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and the Environment  
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**Nursing home staff exchange and nursing home characteristics associated with methicillin-resistant *Staphylococcus aureus* (MRSA) transmission in Dutch nursing homes – A case control study**

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## Abbreviations

**HCI** : health care institute

**HCIs**: health care institutes

**NH** : nursing home

**NHs**: nursing homes

**RIVM**: Dutch National Institute of Public Health and Environment

**WIP**: Working Party for Infection Prevention.

## Summary

**Introduction:** Methicillin-resistant *Staphylococcus aureus* (MRSA) is one of the most common antibiotic resistant microorganisms and is still a threat for health care institutes worldwide. The development of more resistance of the bacterium to antibiotics is a big health concern and fewer effective antibiotic therapies for treating infections with MRSA are available. In the Netherlands, a low prevalence of MRSA exists due to the prudent use of antibiotics and the effective search and destroy policy. Despite this, some outbreaks have occurred in Dutch health care institutes. A recent outbreak of MRSA-t1081 was found in Dutch nursing homes, specifically for this outbreak was the high number of MRSA positive staff members. The transmission of MRSA between nursing homes is not well studied. The transfer of patients between hospitals is established in literature as an MRSA transmission pathway between hospitals. The extent of patient transfer between nursing homes was expected to be less than between hospitals. Because some indications found in literature about the role of staff exchange in MRSA transmission, the high involvement of staff members in MRSA colonization and the increase in the use of flex workers in the Netherlands, this study investigated the extent of staff exchange in nursing homes and the role in MRSA transmission. Additionally, characteristics of nursing homes were studied to identify some predicting factors for MRSA outbreaks.

The following **research questions** were developed in this study:

1. “What is the extent of staff exchange between nursing homes and based upon this, how likely is this to play a role in inter-institutional MRSA transmission?”
2. “Which nursing home characteristics can predict an MRSA outbreak in a nursing home?”

**Methods:** This study had an iterative approach whereby input of two explorative interviews, literature and an existing questionnaire for measuring nursing home characteristics were used to get a broad insight in staff exchange and possible nursing home characteristics. Additionally, these three elements were used to develop the conceptual framework with two concepts: staff exchange and nursing home characteristics. This conceptual framework was used as preparation for the interviews with key-experts. With the findings of the interviews, the most important nursing home characteristics could be selected and two questionnaires ‘staff exchange’ and ‘nursing home characteristics’ were developed. The two explorative interviews were held with a microbiologist and an infection prevention consultant who were involved during the first outbreaks of MRSA-t1081 in Amsterdam. The key-experts of the in-depth interviews were: infection prevention consultants, nursing home managers, an elderly care physician and a microbiologist who had all experience with a recent MRSA-t1081 outbreak in a nursing home in the period 2014-2015. The key-experts were guiding in selecting the most important issues from the conceptual framework for developing two questionnaires. The first questionnaire ‘Staff exchange’ consisted of 8 questions and the respondents were staff members of nursing homes. The second questionnaire ‘Nursing home characteristics’ was filled in by each participating nursing home. 30 nursing homes were approached to take part in this research. Of the 10 case nursing homes (with an outbreak of MRSA t1081 in 2014-2015) 6 participated in the part of staff exchange with 173 staff members and 7 nursing homes for the nursing home characteristics. Of the 20 control nursing homes, 9 participated in the part of staff exchange with 301 staff members and 10 responded to the questionnaire about nursing home characteristics.

**Results:** Almost all key-experts made suggestions about the role of staff exchange in MRSA transmission, but they were unable to prove it by means of screening. 13.1 percent of staff members (59/474) reported to work in more than one health care institute at the same time. These staff members were employed in 15 participating nursing homes and reported to work at 87 health care

institutes. In the past two years, 19 percent of the staff members (85/474) had a position in another health care institute than their current job. Of all the staff members, 45 percent worked on more than one ward. The key experts stressed the importance of infection prevention measures in prevention MRSA outbreaks and transmission. According to the key-experts, the protocols for MRSA were difficult to interpret and education directly after an outbreak was needed. No differences in nursing homes characteristics were found between nursing homes with an outbreak and control nursing homes.

**Conclusion & discussion:** This study provides substantial evidence that nursing homes are linked by their staff members to a large network of health care institutes, whereby 13 percent of the nursing home staff members do exchange. This network consists for 63 percent of nursing homes, other health care institutes are residential care homes, home care and hospitals. Almost all key-experts in the field of MRSA-t1081 in Dutch nursing homes have strong suspicions that staff exchange could play an essential role in MRSA transmission between nursing homes (and other health care institutes). Therefore, it is possible that staff exchange is responsible for MRSA transmission between nursing homes. In this study, no predicting characteristics of nursing homes were found for MRSA outbreaks.

Based on the findings of this study, we recommend more awareness for the extent of staff exchange of nursing homes and the possible role of it in MRSA transmission by policy makers and staff members. A revision of the protocols for MRSA in nursing homes together with more education for staff members in how to handle MRSA positive clients are needed to ensure better and more consistent infection prevention practice between nursing homes. Additional studies are necessary to investigate the precise role of staff exchange and MRSA transmission between nursing homes. For example, a detailed investigation of an outbreak is needed to unravel the transmission tree, or the use of a modeling study to investigate the likely impact of personnel exchange on MRSA transmission.

## Acknowledgement and reflection

The internship at the National Institute of Public Health and Environment in the Netherlands is part of my first year of the Master MPA (Management Entrepreneurship Policy-Analysis in Health and Life Sciences) at the Vrije Universiteit Amsterdam. My learning goals for this internship were to expand my knowledge about infectious diseases, improve my quantitative and qualitative research skills and develop my English scientific writing skills. This internship gave me the chance to get involved in several meetings both specific for my subject 'nursing homes and resistant micro-organisms' as more general about infectious diseases. During these meetings, I could take part in interesting discussions about infectious diseases and research approaches. I am very thankful for the opportunity to present my research in one of the general meetings because I faced some challenges halfway of my internship in selecting the right control group. In response to my presentation, I received very useful feedback on my research design and one of my colleagues, Linda Verhoef, proposed to use the nursing homes of the SARAH study as control nursing homes.

