial drugs is by producing enzymes that will add different chemical groups to antibiotics' existing compound, altering the binding site of the antibiotic, rendering it no longer bindable to the target bacterial cell. When it comes to alteration or bypass of the target, mutations in bacterial DNA can result in a change in the composition of the receptor in the bacterium, preventing the antibiotic from binding (Dever & Dermody, 1991). The overconsumption of these antibiotics results the mechanism of antibiotic resistance to occur faster therefore by understanding these mechanisms, it is possible to develop new antibiotics and alternative treatment approaches that are less susceptible to resistance (Martínez & Baquero, 2014).

1.3 Strategies for Controlling and Preventing Antibiotic Resistance

1.3.1 One Health Approach

Antibiotic resistance is not limited to humans but is a broader issue affecting animals, wildlife, plants, and the ecosystem. The One Health approach is designed to address this interdependent problem on a global scale, with collaborative efforts in designing and implementing policies, legislation, programs, and promoting research by bringing health science professions and institutions together to achieve better public health outcomes. The key focus of the One Health Approach is to preserve the effectiveness of antibiotics and prevent the spread of infections (McEwen & Collignon, 2018). In humans, prevention and control of infection are tackled by promoting improved hygiene and sanitation. Pollution from residential, industrial, and farm waste has contributed to poor oceanic waters, ever-changing marine organisms, and human respiratory health, all of which have expanded resistance in the ecosystem. The over-prescription of antibiotics to tackle acute health conditions and a lack of public understanding have also contributed significantly to antibiotic resistance in humans (Aslam et al., 2021; Hamers et al., 2022).

1.3.2 STRAMA: The Swedish Strategic Program Against Antibiotic Resistance

The Swedish Strategic Programme Against Antibiotic Resistance (Strategigruppen för rationell antibiotikaanvändning och minskad antibiotikaresistens (Strama) is a program in Sweden established in 1995 to prevent antibiotic resistance. To prevent and control antibiotic resistance, a cross-functional input was required, and a voluntary network of authorities and organizations collaborated with 21 counties in Sweden to form the Strama group at a national level. Strama has become an independent governmental body aimed at creating a platform for national and local authorities to share knowledge on bacterial infections, implement guidelines and policies to preserve the effectiveness of current antibiotics used for animals and humans (React Group, 2022; Molstad et al., 2008). Strama advocates for the rational use of antibiotics and measures treatment guidelines compliance to the percentage of antibiotics prescribed. The program also focuses on raising awareness of antibiotic resistance, minimizing antibiotic prescriptions, and developing programs to improve antibiotic use (React Group, 2022).

The Swedish Ministry of Health and Social Affairs funds Strama with an annual budget of 10 million krona. The program consists of two levels: a government-funded national executive group and county groups (Molstad *et al.*, 2008). Each council is organized to provide primary and secondary care, while tertiary care is provided by regional university hospitals (Mölstad *et al.*, 2008b).

The national Strama group coordinates activities to prevent antibiotic resistance nationally. These activities include analyzing trends in antibiotic resistance and consumption, identifying areas lacking knowledge, and conducting studies to improve these areas. The group also supports county groups and yearly action plans. Annual meetings are held for county groups

where a thorough analysis and current situation on antibiotic resistance is provided, and educational programs are discussed (Mölstad *et al.*, 2008b).

1.4 Antibiotic Prescription and Use

1.4.1 Swedish County-level Variations in Antibiotic Prescription

Sweden has successfully managed antibiotic resistance in human use compared to the global market. In 2021, the average number of daily defined doses (DDD) of antibiotics on prescription in healthcare facilities was 9.7 per 1000 inhabitants per day. The national goal is to achieve ≤ 250 prescriptions per 1000 inhabitants and year in all 21 counties, with 19 counties successfully meeting this target in outpatient care by prescribing 230 prescriptions per 1000 inhabitants. 9 counties of which had < 220 prescription/1000 inhabitants in 2021 and 12 had over > 220 prescription/1000 inhabitants (Swedish National Veterinary Institute, 2022). Between year 2017 and 2021, a gradual decline is observed in the prescription/1000 inhabitants and year, see **figure 1** (Socialstyrelsen, 2022).

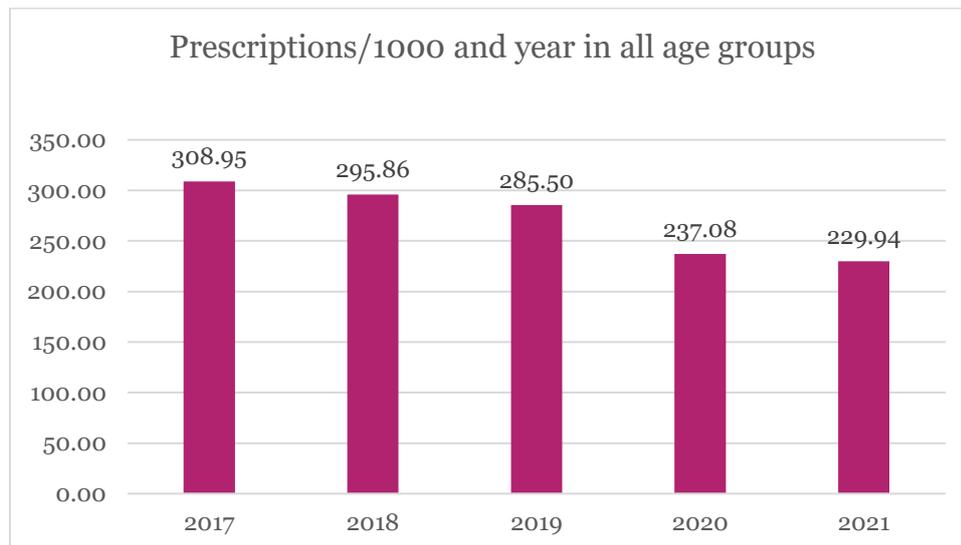


Figure 1: 2017-2021 prescriptions per 1000 inhabitants and year. Source: Using the Swedish Statistical data website (sdb.socialstyrelsen.se), filters were put to select counties and yearly.