My knowledge about infectious diseases was not only enlarged during the meetings at the RIVM, but also in interviews with e.g. microbiologist P. Gruteke from the Onze Lieve Vrouwen Gasthuis Amsterdam and T. Bosch from the laboratory of the RIVM. Additionally, I spoke with many different key-experts in the field of MRSA in nursing homes. I want to thank all the interviewees I spoke with and specifically thank my on-site supervisor Anja Haenen for bringing me in contact with all these interesting and enthusiastic experts. Furthermore, my on-site supervisors promoted my self-dependence and when I had questions or if I wanted to discuss some decisions during the research process they made time free to help me out. I liked this way of collaboration because they give me confidence in how I perform at my internship.

During my internship, I had to attend some lessons 'Scientific writing in English' which have helped me in writing my report. Also my on-site supervisor Carline van den Dool and VU supervisor Marije de Jong provided several times feedback on my report which was very useful. Despite this, I needed more time to write the report than only the five months. One of the reasons for this delay can be explained that a large part of my internship consisted of data-collection. I had to face some challenges in reaching nursing homes or the right contact persons, but in the end I am very satisfied with the high number of health care workers who participated in this study. Therefore, I am glad that I put that much of effort in reaching all the nursing homes and as much staff members as possible instead of stick strictly to planned period of data collection. For my second internship I learned that data-collection could need far more time than you expected in advance. I couldn't fulfill this study, without the help of the already mentioned persons. Altogether, I enjoyed working at the RIVM and I am very thankful for those who helped me during the process of doing research.

## 1. Introduction

There is an increasing threat of antibiotic resistant microorganisms for health care institutes worldwide, which leads to morbidity, mortality and an increase in health care costs (Simor, 2001). One of the most common antibiotic resistant microorganisms is the major nosocomial bacterium methicillin-resistant *Staphylococcus aureus* (MRSA) (Enright, 2003). MRSA can cause colonization and infection in humans. Humans colonized with MRSA on their skin or in their nose are often asymptomatic carriers of the bacterium and therefore, MRSA can easily spread unnoticed by hand-to-hand contact between patients and health care workers (Muto et al., 2003). Once colonized with MRSA, there is an increased risk to develop an MRSA infection (Lowy, 1998). These infections are difficult to treat due to the insensitivity of MRSA to first-line antibiotics (Hughes, 2013). Because of the easy nosocomial transmission and the limited number of antibiotics available to treat MRSA infections, health care institutes have high concerns about this organism.

The prevalence of MRSA, defined as the percentage of MRSA found in *Staphylococcus aureus* isolates, varies across countries and types of care institutes. Recently, MRSA prevalence has decreased in European countries (ECDC, 2013). Nevertheless, in seven of the European countries the prevalence of MRSA still exceeds 25 percent, with a European mean of 17.8 percent (ECDC, 2013). The lowest prevalence of MRSA is found in Norway, Sweden, and the Netherlands (ECDC, 2013). These countries are known for their effective search and destroy policy and discrete use of antibiotics (Bode et al., 2011). The Dutch search and destroy policy includes an active searching for MRSA and an adequate treatment of colonized people (Gezondheidsraad, 2006). In 2011, 1.8 percent of all *Staphylococcus aureus* isolates was methicillin resistant in the Netherlands. Despite the low prevalence, MRSA outbreaks still occur in Dutch health care institutes, and therefore MRSA remains an important health concern (Lekkerkerk, 2012).

During the last few years, an outbreak of MRSA *spa*-type 1081 has spread over the Netherlands (Gruteke, 2015). MRSA-t1081 is asymptomatic in colonized patients and has been detected among residents and a significant part of the nursing home staff after screening (SWAB, 2014). Noteworthy for this outbreak was the high MRSA burden for nursing homes compared with hospitals, which raised questions on how the outbreak could spread across the country. Previous studies have reported the spread of MRSA between hospitals via patients that are transferred between the hospitals (Donker, 2010; Lee et al., 2011). However, just a few studies have addressed the spread of MRSA from one nursing home to another (Cheng et al., 2013; Tsao, Kou, & Huang, 2015). Because nursing homes do not share many patients another transmission pathway than patient transfer may be presumed. With the high fraction of colonized staff members, staff exchange might play a role in transmission between nursing homes.

Cimolai et al. reviewed in their study several studies in which spread of MRSA was ascribed to health care workers in health care institutes. The same study refers to articles in which health care staff worked at multiple health care institutes and might have caused transmission from one health care institute to another (Cimolai, 2008). Also the review of Albrich et al. found some indications of introduction of MRSA in health care institutes by hiring new employees (Albrich & Harbarth, 2008). Evidence for the role of staff exchange in causing outbreaks is missing in literature both for health care institutes in general and for nursing homes specifically. To investigate the possible role of staff exchange in MRSA transmission between nursing homes, first the degree of nursing home staff exchange needs to be mapped. By now, only a Swedish study reported the degree of nursing home staff exchange with other health care institutes (Andersen, Rasch, & Syversen, 2007). This study of Andersen et al. concluded that 18 percent of the staff members worked in more than one health care institute.

The spread of MRSA between nursing homes is of interest because nursing homes provide ideal reservoirs for MRSA (Hughes, 2013). The residents of the nursing homes often have multiple risk factors for acquiring MRSA like advanced age, frequent antibiotic use, co morbid conditions and intensive contact with hospitals and people from the community (Tsao et al., 2015). Although colonization with MRSA is often asymptomatic, treatment is preferred to prevent further transmission. In elderly people decolonization treatment are less effective due to for instance indwelling devices (Bradley, 1999) and because of this part of the residents, despite treatment remain chronic carriers. If they become infected, elderly are at higher risk of morbidity and mortality than younger MRSA infected people (McClelland, Fowler, Jr, Sanders, & et al., 1999). Various studies pointed out that nursing homes face challenges in maintaining a homelike environment while in the same time establishing a good infection prevention policy and subsequently, reducing MRSA transmission (McClelland et al., 2012; Murphy et al., 2012a).

The susceptibility of nursing homes for MRSA outbreaks is not very well studied. Previous studies have mainly determined risk factors for MRSA on patient level both for nursing home patients (Cassone & Mody, 2015) and patients in other health care institutes. One study of Murphy et al. looked at the difference in environmental cleaning between nursing homes with low MRSA prevalence and high MRSA prevalence in the United States (Murphy et al., 2012a). Another study of Murphy et al. researched characteristics of nursing homes related to point prevalence and admission prevalence in nursing homes (Murphy et al., 2012b). But none of these studies focussed on differences between nursing homes with a recent MRSA outbreak and nursing homes without a recent MRSA outbreak. This investigated nursing home characteristics of Dutch nursing homes in order to find some predicting values for an MRSA outbreak.

**Problem statement:** Given that MRSA-t1081 is capable of colonizing a significant part of the nursing home staff, staff exchange could be of particular relevance with respect to MRSA transmission between nursing homes. There is an increased use of flexible and freelance personnel in health care institutes. In 2005, 18 percent of all employees in the Netherlands had a flexible contract, in 2006 this was 26 percent (CBS, 2013). Staff exchange is more likely to be the cause of MRSA transmission between nursing homes than patient exchange, as nursing homes, in contrast with hospitals, do not share many patients. Transmission of MRSA and risk factors for MRSA outbreaks are studied less in nursing homes than in other health care settings. Research into the differences in nursing home characteristics between nursing homes with an outbreak and without an outbreak could help identify these risk factors.

The aim of this study is:

*to gain more insight in the transmission of MRSA between and within nursing homes by making an analysis of the transmission related factors, specifically staff exchange and relevant nursing home characteristics.*

In order to accomplish the aim of this study, the following main question is used. The hypothesis that nursing home staff exchanged with other health care institutes have to be tested.

*“What is the extent of staff exchange between nursing homes and based upon this, how likely is this to play a role in inter-institutional MRSA transmission?”*

A second main question was formulated in order to explore the characteristics of nursing homes related to MRSA transmission within nursing homes. Predictors have to be identified by analyzing differences between nursing homes with a recent MRSA outbreak and control nursing homes.

*“Which nursing home characteristics can predict an MRSA outbreak in a nursing home?”*

## 2. Contextual Background

### 2.1 MRSA

*Staphylococcus aureus* is a gram-positive coccus that has developed multidrug resistant strains over time. Currently, almost all isolates are resistant to penicillin and 60 to 70% of all *Staphylococcus aureus* strains are methicillin resistant (Kim, 2009). Methicillin-resistant *Staphylococcus aureus* (MRSA) is effective due to the production of low-affinity penicillin-binding protein by the activation of the *mecA* gene (Kim, 2009). Both methicillin-susceptible *Staphylococcus aureus* (MSSA) and MRSA can colonize or infect people. If the bacterium multiplies at the skin or in mucosal membranes of the nose or rectum, the patient is colonized with MRSA. If the bacterium enters the bloodstream and triggers an immune response of the body, the patient is infected with MRSA. MRSA can cause several diseases in humans and animals ranging from small soft tissue damage to severe pneumonia (Kim, 2009). The degree of pathogenicity is dependent on the virulence factors of the MRSA and susceptibility of the host. Especially immunosuppressed people are vulnerable for infections and suffer from the side effects of the severe antibiotics, which have to be used for treatment due to the insensitivity of MRSA for several first-line antibiotics. In general, it is important that these antibiotics are used as little as possible, to prevent MRSA from developing resistance to these antibiotics as well. In most cases, MRSA will be asymptomatic, therefore it can easily spread between persons.

MRSA can be acquired from three different reservoirs: the community, life-stock or healthcare institutes. Community-acquired MRSA (CA-MRSA) is becoming more common among people outside the hospital and can cause severe infections in healthy people. The CA-MRSA strains contain the Panton Leukocidine Valentine(PVL) factor which enables the bacterium to produce substances that make the bacterium more aggressive and invasive. Life-stock acquired MRSA (LA-MRSA) is transmitted less frequently from person to person compared with CA-MRSA and health care associated MRSA (HA-MRSA). HA-MRSA infection or colonization is acquired in a health care institute and can cause severe infections in immune depressed patients and elderly people. This paper focuses on HA-MRSA, also called nosocomial MRSA.

Due to the ability of MRSA to cause severe infections in immunosuppressed patients and the risk of MRSA developing new resistance patterns in response to the use of broad-spectrum antibiotics in many patients, it is important to minimize the amount of colonized people. Surveillance of MRSA is done in many countries. By analyzing transmission and outbreaks, risk factors have been identified and infection control measures implemented. With help of typing methods different types of MRSA can be distinguished. If the same type is found in two related patients (in place and time) this may be an indication of transmission of MRSA between these patients. On the other hand, if two different types are found in two patients in a hospital this indicates that there was no transmission from one patient to the other. *Spa* sequence typing, based on sequence polymorphism in the variable X region of the *spa* gene for *Staphylococcus aureus* surface protein A, is the most common typing method worldwide (Stefani et al., 2012). This study focuses on MRSA *spa* type t1081.

### 2.2 Search and destroy policy

In the Netherlands, the prevalence of MRSA is low compared to other countries, due to prudent antibiotic use and the effective search and destroy policy. The search and destroy policy includes the screening of risk groups for carriage of MRSA and the implementation of infection prevention guidelines for preventing further MRSA transmission. This search and destroy policy is reasonably similar to the search and destroy policy in Scandinavian countries but differs in the choice of measures and target groups (Elstrom & Aavitsland, 2008). In the Netherlands, both patients and staff with suspicion of MRSA carriage are screened. Risk categories are admissions from a foreign health care institute, a health care institute in the Netherlands with a recent MRSA outbreak etc. Based on a patient's or health care worker's risk profile for MRSA colonization, additional measures can be

taken, for example, by placing the patient in isolation or obliging the health care worker to temporarily stop their work (Gezondheidsraad, 2006).

The infection prevention guidelines aimed at hospitals are different from those aimed at nursing homes. Specific guidelines for each type of health care institute are developed because each setting provide care for different patients, which results in differences in the risk of MRSA transmission, the burden of MRSA acquisition and the feasibility of infection control measures. For example, immunosuppressed patients in a hospital or patients who have to undergo a surgery are more vulnerable for infections than residents in an elderly care facility. Also, the balance between a home-setting and a clinical-setting is perceived more important in a nursing home than in a hospital by staff, residents and their family (McClellan et al., 2012). Because of fewer possibilities of applying isolation measures and the wish to maintain a homelike environment, the isolation measures for MRSA carriers in nursing homes are far less strict than in hospitals. Nursing home guidelines prescribe that residents of nursing homes who are colonized with MRSA have to be nursed in private rooms, but they are allowed to take part in social activities. During care moments, the nursing staff has to wear protective clothes. These measures are also necessary during a suspicion of MRSA in a resident. In addition, swabs of suspected residents will be taken to determine whether or not there is MRSA colonization.