1.4.2 Prescriber Knowledge and Practices

The knowledge and attitude of prescribers are crucial for the rational use of antibiotics. The Swedish Strategy to Combat Antibiotic Resistance, adopted in 2020, has the overarching goal of preserving the possibility of effective treatment of bacterial infections in humans and animals. This strategy has seven objectives that work towards achieving the goal; both nationally and internationally. The fifth objective of the strategy is to improve awareness and understanding in society of antibiotic resistance and countermeasures (Swedish Government, 2022). The government expects to disseminate knowledge about antibiotic resistance and preventive measures to build on Sweden's expertise in this area. Furthermore, efforts to drive the rational use of antibiotics have been made by Strama and the Public Health Agency. The aim of the researchers' project is to support local county councils in creating and spreading

informative material on antibiotics and their resistance. Rational usage of antibiotics, including type, dosage, and duration of treatment, is essential in minimizing the risk of developing antibiotic resistance. Studies at the county council level have examined the quantity, adherence to treatment recommendations, and doctors' reasoning when prescribing antibiotics. The public health agency has reported a significant decline in antibiotics sales since its peak in 1992, with the greatest decrease observed in children aged 0-4. The public health agency is collaborating with stakeholders to fight against antibiotic resistance and has a communication strategy document outlining how to communicate with different target groups to educate and raise awareness in society. There is variation in how a prescriber resonates around their prescription of antibiotics, with differences seen in the way prescribers prescribe antibiotics and the informative platforms that relay information to them (Folkhälsomyndigheten, 2022a).

1.5 Public Health Relevance

The One Health approach in public health acknowledges the intimate connection between human health, animal health, plant health, and the environment. Antibiotic resistance is a global threat to public health, and overuse of antibiotics in humans and animals contributes significantly to the problem. By applying a One Health approach, public health professionals can address the drivers of antibiotic resistance across different sectors, emphasizing the importance of collaboration between stakeholders (Aslam *et al.*, 2021). However, despite years of research, much remains unknown about the problem of antibiotic resistance. For example how can people use antibiotics rationally or how can effective communication method be employed to improve prescriber's reasoning around prescription of antibiotics?

Many individuals are unaware of the dangers of antibiotic misuse and overuse, leading to the development and spread of antibiotic-resistant infections. Therefore, information activity research is critical for preventing the spread of antibiotic resistance. Increasing public awareness and education about antibiotic resistance can encourage people to take action to prevent its spread. This can include developing educational materials and campaigns, training healthcare providers on appropriate antibiotic prescribing practices, and promoting the development of new antibiotics and alternative therapies to treat infections. Ultimately, a multifaceted approach that combines research, education, and action at both individual and societal levels is necessary to combat antibiotic resistance (Hamers *et al.*, 2022). As per the FN agenda 2023, the One Health approach will play a significant role in addressing global public health challenges like antibiotic resistance (Dietler *et al.*, 2019).

2 AIM

The purpose of this study was to investigate the Swedish regional pharmaceutical committees information activity to prevent antibiotic resistance. Also to explore if there are certain lessons to be learned regarding effective information activities, and to identify any rooms for improvements.

3 METHOD

3.1 Study Population

In order to conduct this study, questions were put to the pharmaceutical committee in all 21 counties in Sweden. The purpose of the pharmaceutical committee in the county is to contribute to medication use in a safe, rational and cost effective manner. There are 21 county councils which have their own process to adhere to the governmental recommendations for pharmaceutical related questions. These committees were chosen based on their ability to provide relevant and reliable data for the study. The committees were informed about the objectives and were requested to participate by answering the questions relevant to their county management.

3.2 Selection

For the purpose of this study, a total of 21 Pharmaceutical committees (Läkemedelskommitten) were selected from all counties in Sweden. **Figure 2** shows all 21 Pharmaceutical committees across Sweden's counties.

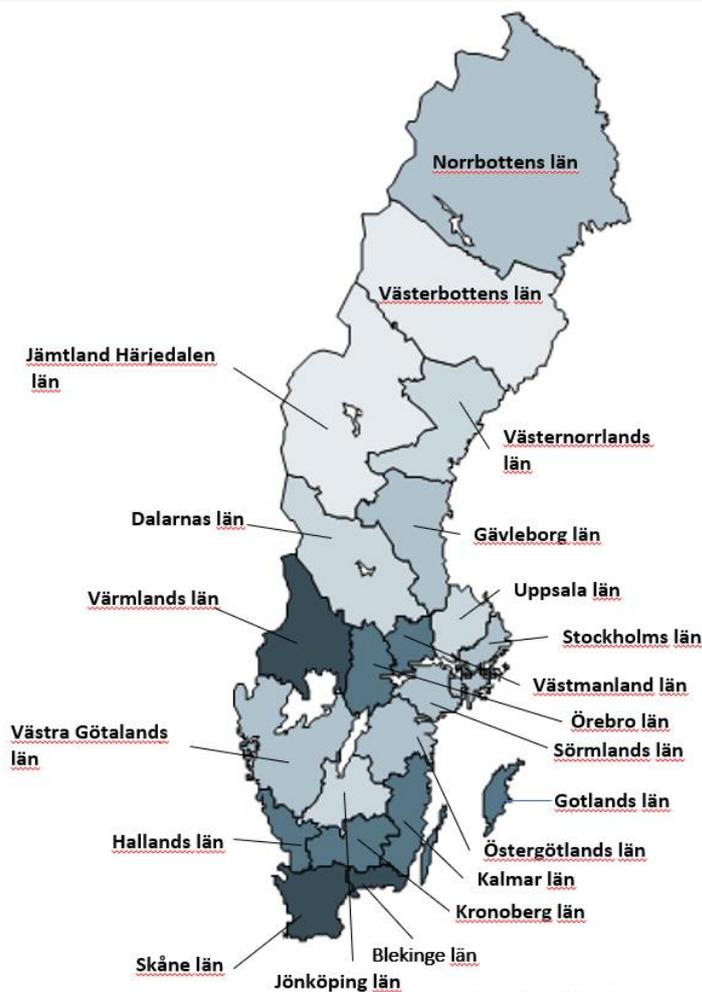


Figure 2: 21 counties in Sweden. Source: Map taken from the Swedish Statistical data website (sdb.socialstyrelsen.se), MicroSoft PowerPoint was used to locate the counties.