### 2.3 MRSA outbreak detection

The swabs, taken from a suspected MRSA patient, are sent to the laboratory affiliated to the health care institute. If MRSA is demonstrated in the culture, every first isolate of the patient or health care worker is sent to the National Institute of Public Health and the Environment (Rijksinstituut voor Volksgezondheid en milieu, RIVM) for surveillance of MRSA and *spa*-typing. The RIVM provides information about the type of MRSA, which gives an indication of the aggressiveness of the detected MRSA. If two or more patients within a health care institute are colonized or infected with the same type of MRSA, this is defined as ‘an outbreak’. After detection of an outbreak in a health care institute the Public Health Service (Gemeenschappelijke Gezondheidsdienst, GGD) has to be informed (Working Party for Infection Prevention, 2012). The GGD gives advice to prevent further transmission. In some Dutch regions the GGD sends a hygienist. See also Figure 1.

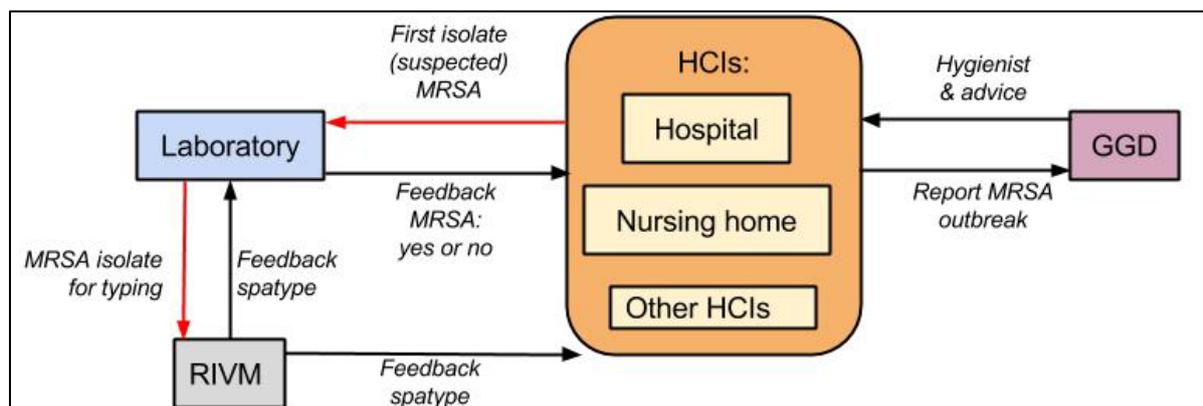


Figure 1: Communication and actions between institutes as a result of (suspected) MRSA colonization or infection

### 2.4 Long term care facilities

The definition of long term care facilities differs across countries. Examples of long term care facilities are: nursing homes, retirement homes, rehabilitation facilities, inpatient behavioral health facilities and long-term chronic care hospitals. In the Netherlands, a person becomes eligible for a place in a nursing home after an indication based on their Care Intensity Package. CIP indication is determined by Centrum Indicatie Care (CIZ) and indicates the level of care the client needs. The CIP indication ranges from CIP 1 till 10 where CIP 1-2 indicates care delivery in the home situation and CIP 3-4 is provided in a retirement home. Clients with a CIP indication of 5-10 are eligible for admission in

nursing homes. In the past years, decompartmentalisation of these different long term care facilities has taken place. Because of this, clients with a nursing home indication now sometimes reside in a retirement home. During an MRSA outbreak, there are different guidelines and policies for these different kinds of clients despite of residence in the same ward. Besides guidelines, also financial resources for example culturing MRSA, are different for residents in a retirement home and residents in a nursing home. In addition, a nursing home has a nursing home doctor (elderly care physician) who serves as a general practitioner for all of the residents, whereas residents of retirement homes have their own general practitioner. If a resident becomes an MRSA carrier, the general practitioner has to be consulted before the nursing staff can start treatments. This can be a problem in an outbreak situation in a retirement home where all general practitioners of the patients have to be consulted and there may be disagreement about the approach. In a nursing home the elderly care physician can make this decision for all of the residents. Also, the elderly care physician is the direct contact person for corresponding with the laboratories which has as advantage that one person has a total overview of the MRSA and or multidrug resistant organisms present in the nursing home.

### 3. Conceptual framework

The conceptual framework is designed as preparation for the interviews with key experts in infection prevention. The conceptual framework together with the interview results are used to develop the final questionnaires for this study, this process will be further explained in the methods chapter.

In this section, two main concepts will be discussed: 'staff exchange' and 'nursing home characteristics'. The concept 'staff exchange' will be mainly discussed on the basis of two explorative interviews with key-experts on MRSA-t1081 in the Netherlands because few studies addressed staff exchange in relation to MRSA transmission. The second concept 'nursing home characteristics' will be further explained by means of an existing questionnaire used in the Dutch surveillance of infectious diseases to measure nursing home characteristics. In addition, previous studies in nursing homes will be used to describe nursing home characteristics which may be associated with MRSA transmission or prevalence.

#### 3.1 Staff exchange

##### *Explorative interviews with two key experts on MRSA-t1081*

Two explorative interviews were held with key-experts, one microbiologist and one infection prevention consultant of the GGD, to find out more about the issues regarding MRSA-t1081 in the Netherlands. Both of the key-experts were involved in the response to the first outbreaks in Amsterdam. According to the key-experts, many flexworkers are employed in this region. Both key-experts have suspicions of involvement of the flexworkers in the spread of MRSA over the nursing homes in Amsterdam. One interviewee stressed the problem of staff shortage, in particular well-trained staff. Many temporary employment agencies are established in the city. The infection prevention consultant explained how the use of flexible teams in hospitals can be a disadvantage for making agreements on infection prevention: the agreements have to be made again after a month because a whole new team is working on the department by then. Another problem faced in particular in nursing homes is the low education level of staff. Both key-experts stressed the importance of mapping staff exchange. They expected a high interaction with home care. One of the interviewees expected a difference in staff exchange between regions in the Netherlands. He suspected, more personnel will exchange in high density regions compared with low density regions.