3.3 Data Collection

This study has been carried out in a professional manner by sending a formal email to the county councils registrar office, see appendix 1 for the formal letter with questions. Using the county's local website, the registrar's email was collected. Creating an excel sheet, all email addresses were compiled. For counties where the main registrar's email address were not accessible at their homepage, the email address was instead obtained by contacting the county council's contact centre. The email to the registrar's office, consisting of 5 questions, was intended to provide information that the questions are a part of a student thesis and that only answers provided within a specific time period will be considered. This email was sent to all the 21 county's at the same timepoint (October 2022). Later another reminder (November 2022) was sent to the remaining county councils who had not responded by the initial deadline and another deadline date was conveyed.

3.4 Analysis

Braun & Clarke (2006) thematic analysis is a method which can allow two aspects; *“reflect reality and unpick or unravel the surface of reality”* (Braun & Clarke, 2006). Thematic analysis is a method in qualitative research that involves the identification, analysis, and reporting of patterns or themes within data. It is a flexible and accessible approach that can be applied to various types of data set to be searched in any focus group, texts or interviews. The purpose behind using thematic analysis becomes to find meaning behind repeated patterns. In this study, the focus group was county registrars responses from the questionnaire. The aim of this study was to explore the Swedish regional pharmaceutical committees information activity to prevent antibiotic resistance and to suggest areas to improve on. Hence, thematic analysis was suitable to be used in this study to analyse data collected from 18 informants, county registrar office responsible person. After the responses were received from respective county councils, a compilation of these responses were made using Microsoft Excel. Each row was distributed into respective county council and column on questions asked (see **appendix 1**). Every time a response was received from a county, responses were inserted to each question. Braun & Clarke (2006) describe this as phase I where the author comes somewhat familiar with the subject. Despite the familiarity and thoughts, the content needs to be analysed by possibly reading the content, in this case responses from the registrar officers were read at this Phase I stage. Moreover, this an active approach is taken to identify meaning behind the responses. After the collected responses, the responses were systemically read several times to generate initial codes from the questionnaire answered by the informants, hence entering the, Phase II of the analysis (Braun & Clarke, 2006). The responses given by the county registrar offices, their responses were organised into groups by the author, moreover the text was read several times and text and words were highlighted in the Microsoft Excel sheet. It was observed that the responses were repetitive regarding how often and what type of activities are carried out. As seen in **table 1**, once these codes were identified, the analysis proceeded to its phase III which is to create

themes from the identified codes i.e “visit every primary care clinic 1 time yearly and pharmaceutical committee”, “strama representatives at all primary care centres”, “The pandemic has contributed to not having bigger educational courses or campaigns” and that patients are not primary focus for councils to convey information regarding antibiotics. In the third stage, the researcher searches for themes, which are patterns or clusters of codes that capture a specific idea, concept, or phenomenon. In the fourth stage i.e. phase IV, the themes were reviewed and refined, ensuring that they accurately reflect the data and do not overlap with other themes. The fifth stage involves defining and naming the themes, which involves writing a brief description of each theme and giving it a descriptive name which was done and ultimately reached the following themes: National regulation and surveillance tools are important for counties, The COVID-19 pandemic’s impact on information activity and Patient’s awareness – an area to focus on.

Table 1: Analysis process using thematic analysis; codes and themes

Code	Themes
“visit every primary care clinic 1 time yearly and pharmaceutical committee” ”Bigger educational program every other year” “Antibiotic weak” ”Different activities and information campaign” ”Implement antibiotic rounds” “Antibiotikasmart”	National regulation and surveillance tools are important for counties
“strama representatives at all primary care centres” “every year to have diagnosed linked meetings for an hours at prescriber’s level” Strama’ follow up visit should be planned in 2022 ”Treatment guidelines are produced by Strama, Folkhälsomyndigheten och Läkemedelsverket”	National regulation and surveillance tools are important for counties
“Primary care centre meetings have been digital during worst covid times” “The pandemic has contributed to not having bigger educational courses or campaigns”	The COVID-19 pandemic’s impact on information activity

"Has not worked optimally since the pandemic started"	
"collaboration with local media on using antibiotics responsibly" "We have not targeted directly the general public." "we have patient brochures" " information campaign on social media"	Patient's awareness – an area to focus on

3.5 Ethical aspects

As this study is being conducted as a master's thesis, it falls outside the scope of the Ethical Review Act (SFS 2003:460). However, it is important to note that research studies in general are required to adhere to this law and it can therefore be of importance for students who are planning to have research publication to ensure adherence to the Ethical Review Act (SFS 2003:460) (European Network of Research Ethics Committees, 2022). Certain ethical principles need to be followed in Swedish research which are also outlined in the Helsinki Declaration, research principals have been specified as per the medical research. It states that upon research, a patient's integrity, anonymity and right to make their decision should be taken into consideration (Allea, 2017). Therefore when participants are on a project, they should be well informed about the purpose of the study and give their consent to enrol in the study. In this study, using the questions sent to the county councils, a brief purpose and contact information of the researcher were also provided in case the respondents wanted further information. Furthermore, their right to opt out of the study whenever they want to. Moreover, the utilization requirement means that the information collected about the informant may only be used for the purpose of the study (Allea, 2017). When this study has been approved and the data material for this study collected through the university's official email system, it is important to ensure that this data is handled appropriately, and as such, all data will be destroyed after analysis and no unauthorized individuals will have access to it.

As per the Good Research Practice guidelines; a study needs to be conducted in a satisfactory way which is scientifically and ethically sound. Furthermore, The European Code of Conduct for Research Integrity mentions four concepts relating to ethical requirements of a research; reliability, honesty, respect and accountability (Allea, 2017).

3.6 Author's prior knowledge within the topic

The author is a registered pharmacist in Sweden who is aware of antibiotic resistance. The

author is also a Medical Information Specialist. Being a community pharmacist, it is known that patients are unaware about most of their treatment but sometimes even the prescriber's do not have proper knowledge about treatments. Being able to communicate effectively with patients can be challenging but being confident in your decision is helpful. So the author knows the importance of confident decision making. Being a Medical Information Specialist, a lot of the healthcare professionals contact to get more information/ internal data on a particular medical product to make an informed decision for their patients. This confidence stems from proper training in various areas in the fields. The author has also lived in Sweden and the UK, where observations have been made in several instances where prescriber's lack of attention or perhaps knowledge has contributed to medication prescription errors.

4 RESULTS

The primary objective of this study was to explore the Swedish regional pharmaceutical committees information activity to prevent antibiotic resistance. The initial request for responses was sent to 21 registrar officers, of which 7 responded within the first two weeks, and a total of 12 responded after a month. A reminder was sent to the remaining county councils.

Ultimately, 18 out of the 21 county councils/informants responded to the questionnaire.

Upon analyzing the data collected from the 18 counties, three distinct themes emerged from the informant's responses. The first theme, "National regulation and surveillance tools are important for counties," was identified by all 18 counties who acknowledged the significance of using guidelines and databases to obtain prescription data. Additionally, 10 of the 18 informants highlighted the impact of the COVID-19 pandemic on communication activities, which was categorized as the second theme, "The COVID-19 pandemic's impact on information activity." The third theme, "Patient's awareness - an area to focus on," was mentioned by all 18 informants.

Furthermore, the first theme had a sub-theme, "Frequency of information sharing regarding antibiotics."

Table 2: Themes and sub-themes

Themes	Subthemes
National regulation and surveillance tools are important for counties	Frequency of information sharing regarding antibiotic prescription
The COVID-19 pandemic's impact on information activity	
Patient's awareness – an area to focus on	

4.1 National regulation and surveillance tools are important for counties

The informants concluded that majority of the discussions on how prescriber's should prescribe antibiotics in order to prevent antibiotic resistance has been taking place since the 1990s.

However, since the beginning of 2000s a more systematic approach has been developed. The pharmaceutical committee and Vårdval focus on different goals on a yearly basis, stated 2 informants. These meetings held are often adjusted and vary from counties to counties. Predominately, all 18 county informants responded that an hour's lecture takes place where the assigned county representatives, i.e. Strama agents or county coordinators are involved to educate the primary care doctors as well as hospital staff. 5 counties out of these total responded described that they have more than 2 occasions at which these meet ups take place to disseminate information on antibiotic use are taken place

“Visits to each health centre once a year and that the pharmaceutical committee addresses antibiotic resistance during their annual visits” [Informant 1]

Furthermore, in these lectures, a “*diagnosis-linked data*” at prescriber level data is presented. This basically means that indication and the prescribers are compared, both on how many prescriptions for that particular indication have been made but also what kinds of antibiotics the prescriber has prescribed. How many antibiotic prescriptions were prescribed from number of infection visits per prescriber. The counties compare the healthcare centres in prescription/1000 inhabitants and number of first-line antibiotics prescribed. Moreover, for the individual prescriber, digital prescribing and whether they have patients who received more than 3 antibiotic prescriptions in the last year are shown in the lectures. National statistical database is used to extract data statistics on number of prescriptions. These dictate the direction of those educational lectures targeted towards the healthcare staff. MedRave, a software is used to analyse data from that too, mentioned by several informants. These also determine which allow discussions on the procedures and guidelines are communicated at these educational lectures.

“... then diagnosis-linked prescribing data and treatment guidelines are also discussed” [Informant 13]

“At the beginning of each year, the drug committee generates statistics regarding antibiotic prescribing in the region, including comparisons in antibiotic prescribing between different health centres. The statistics are presented and discussed with the prescribers at meetings at each health centre. Strama regularly conveys reports from the infection tool (Infektionsverktyget) to health centres and clinics and has an annual meeting with an antibiotic manager at each unit/activity. This person is tasked with conveying information and coaching colleagues.” [informant 9]

“Data via ”Infektionsverktyget” among other things data feedback allows the primary care center and clinic do not to work on things that look good, instead can delve deeper into what they need to work on [Informant 2]

Moreover, healthcare professionals are encouraged to discuss routines and their habits of doing things at work.

"We also want them to discuss routines and how they do things in their workplace so that both nurses and doctors are involved." [Informant 2]

The county primary care centres are responsible for their own learning and majority of the informants stated that it is prescriber's responsibility to keep themselves up to date with treatment guidelines. However, updating prescribers on new guidelines take place by sending push notifications for some of the counties. All of 18 counties update their websites. There is also counties who physically visit clinics and primary care to update them on new guidelines meanwhile other counties rely on push notifications and prescriber's ownership for their own learning.

"Each year the primary care centres also get the mission to individually work on these questions" [informant 12]

Treatment guidelines are originated by The Swedish Medicinal Agency, the Public Health agency and Strama. These guidelines are basis for information activity carried out by the counties. The informants also relayed that a project is ongoing; AntibioticSmart. This is another approach which is being implemented to minimise antibiotic prescriptions. These have criteria, 4 of them: 250 antibiotic prescriptions/1000 listed; At least 70% of collected antibiotics (J01 excl. J01XX05) must consist of first-line antibiotics (Pivmecillinam, Nitrofurantoin, Flucloxacillin & Penicillin V); Strama's follow-up visit must be planned or carried out in 2022; Self-declaration must be completed and submitted by 30 September at the latest.

"Treatment guidelines are produced by Strama, The Swedish Public Health agency and Swedish Medical Product Agency" [informant 12]

4.1.1 Frequency of information sharing regarding antibiotic prescription

A sub-theme resided in the responses received from the participants; Frequency of information sharing regarding antibiotic prescription. All 18 counties have at least 1 occasion per year to share data with prescribers. However, 9 out 18 counties focused whether there is also a need for additional events or meet ups to relay information and ensured that there is multiple occasions to disseminate information.

One informant mentioned that during the spring and autumn the county council responsible person goes out to primary care centres alongside a pharmacist and bring antibiotic resistance topic up in different ways

“Pharmacists and I go to all health centres in autumn and spring and address this topic in different ways. [Informant 2]

Another informant mentions that 4 times annually events are organised to share information at hospitals. Counties also mention that they also have a doctor in their contact who acts like an extended arm and antibiotic statistics is sent quarterly in the purpose to serve like a development process for the primary care level. Depending on the need, additional visits are made by the counties to support improvement process for a rational antibiotic use basically high compliance to treatment guidelines They also send regular information with news.