##### *Literature*

The role of health care workers in patient to patient transmission of pathogens within a health care department is commonly accepted in literature (Cimolai, 2008; McBryde, Bradley, Whitby, & McElwain, 2004; Pittet, 2000). Nevertheless, few studies investigated the role of health care workers in transmission between health care institutes and between wards. To the author's best knowledge only one study has discussed the degree of staff exchange of nursing home staff (Andersen et al., 2007). In the questionnaire of this study, the staff of nursing homes in Oslo was asked if they worked in another health care institute in the past year. Other studies only made suggestions of staff exchange and their role in inter- and intra-institutional transmission as described in the introduction of this report. In a study of Cimolai et al. MRSA colonization is reported in the following types of health care workers: doctors, nurses, nursing staff, physiotherapist, volunteers etc (Cimolai, 2008).

#### 3.2 Nursing home characteristics

##### *General facility characteristics incidence-measurement questionnaire SNIV 2014 – Surveillance Network Infectious Diseases in Nursing homes*

The surveillance network for infectious diseases in nursing homes (SNIV) has been set up by the Dutch Centre for Infectious Disease Control (CIDC) in 2007. Nursing homes are affiliated to this surveillance system on a voluntary basis. The aim of SNIV is to provide year-round surveillance data

on infectious diseases in nursing homes. The data can serve as input for interventions and policy making in the field of infectious diseases and for improvement of infection control guidelines for nursing homes. Since January 2009, incidence rates of five infectious diseases are gathered weekly from approximately 30 Dutch nursing homes affiliated to the SNIV-Network. Once or twice per year, the nursing homes characteristics of each of these nursing home are measured by the following questionnaire: '*General facility characteristics incidence-measurement questionnaire SNIV 2014 – Surveillance Network Infectious Diseases in Nursing homes*'. The nursing home characteristics are included in this surveillance because of the probability of influencing the incidence of infectious diseases. For instance, in 2013, nursing homes with regular exchange of staff between wards had higher incidences of gastro-enteritis than nursing homes without regular exchange of staff. Another example is the higher incidence of probable pneumonia in nursing homes with a higher percentage of private bathrooms (RIVM, 2014).

The questions of the *General facility characteristics incidence-measurement questionnaire SNIV 2014 – Surveillance Network Infectious Diseases in Nursing homes* are divided in five categories: capacity data, residents data, infection control policy, antibiotic policy and dental hygiene. Capacity data contains information about the size of the nursing homes (e.g. number of beds, number of common areas), care intensity packages of the residents, exchange of staff between wards and wearing professional clothing by staff. Influenza vaccination coverage among residents and personnel, type of wards (e.g. psycho-geriatric, somatic, rehabilitation), age distribution of residents and availability of private room, bathroom and/or toilet facilities are gathered in the category resident data. The third category includes questions regarding infection prevention committees (e.g. the composition) and whether or not the nursing home employs an infection prevention consultant. The category about antibiotic policy consists of questions about an antibiotic committee and guidelines for the use of antibiotics. The last category comprises questions about dental hygiene (e.g. whether or not professional dental care is provided). For the complete questionnaire, see Appendix I.

### *Literature*

Nursing homes form an excellent environment for MRSA mainly because their residents often have several risk factors for MRSA colonization. It is interesting to look more closely into these risk factors because it is likely that the prevalence of MRSA in nursing homes can be linked to the risk profile of the residents. Several studies have identified risk factors for MRSA colonization in residents of nursing homes and long term care facilities. These risk factors are advanced age (Manzur et al., 2008; Tsao et al., 2015), different co morbidities (e.g. diabetes, pulmonary diseases, heart failure) (Cassone & Mody, 2015; Cheng et al., 2013; Manzur et al., 2008), indwelling devices (Barrufet et al., 2014; Cassone & Mody, 2015; Cheng et al., 2013; Manzur et al., 2008; Mossong et al., 2012), chronic wounds, skin lesions or pressure sores (Barrufet et al., 2014; Cassone & Mody, 2015; Cheng et al., 2013; Manzur et al., 2008; Mossong et al., 2012), length of stay (Cassone & Mody, 2015; Mossong et al., 2012), antibiotic use (Barrufet et al., 2014; Cheng et al., 2013; Furuno et al., 2011; Manzur et al., 2008; Mossong et al., 2012), history of MRSA (Barrufet et al., 2014; Cassone & Mody, 2015; Mossong et al., 2012), urinary incontinence (Cassone & Mody, 2015; Mossong et al., 2012), low cognitive score (Cassone & Mody, 2015), history of hospitalization (Cassone & Mody, 2015; Cheng et al., 2013; Manzur et al., 2008), more than moderate assistance during daily activities (Barrufet et al., 2014; Furuno et al., 2011), residence in facilities with less than 150 beds (Manzur et al., 2008) and being bedbound (Furuno et al., 2011).

The study of Murphy et al. reported a number of the above listed risk factors as predictors for a higher MRSA point prevalence in nursing homes. According to this study, nursing home with a higher percentage of residents with some specific characteristics in their nursing homes, are at risk for a higher MRSA point prevalence. The study of Murphy et al. reported the following residents: residents who are admitted from acute cure; with co morbidities (10 percent more residents with diabetes resulted in an increase of 7.2 percent MRSA point prevalence); with devices resulted in an increased

MRSA point prevalence . According to the same study, nursing homes are more likely to have a high MRSA transmission risk within the nursing home if they accommodate a higher percentage of residents: aged 85 and over; with diabetes; who are Hispanic; who are less educated than high school. Besides, a higher annual admission rate is found as a non-host related predictor for an increased point prevalence of MRSA in nursing homes. This study stresses the differences in the burden of MRSA in nursing homes with the same admission MRSA prevalence and suggests that infection control policies are highly important in preventing transmission and minimizing the burden of MRSA in nursing homes.

The study of Cheng et al. researched MRSA transmission in long term care facilities in Hong Kong, where the most common *spa* type was t1081. This study reported an inverse linear association of average living area with MRSA prevalence in long term care facilities (Cheng et al., 2013).