“...feedback to all prescribers in outpatient care four times a year.” [Informant 13]

4.2 The COVID19 pandemic’s impact on information activity and the future of antibiotic resistance

In the responses received, 10 informants out of the 18 clarified that the pandemic has contributed in the way educational courses and yearly campaigns have been communicated with the healthcare staff. One informant mentioned specifically that these meetings have not been big due to the pandemic.

“...the pandemic has resulted in that we have not had any big educational programs or campaigns” [informant 1]

Moreover, during the pandemic the primary care centre clinic visits have transitioned over in digital format as compared to physical meet-ups emphasized the informant. Though, one of the informants concluded that it is better with physical meetings as it allows discussions in the groups. The informant relayed that during the pandemic, both Disease control physicians (Smittskyddsläkaren) and The Swedish Public health agency encouraged measures like home quarantine, washing hands and social distancing. This led to a decreased antibiotic prescription. However, an increase in the prescriptions has been observed again since the pandemic restrictions were lifted. The informant stated that they wished that people could continue with these rules, specifically during winter times as this period results in increased respiratory tract infections. The informant also wished for schools and nurseries to wash more hands.

“During the pandemic, Disease control physicians and The Swedish Public Health agency emphasized to stay at home when sick, wash hands and maintain distance. This has led to a steep decrease in antibiotic prescription. It is increasing again. One would wish that people continue to adhere these rules, more during the winter period since all respiratory infections increase. To wash hands also contributes to decreased gastroenteritis. Good if nurseries and schools could emphasize the importance of washing hands, for example, before the children eat.” [Informant 2]

Furthermore, 10 county informants out of 18 stated that clinic visits/rounds at the hospital have decreased but are aiming at getting started with this again after a halt during the pandemic.

"Before the pandemic started the infection physicians had "antiotic rounds" at other clinics but this has not restarted." [informant 7]

"Vårdcentralsmötena har varit digitala under den värsta covid-tiden." [Informant 5]

There is also a general trend in the informants relaying that there has been projects which came to an halt during the pandemic. It was mentioned specifically by one informant that there is a dormant project with the "antibiotic and catheter smart team" as they had intended to use their own version of the circular card that Strama previously printed. The pandemic and a very difficult health care situation in their region and a lack of hygienist doctors and Strama doctor resources mean that they do not know if the project can become a reality.

"We have a dormant project with antibiotics and catheresmart team...The pandemic and an extremely hard healthcare situation in our region and lack of hygiene physicians and Strama physicians has resulted that we do not know if the project will ever be reality" [Informant 15]

The information exchange occurs once a year according to all informants via meetings, though one of the informants emphasized that physical meetings allow discussions to take place hence yearly meetings are preferred to take place physically and not digitally.

" During the pandemic the primary care visits have transitioned digitally. Otherwise it is better with physical meetings due to the discussion in the working group which is the most important" [Informant 2]

4.3 Patient's awareness – an area to focus on

12 out of the 18 informants loosely put that they are or have previously focused on to inform the general public on using antibiotics responsibly by working together with the local media. There has been efforts to use social media and patient leaflets by some counties moreover one informant stated that cinema advertisements has been used to make the patient aware on antibiotic resistance.

"..collaboration with the local media to inform about the important on using antibiotics responsibly" [informant 13]

There are counties that have mentioned that the general public is not being communicated to for county's part for antibiotic resistance. 5 counties out of the 18, stated clearly that they are not focusing on the public currently. They have targeted information towards patient/ the general public is something they are planning to do, or this is an area that they are not focusing on and also that pre-pandemic this was an area that was being look into. Moreover, some counties also stated that they do relay information to patients when requested to on behalf of

the patient organizations.

“It was several years ago, about 5-6 years ago, when we sent out an information brochure to all households. A few years ago we had an information campaign on social media.” [Informant 1]

” We have not directly targeted (information on antibiotic use) towards the general public” [Informant 6]

Waiting room at the general practitioner’s Centre, TVs are available, 4 informants mentioned that these are being used to inform patients while waiting for their appointment. One informant concluded that buses have also been a medium to send across the message on rational antibiotic use.

” Yes, the information on TV and on buses and trains, to visitors to healthcare facilities (e.g. waiting room material) and to the general public in radio and newspapers linked to press releases about antibiotic use and antibiotic resistance” [informant 10]

Only One informant out of the 18 who responded stated that this year, focus groups with the general public of various ages have been targeted to have events during the evenings. The aim for this county is to find out the public's knowledge about antibiotics.

” Focus groups with members of the public of various ages have also been held this year over a couple of evenings. The aim has been to find out the public's knowledge about antibiotics” [Informant 11]

The same informant described that there is half-day seminars for teachers on antibiotic resistance, there is half-day webinar on ”Hygiene and contagion in preschool” for preschool staff”. The same informant stated that due to financial reasons this was not possible to be conducted in year 2017.

“Half day webinars for teachers on antibiotic resistance”

“Half day webinar seminar “Hygiene and infection in the nursery” [Informant 11]

5 DISCUSSION

5.1 Result Discussion

The purpose of this study was to investigate the information activities of Swedish regional pharmaceutical committees with respect to preventing antibiotic resistance. The findings emphasize the importance of national monitoring, which can be achieved through the use of tools such as MedRave, the National Statistical Database, and the Infection Tool

(Infectionsverket), as well as a shared objective to combat antibiotic resistance by encouraging prescribers to use antibiotics rationally. The study also suggests that county councils have gained insights into effective antibiotic communication with prescribers during the COVID-19 pandemic and that physical meetings are preferable for facilitating discussions among healthcare professionals. However, there is still a need to focus on improving patient knowledge, which should be a priority for several county councils. Below, an in-depth discussion is provided with respect to each theme.

5.1.1 National regulation and surveillance guidelines are important for counties

The theme national regulation and surveillance indicates that in order for antibiotic resistance to be controlled and potentially prevented, the prescribers need to receive appropriate education and training. This leads to rational antibiotic prescription. Even, WHO supports this result as one of their reports mentions that in order to prevent or decrease the rate at which antibiotic resistance is happening, increased knowledge at prescriber level as well patient level are beneficial (WHO, 2022). Thus, the information activity conducted by counties is of significant importance as they heavily rely on national guidelines from the Swedish Public Health Agency, the Swedish Medical Agency, and input from Strama. It is concluded that for any country to increase rational antibiotic use, national-wide input is required, whether it is to put guidelines, have representatives educate healthcare staff, or use tools to extract data. Counties have stated that there is tailored education programs, materials and statistics that are being shared at prescriber level using useful tool.. Sweden has achieved tailored educational programs at prescriber level to allow for better knowledge on antibiotic resistance. Counties are dependent on their national recommendations. Looking ahead, as illustrated in **Figure 3**, an interdisciplinary approach is required for any country to achieve better information activity and national regulation and surveillance tools. The figure proposes a systematic approach of how information activity from cross-functional government bodies can impact information activity. This illustration is inspired from reports such as "*Health in the 2030 Agenda for Sustainable Development*" who have highlighted the importance of inter- and transdisciplinary and equitable partnerships in achieving global health goals (Dietler *et al.*,2019). The illustration was solidified by the results achieved in this study i.e. the counties having the national goal to achieve ≤ 250 prescriptions per 1000 inhabitants and year and counties having surveillance tools like MedRave, Antibiotikasmart to achieve the national goal. Therefore, it is essential that countries worldwide adopt strategies like the Countries that lack significant monitoring may be due to inadequate national recommendations, and agencies are required to make policies and systems to allow for a common goal (WHO, 2020). Simply relying on prescribers or counties would not suffice in reaching sufficient information to prescribers.

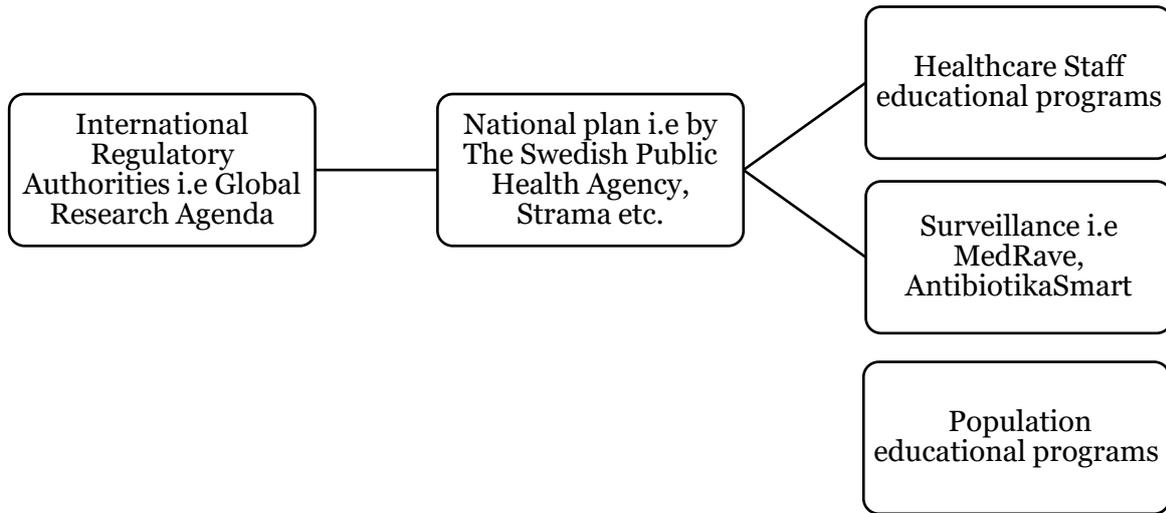


Figure 3: A systematic national and international wide input approach where multidisciplinary input is needed

The use of the national statistical database is a significant tool for extracting data on the number of antibiotic prescriptions made. This tool is used by national organizations in counties to base their educational programs on the number of prescriptions made, as antibiotic prescription control and prescription already made go hand in hand. This knowledge can be applied to a wider perspective, as countries with high rates of antibiotic prescription such as the U.S, China, and Kuwait can use this data to implement tools like MedRave and guidelines for educating prescribers and improving the antibiotic resistance situation (Zhang et al., 2006).

The One Health approach is applicable to this theme. In order to prevent global health threats such as antibiotic resistance, the World Health Organization emphasizes the need for integrated work on human, animal, and environmental health across the globe (WHO, 2017). Therefore, tools and guidelines are equally important for addressing the use of antibiotics in animal and environmental health, in addition to human health.

In the sub-theme, 7 counties had <218 prescription/1000 inhabitants in 2021, 5 out of these described that they have more than 2 occasions at which these meet ups to disseminate information on antibiotic use are taken place. Though two counties which had over >235 prescription/1000 inhabitants had similar approach to the abovementioned ones, in addition provided quarterly and monthly reports to primary care. And the rest of the counties reported clearly that 1 meet up in a year takes place. This could possibly indicate that the frequency at which these meetups occur could potentially lead to a reduced prescriptions in certain counties. Though more data would be required, potentially quantitative to explore further the correlation between frequency of content delivery and prescriptions.

5.1.2 The COVID19 pandemic's impact on information activity and the future of antibiotic resistance

In this study, COVID-19 related theme was unexpected however as the informants responses reside, it became evident that the Covid-19 pandemic has resulted in the following points; lower prescription of antibiotics, halt in the educational programs, transitioning to digital meetings instead of physical meetings. This is reinforced by several studies that have concluded that the pandemic has infact impacted in the way antibiotics are prescribed (Rodríguez-Fernández et al., 2022).

As the result showed in this theme, the respondents from the the counties mention that they focus on educating prescribers, students, nurses on how often they prescribe a particular antibiotic. It is interesting to see that informants are using physical meetings and mentioning that these are better as it can result in better discussions. A recent study conducted by Honavar (2021) also supports this theme of the pandemic, COVID-19 impacting in the way educational programs were conducted. Honavar (2021) reports in his study that physical meetings are better which can contribute to spontaneous interactions, gives an opportunity to the meeting attendees to build up relationships and moreover more complex scientific issues can be targeted. The article further emphazies that digital medium can be impersonal and faceless while the lack of attention from the listener can be more due to the distracting environment at their end (Honavar, 2021). Honavar's study reinforces the theme emerged from the answers the informants gave in this study, since majority of the counties concluded that physical and digital meetings are not equivalent. Based from the results achived in this study and articles reinforcing this, a proposal can be made for future counties to work on; to combine these mediums because sticking to the virtual medium only could result in weakened information activity from the counties. This could financially contribute to increased investments but lower yield of prescribers or patients not actually learning at the same level as physical meetings.