Other studies and guidelines confirmed the importance of infection control policies in nursing homes. Infection control policies comprise in the first place hand hygiene for staff members and exchange of staff between wards. Murphy et al. measured the practice of infection prevention control of several nursing homes and concluded differences in practice between US nursing homes (Murphy et al., 2012a). The following infection prevention control components were studied: restriction of MRSA patients from common areas; implementation of contact precautions (e.g. the use of protecting clothes during intensive contact with patients); decolonization treatment; screening conducted for MRSA carriers; management staff's time for infection control and prevention. Another infection control measure, which is mainly used in hospitals, is placement of positive patients in private rooms or in a cohort with other MRSA positive patients nursed by a permanent team of health care workers. In a study of Furuno et al. sharing a room with an MRSA resident was not associated with acquiring MRSA (Furuno et al., 2011). The study of Murphy et al. discussed besides the infection prevention control also the association between environmental cleaning and MRSA prevalence in nursing homes. The following questions regarding environmental cleaning were asked: employment of cleaning staff by the nursing home; number of rooms assigned per cleaning staff member; median time spent for cleaning a room; type of cleaning products used; whether or not the room of MRSA patients was cleaned each day; frequency of cleaning of common areas. In another part of the study, in an experimental setting, a higher proportion of MRSA positive objects was found after cleaning in high MRSA prevalence nursing homes compared with low MRSA prevalence nursing homes. Furthermore, less time spent on cleaning rooms and less frequent cleaning of common rooms was associated with finding MRSA positive objects. The study suggests that modifying cleaning practices may reduce MRSA environment contamination and MRSA burden in nursing homes (Murphy et al., 2012a).

Next to the infection control policy, antibiotic stewardship is an important part of the nursing home policy for preventing MRSA transmission (Marshall, Wesselingh, McDonald, & Spelman, 2004). As described above, the use of antibiotics is a risk factor for MRSA acquisition. Most of the antibiotic susceptible bacteria of the host will not survive the therapy. The MRSA bacterium, which is resistant to first line antibiotics, can then colonize easily on the host because there are less other bacteria in the host to compete with. The antibiotic stewardship in nursing homes is guiding the use of antibiotics in residents. A restrained policy resulting in prudent prescribing of antibiotics for residents may be a protecting characteristic of a nursing home in the susceptibility for an MRSA outbreak. In contrast, no antibiotic stewardship and a high use of antibiotics may be a risk factor for an MRSA outbreak in nursing homes. In addition, the prescribing of broad-spectrum antibiotics is a risk factor for the development of resistance in *Staphylococcus aureus* (Bronzwaer, 2002).

### 3.3 Research questions

In order to answer the main questions, the below listed sub-questions were formulated. In short the relation between the sub-questions and the conceptual framework are described, a more detailed explanation can be found in the methods chapter. By developing the sub-questions, also the findings from the interviews were taken into account. These findings are listed in the results chapter.

#### Main question 1:

“What is the extent of staff exchange between nursing homes and based upon this, how likely is this to play a role in inter-institutional MRSA transmission?”

- ❖ What percentage of the nursing home staff worked in another health care institute besides and before their current job in the nursing home?  
*Before the role of staff exchange in MRSA transmission can be investigated, first we have to measure the extent of staff exchange of nursing home staff. By answering this sub-question we hope to identify if nursing homes are linked by their staff members to other health care institutes (including nursing homes).*
- ❖ What percentage of the nursing home staff normally worked on more than one ward in the nursing homes?  
*We decided to not only look at the staff exchange between nursing homes but also to the staff exchange within nursing homes. Despite the sub-question will be less important for answering the main-question, it is interesting to know how many staff members do exchange within nursing homes. Because this type of staff exchange is identified by key-experts and in literature as an important transmission pathway between wards in nursing homes.*
- ❖ How likely is it that staff exchange plays a role in MRSA transmission?  
*This sub-question is developed because the key-experts had almost all indications about the role of staff members in the transmission of MRSA. Therefore, we added an third sub-questions to bundle these experiences and thoughts. It is interesting what the extent of staff exchange is but even more important is the likelihood if staff exchange involved in MRSA transmission.*

#### Main question 2:

“Which nursing home characteristics can predict an MRSA outbreak in a nursing home?”

- ❖ Which nursing home characteristics and issues regarding MRSA outbreaks are discerned by professionals (hygienists, managers, elderly care physicians) affiliated to nursing homes with a recent MRSA outbreak and control nursing homes?  
*The existing questionnaire in the conceptual framework is used to measure nursing home characteristics in general. By using this sub-question, the most important nursing home characteristics for MRSA transmission can be selected.*
- ❖ Are there any differences in nursing home characteristics between nursing homes with a recent MRSA outbreak and control nursing homes that can be related MRSA outbreaks?  
*This sub-question was developed to fulfil the research gap in literature. Only a few studies reported nursing home characteristics related to MRSA transmission. By using these sub-question, we attempt to find any predicting nursing home characteristics for MRSA outbreaks.*

## 4. Methods

### 4.1 Research approach

This study was conducted to gain more insight in the transmission of MRSA between and within nursing homes by making an analysis of transmission related factors, especially staff exchange and nursing home characteristics. In order to accomplish this aim, we investigated the extent of staff exchange between and within nursing homes and based upon this, the involvement of staff exchange in MRSA transmission. Secondly, we studied characteristics of nursing homes to find any predicting factors for an MRSA outbreak. In order to answer the research questions of this study, three methodologies were used, see also Table 1.

This study followed an iterative approach, which means that a great part of the researcher's choices were not predetermined at the beginning of this study. These choices have to be made during the research process. In this approach, these choices influence other parts of the study, in this way these parts can be revised and completed. In case of this study, at the start of this study there was no questionnaire for staff exchange, and the existing questionnaire for nursing home characteristics was not specific for MRSA outbreaks. Because of this, two questionnaires were developed during this study, whereby findings of interviews had to be integrated with articles from literature and an existing questionnaire for nursing home characteristics. In this way, this research was not a linear process as described in the following paragraph.

The first step in this iterative approach was holding two explorative interviews with a microbiologist and an infection prevention consultant of the GGD, both were involved during the first outbreaks of MRSA-t1081 in 2011 in the Netherlands. The main purpose of these explorative interviews was to get background information about MRSA-t1081 outbreaks in the Netherlands. Additionally, the role of staff exchange and some important infection prevention measures were discussed. Thereafter, the background information obtained in the interviews was considered when writing the contextual background in the way that important issues could be elaborated with literature. The explorative interviews were also used in the conceptual framework. The conceptual framework was developed based on: the findings of staff exchange from the explorative interviews; an existent questionnaire for nursing home characteristics; literature on staff exchange and literature on possible predicting nursing home characteristics for an MRSA outbreak. The conceptual framework was conducted in order to clarify the concepts of this study and to develop research questions. After constructing the conceptual framework, the in-depth interviews were held with key-experts in the field of infection prevention and experience with MRSA-t1081 outbreaks. These interviews were based on the conceptual framework in order to find out what according to the key-experts were the most essential issues in preventing MRSA outbreaks in nursing homes. The findings of the interviews were used to confirm the issues mentioned in the conceptual framework and to add other important issues, this process has been elaborated in the results chapter. Hereafter, the conceptual framework and the findings from the interviews were integrated in order to develop the two questionnaires: '*Questionnaire: Staff exchange in nursing homes*' and '*Questionnaire: Nursing home characteristics*'. Due to methodological restrictions not all of the mentioned issues were conducted into the questionnaires. These methodological considerations are discussed in section 4.3 and 4.4 of this chapter. The research approach is visualised in the Appendix II.

#### *Justification for methodologies*

Interviews with key-experts were chosen because the approach to MRSA outbreaks in the Netherlands is quite different from other countries. As described in chapter 2, the Netherlands used a search and destroy policy and have low prevalence of MRSA compared with other countries. By holding interviews with key-experts who had experience with an MRSA outbreak in the Netherlands the researcher aimed to identify important issues in preventing transmission and MRSA outbreaks

specifically for Dutch nursing homes. In this way, the interviewees can provide the researcher more insight in the role of staff exchange in transmission between nursing homes and in addition what characteristics of nursing homes are important in preventing MRSA outbreaks.

The first questionnaire: *'Questionnaire: Staff exchange in nursing homes'* was conducted to measure the extent of staff exchange of nursing home staff. The digital questionnaire consisted of eight questions allowing to reach and analyse a great number of staff members within a short time.

The second questionnaire *'Questionnaire: Nursing home characteristics'* was developed to compare characteristics of nursing homes. An advantage of using a questionnaire above interviews some characteristics were very specific and the respondents did not know this by heart but have to look it up in their administration which is not preferable during an interview. Another reason is the comparability of the results in the way that in a questionnaire all the nursing homes receive the same questions, in interviews the interaction between the interviewee and the respondent is taken into account and can disturb the order of questions. Because of this reasons and the advantages of triangulation and iterative process the questionnaires are chosen.

### *Research design*

The design of this study can be viewed as a case-control design. The design of this study is chosen to determine if an exposure is associated with an outcome. The exposures in this study were the degree of staff exchange and the nursing home characteristics. The outcome in this study was an MRSA-t1081 outbreak in a Dutch nursing home registered in the period between 1st January 2014 and 1st March 2015. An MRSA outbreak has been defined as followed: two or more people, including residents and health care workers, in a nursing home colonized or infected with the same type (t1081) of MRSA. The cases, nursing homes with an MRSA outbreak, have been identified as a group known to have the outcome. The controls, nursing homes without an MRSA outbreak, have been identified as a group known without the outcome. The researcher selected control nursing homes from a list provided by researchers of the SARAH study (Surveillance of Antibiotic Resistance and usage in nursing Homes). The SARAH study measured the prevalence of resistant *Staphylococcus aureus* and *Escherichia coli* in nursing home residents in 2013/2014. In this way, the researcher could easily select 20 control nursing homes from the list of the participating nursing homes in which no MRSA colonization or infection were determined during the SARAH study. Inclusion criteria for this selection were that more than half of the residents had to be tested and the capacity of the nursing home had to be more than 30 beds. 10 nursing homes were selected in the same geographical area as the case nursing homes, another 10 nursing homes were selected in a region where no case nursing homes were selected.

Table 1: Research questions with corresponding methodology

Question	Methodology
What is the extent of staff exchange between nursing homes and based upon this, how likely is this to play a role in inter-institutional MRSA transmission?	
❖ What percentage of the nursing home staff worked in another health care institute besides and before their current job in the nursing home?	A <b>questionnaire</b> of eight questions regarding staff exchange was conducted to answer this sub-question. The questionnaire has been send to nursing home staff affiliated to 17 Dutch nursing homes.
❖ What percentage of the nursing home staff normally worked on more than one ward in the nursing homes?	A <b>questionnaire</b> of eight questions regarding staff exchange was conducted to answer this sub-question. The questionnaire has been send to nursing home staff affiliated to 17 Dutch nursing homes.
❖ How likely is it that staff exchange plays a role in MRSA transmission?	<b>Interviews</b> with key-experts on infection prevention, managers and elderly care physician were hold to investigate the role of staff exchange in MRSA transmission.
Which nursing home characteristics can predict an MRSA outbreak in a nursing home?	
❖ Which nursing home characteristics and issues regarding MRSA outbreaks are discerned by professionals (hygienists, managers, elderly care physicians) affiliated to nursing homes with a recent MRSA outbreak and control nursing homes?	<b>Interviews</b> with key-experts on infection prevention, managers and elderly care physician were hold to answer this sub-question.
❖ Are there any differences in nursing home characteristics between nursing homes with a recent MRSA outbreak and control nursing homes that can be related MRSA outbreaks?	Nursing home characteristics were measured by conducting a <b>questionnaire</b> for 17 nursing homes (7 case nursing homes and 10 control nursing homes).

## 4.2 Interviews

### *Study population and recruitment*

The respondents for the interviews all had experience with an MRSA-t1081 outbreak in Dutch nursing homes. Two explorative interviews were with infection prevention consultant and a microbiologist which were involved during the first outbreaks of MRSA-t1081 in 2011, presented in Table 2. The respondents of the in-depth interviews had experience with outbreaks in 2014/2015 and consisted of elderly care physician, infection prevention consultants, managers and a microbiologist, see also Table 3. The respondents were recruited by e-mail and phone to participate in this study. The RIVM already had contact with a large part of these respondents.