The results in the theme also pointed out on the lowered prescription rates for antibiotics during the pandemic; this can be supported by the study "*Antimicrobial prescription fills and hospital requisitions in Sweden during 2020 against those of preceding years*". This study has highlighted a decline in annual dispensing of antibiotics by 17%. The study further states that this decline can be supported by a probable decrease in the incidence of bacterial infections due restrictions that were implemented to mitigate COVID-19 pandemic i.e. Social Distancing and Working from Home. Lower levels of infections led to fewer visits to doctors and thus lesser occasions of prescription of antibiotics (Nakitanda et al.,2022). This further explains why informants concluded that lower antibiotic prescription was seen. In addition, this also explains why there is a need to focus on information activity provided by the nation representatives. Moreover, to have programs like Strama as the same study also states that this trend of lower antibiotics usage level during COVID-19 was not supported in low/middle countries. In particular countries with inadequate access to health care settings and minimal/relaxed antibiotic prescription control. The lack of knowledge around antibiotics usage, paired with the panic of COVID-19 infection - lead to a direct increase in the usage of over the counter antibiotics. The study also reported that 68.9% of COVID-19 patients had received antibiotics with a self-medication rate of 33.0% before hospital admission. These stats magnified the abundance of misinformation on the value of antibiotics in countries; where information failure

through health care professions and government lead to such mishandling of COVID-19 pandemic. (Nakitanda et al.,2022).

The future of antimicrobial resistance relies on coordinated and collaborative programs on designing interventions to improve antibiotics prescription. These programs consist of promoting controls on dispensing, dosing and duration of therapy of antimicrobial drugs. All these efforts fall under Antimicrobial Stewardship (Ghosh et al., 2021). Internationally, countries need to collaborate to disseminate information and influence the information activity in a country.

5.1.3 Patient's awareness – an area to focus on

Majority of the counties are not targeting the general public directly. There were inconsistencies in the way information was being relayed from the county pharmaceutical counties and also the frequency of it. Several county councils stated that they had worked on making the patient aware however mainly one county specified on a detailed work that they are doing for patients and their knowledge on antibiotic resistance. As seen in section 4.3, there are counties who are relaying information on antibiotic resistance by utilizing the local media/social media, waiting rooms at the general practitioner's office, local newspapers, buses, patient leaflets or general material created to inform the patient. While this is a great effort as the Swedish public is being made aware of antibiotics rational use. There is still counties that are not targeting this group and are not focusing on the general public at all. Some efforts are made as by counties who are not limited to inform in various platforms and way of communicating this to prescribers but also the general public. The general public's knowledge is being considered at pre-school level as well as half day seminars for teachers. This educational programmes to children could prove to be beneficial in the future generations as they will be made aware of the issue at an early age and growing older could serve the community in general by using antibiotics rationally. As one of the main causes of antibiotic resistance is incorrect use of antimicrobial drugs (Antwi *et al.*,2020). This could partially depend on the lack of knowledge on the correct use of antibiotics by both the general public as well as the prescribers. Due to irrational use of the antibiotics, this can lead to antibiotic resistance due to bacteria's DNA developing mutations which make them resistant to the antibacterial action. Furthermore, extended consumption of antibiotics lead to the survival of resistance bacteria while the sensible bacteria reaches a decline phase, it dies (Gualano *et al.*, 2015). Antwi *et al.* (2020) have postulated that in order to combat antibiotic resistance, the general public needs to be educated and also there is a requirement for development and implementation of policies that are transferable. The reason behind this is that there are misconception on the use of antibiotics and is the case in various countries (Antwi *et al.*,2020).

There is currently no policies on how much, what level and which age groups the public should be informed. The Swedish system has a great way of monitoring this type of information. Therefore, perhaps making a policy on that it should be a requirement to focus on the patient group to enhance their knowledge on antibiotic resistance is an area for the counties to work on. The government could potentially even provide finances and resources to encourage the counties to target this area of the group as well similar to the prescribers.

5.2 Method discussion

5.2.1 Evaluation of the Method: Strengths and Limitation

The current study employed a qualitative research design utilizing thematic analysis as described by Braun and Clarke (2006). This method was chosen due to its flexibility in reporting experiences, meanings, and reality of participants, and its ability to analyze the ways in which events, realities, meaning, and experiences affect the range of disclosures within a society. It serves as a reflection of reality and reveals the surface of reality. Moreover, it is used where individuals put meaning to their experience where it leads to a wider influence on the social context but ensures that the material and other reality is retained (Braun & Clarke, 2006). In this study, registrar office representatives were the informants and responded from their reality, providing insights into the ongoing information activity from their part. Although the data set obtained from the respondents varied in its amount and richness, it was important to maintain an overall depth and meaning behind the description in order to make the results of this study more reliable. Thematic analysis allowed for the identification of patterns and themes within the data, regardless of the frequency of specific terms or quantifiable measures such as “covid-19,” “pandemic,” or “the worst covid-times.” The analysis focused on the meanings and interpretations of the informants, leading to a deeper understanding of the social context. By utilizing this approach, the study was able to provide a detailed and nuanced analysis of the registrar office representatives’ experiences and the broader social context in how information activity is operated in regards to antibiotic resistance.

Furthermore, the use of thematic analysis allowed for a reflexive and iterative approach to data analysis, which ensured the rigor and trustworthiness of the findings. This was because 3 themes were identified here however have a little relationship to the specific questions asked of the county registrar office’s representatives. In addition, data coding took place without having pre-existing coding frames to work from increasing this study’s trustworthiness. As trustworthiness of a thematic analysis one needs to consider validity and reliability of the themes identified. A detailed description of the data analysis process has been provided where codes and themes are detailed which allows the reader of this study to evaluate the rigor of the analysis (Nowell, 2017). Another way of increasing a study’s trustworthiness is the recruitment process which has been non-partial as all the informants received the questionnaire at the same time. The informants were not influenced by the author/researcher’s perspective as there was no follow up questions, instead whatever the informant understood out of the questions, they were answered. Moreover, as the 18 counties’ responses were received, there were 18 counties who responded to the questionnaire in a total of 21. This represents 85 % of the counties of Sweden who responded to the questionnaire which serves as a great representation of the counties. The codes identified with consistent with the overall themes that were looked into therefore leads one to imply that the reliability of the results in this study is high. The results received, the transferability can be applied across other countries too. Counties are responsible authority that represent a country and are a vital part of the Swedish society to promote several things; including information activity at prescriber level and patient level. All of these factors

contribute to a reliable, trustworthy study. Though one needs to bear in mind that author's preconceptions were being ignored as much as possible, even though it is tough to entirely eliminate this factor.

5.2.2 Methodological recommendations for future studies

While thematic analysis offers numerous strengths as a research method, there are also potential limitations that should be taken into consideration. One of the limitations of this method is that it can be time-consuming, especially if the data set is large or complex. To address this limitation, the author of this study recommends the inclusion of a co-author who can provide an additional perspective, bounce back interpretations, and offer feedback to help ensure the accuracy and reliability of the findings.

Although, this method has been effective to explore the Swedish regional pharmaceutical committees information activity to prevent antibiotic resistance county councils. This could be improved by having a 30 minutes interview perhaps face to face. The responses received varied in the amount of time was put into them. One county had written a word document with several pages and responded in a detailed nuance. Meanwhile, some counties had barely written a meaning to answer the same questions. Hence, an improved method could have been to conduct telephone interviews. Although it is important to note that repeating the same qualitative study through interviews may not necessarily yield the exact same results. This is due to the nature of interviews becoming more detailed and potentially problematic to interpret and perhaps even creating the interviewer's bias (Eriksson-Zetterqvist & Ahrne,2015). Moreover, this would have been more time consuming. This method could have also been improved by introducing a pilot study to ensure the questions were understood correctly on the informants' side. A pilots study is to conduct a specific design on a smaller scale than to directly approach the wider study. This allows the quality and efficiency of the final study to be enhanced. It can also lead to an increased experience with the study method from researcher's perspective. It can be performed as an external or internal study. This implies that it can be independent of the main study or even be a part of the main study (In., 2017). As there are 21 counties in the country, in this case an external study could have not been conducted however the pilot study would have been a part of the internal main study

5.2.3 Ethical Discussion

Ethical aspect of this study adheres to current ethical requirements and would be deemed appropriate to have conducted this study. The author ensured that the counties' were informed about the research and whom it is being conducted by. As per the Good Research Practice (2017); a study needs to be conducted in a satisfactory way which is scientifically and ethically sound. Furthermore, The European Code of Conduct for Research Integrity mentions four concepts relating to ethical requirements of a research; reliability, honesty, respect and accountability (The European Code of Conduct for Research Integrity, 2017). The Good research practice (2017) document describes that the study should be true, the method as well as results should be presented with an open minded. Moreover, the quality is determined by the design of the methodology that validate and the method having a reproducibility. The author of this study has ensured that accurate and true results are reflected in this study and no partial

bias has been made to the results to reflect as certain result. The intention was purely to discover counties' information activity on antibiotic resistance which was achieved by analysing informants' responses received. In the study on antibiotics, participants, who were the pharmaceutical committee in the county councils were the respondents. There was no personal identifying questions and no sensitive data was collected therefore there were not be any issues ethically speaking.

The data material for this study was collected through the university's official email system, specifically from the registrar offices of the councils. It is important to ensure that this data is handled appropriately, and as such, all data will be destroyed after analysis and no unauthorized individuals will have access to it.

There is four concepts as per Good Research Practice (2017); secrecy, professional secrecy, Anonymising or de-identifying and Confidentiality. In this study, the informants were informed and responses received were later deleted permanently and not to be shared with any external/third party.

5.3 CONCLUSION

In conclusion, Swedish counties play a vital role in disseminating information to prevent antibiotic resistance. The counties are heavily involved on updating guidelines, monitoring antibiotic prescriptions at the prescriber level and creating targeted educational programmes. The counties are having useful surveillance tools like MedRave and Infektionsverket to monitor and adapt training information to prescribers. Despite the disruption caused by the Covid-19 crisis, plans are in place to resume educational programs and events, highlighting the importance of county-level involvement in disseminating knowledge about antibiotic resistance. The crisis also emphasized the true importance of conducting physical meetings rather than remote trainings. Although some counties are currently focused on educating the public and also children at pre-school which could be extremely beneficial for the community, more attention is needed in this area, and the government should impose guidelines to target patients and the general public. Countries lacking a similar county-based system can take inspiration from Sweden's approach on preventing antibiotic resistance. Effective information activity on antibiotic resistance could lead to increasing rational use of antibiotics and public awareness thereby encouraging people to take actions to prevent antibiotic resistance spread.

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Appendix 1 (Email to main registry function in each region)

E-post till huvudregistratur

Som en del i en utbildning i folkhälsovetenskap med inriktningen smittskydd och vårdhygien vid Högskolan i Skövde så genomför jag en kartläggning avseende arbete i syfte att minska risken för antibiotikaresistens.

Jag skulle därför vara tacksam för att få följande frågor besvarade.

- På vilka sätt informerar ni förskrivare om användningen av antibiotika i syfte att minimera riskerna för antibiotikaresistens?
- Har ni under de senaste 5 åren genomfört några särskilda aktiviteter (t.ex. kampanjer, utbildningar etc.) i syfte att minska/optimera användningen av antibiotika, och i så fall vilka?
- Har ni på något sätt bidragit till information som vänder sig till patienter/befolkning?
- Har ni i dagsläget några planer på framtida aktiviteter för att ytterligare förbättra antibiotikaförskrivning i er region, och i så fall vilka är dessa?
- Hur informeras förskrivare om nya riktlinjer i er region? (Ex. i skrift, möte, digitalt etc)

Stort tack för hjälpen att besvara dessa frågor. Då detta är en del av ett examensarbete så behöver jag era svar senast den 11 november för att de ska kunna beaktas i kartläggningen. Meddela gärna om ni önskar en kopia på kartläggningen, så skickar jag den gärna.

Med vänliga hälsningar,

Kajol Kaur Sapra

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