**Table 2: Respondents of the explorative interviews**

<b>Respondents</b>	<b>Number per category</b>	<b>Code</b>
Infection prevention consultant – GGD	1	R1
Microbiologist	1	R2

**Table 3: Respondents of the in-depth interviews**

<b>Respondents</b>	<b>Number per category</b>	<b>Code</b>
Elderly care physician	1	R3
Infection prevention consultant – GGD	1	R4
Infection prevention consultant – commercial bureau	3	R5, R6, R7
Manager of a nursing home	2	R8, R9
Microbiologist	1	R10

#### *Data collection*

Two explorative interviews and eight in-depth interviews were conducted from 1 April to 11 May 2015. The sample size for the interviews was reached when saturation was achieved. The interviews were conducted at the participants' location of preference. The interviews were held by a researcher who had experience with interviewing. The duration of the interviews varied from 45 minutes to 105 minutes. The interviews were conducted in Dutch and were audio-taped after consent of the respondents.

For the explorative interviews no topics were predetermined, the interviewees elaborated on their experience with MRSA-t1081 in nursing homes and provided background information.

The following topics for the in-depth interviews were emerged from the conceptual framework regarding nursing home characteristics: infection control policy, client related characteristics, staff related characteristics and additional subtopics emerged from the interaction between interviewer and interviewee. Staff exchange was also a predetermined topic.

#### *Data analysis*

The interviews were replayed and summarized. Thereafter, a thematical analysis was performed by making categories. Several quotes were used to support the findings in the results chapter.

### 4.3 Questionnaire: Staff exchange in nursing homes

#### *Study population and recruitment*

Staff members of fifteen nursing homes were approached to fill in the 'Questionnaire: Staff exchange'. The staff members were approached by contact persons at the nursing homes who had access to the email addresses of the staff members. The researcher asked the contact persons to pass on the amount of staff members they had approached but only ten out of fifteen contact persons did answer this request. Of these ten nursing homes 916 staff members were reached and 423 staff members filled in the questionnaire, resulting in a response rate of 49 percent. During the interviews the key-experts were asked which staff members are at risk for acquiring MRSA colonization. Based on the interviews, the following staff members were included: nurses, nursing staff, physiotherapist, dentist, cleaning staff and hairdresser. The difference between nurses and nursing staff is that nurses have a higher education level (level 4), while nursing staff has an educational level of 2-3. Nurses are qualified to do more nursing treatment to patients than nursing staff. By analysing the data, we only included the staff members who probably have care contact with residents. Other respondents were excluded from analyses.

#### *Data collection*

An online-survey was conducted for staff members of nursing homes using the online survey software: *questback.com*. A link to this online survey was sent by e-mail a contact person of the nursing homes who had access to all the e-mail addresses of the staff members of the nursing homes. The full length questionnaire could be found in appendix III.

#### *Methodological considerations*

Some methodological considerations are made during the development of the 'Questionnaire: Nursing home characteristics'. As further described in the results chapter, the interviewees suggested to include the following questions: what type of job do you have; what types of health care institutes do you exchange to and do you work on more than one ward. The researcher and co-researchers decided to make a distinction between work in health care institute besides their current job and before their current job. Because we expected that a job besides their current job will result in frequent exchange between nursing home and health care institute and therefore more often a possible transmission pathway. However, new employees could also be a transmission vector between health care institutes. Especially trainees work in succession in many health care institutes in a short period so we attempt to also include this form of staff exchange by asking where did you work in the past two years. In consult with interviewees and co-researchers, we decided to add the question: 'What was the name of the health care institute?'. Hereby, we attempt to create a geographic overview of staff exchange between health care institutes. In addition, we expected that some staff members exchange with the same health care institute, what is essential in making a map of transmission.

#### *Measurements*

The 'Questionnaire: Staff exchange' is a result of integrating: the conceptual framework, findings from interviews and methodological considerations. In Table 4, the concept 'Staff exchange' is operationalised by subconcepts and their indicators. In this way, the following Table showed how the subconcepts are measured in the 'Questionnaire: Staff exchange'. These indicators were also the independent variables for the quantitative analyses.

Table 4: Operationalisation of the concept 'Staff exchange'

Subconcepts	Indicator
<b>Staff characteristics</b>	<ul style="list-style-type: none"> <li>❖ Job type: <i>nursing staff; nurse; housekeeping; physiotherapist; hairdresser; other</i></li> <li>❖ Working hours a week</li> <li>❖ Total years of employment</li> </ul>
<b>Staff exchange</b>	<ul style="list-style-type: none"> <li>❖ On how many wards do you work normally?</li> <li>❖ Did you have a job at another HCI besides your job at the current NH? <i>yes/no</i></li> <li>❖ At how many HCI do you work and what type of HCI was this? <i>Nursing home; residential home with nursing department; residential home without nursing department; rehabilitation institute; home care; hospital</i> <ul style="list-style-type: none"> <li>○ What was the name of the HCI and how many hours a week do you work at this HCI?</li> </ul> </li> <li>❖ Besides the HCI mentioned above, did you work in another HCI in the past two years?</li> <li>❖ At how many HCI do you work and what type of HCI was this? <i>Nursing home; residential home with nursing department; residential home without nursing department; rehabilitation institute; home care; hospital</i> <ul style="list-style-type: none"> <li>○ What was the name of the HCI and how many hours a week did you work at this HCI?</li> </ul> </li> </ul>

#### Data analysis

The quantitative analyses were performed by using SPSS Statistics version 22.0 and R statistics i386 3.1.0. A descriptive analysis was conducted in order to obtain an overview of the staff member characteristics, with a distinction between the nursing homes with a recent MRSA outbreak and the control nursing homes. An independent sample T-test was used to demonstrate differences between the two groups. The exchange of staff members between wards is likely to be correlated with the policy in the nursing homes and could therefore not be analysed with a normal logistic regression. The staff members are namely not independent individuals but are grouped by the nursing home where they worked. Because of this, a multilevel logistic regression was used to account for the clustering factor nursing homes. The exchange of staff with other health care institutes seems less likely to be correlated with the policy in the nursing homes. For comparing the degree of staff exchange between nursing homes with an outbreak and control nursing home a normal logistical regression analysis was used.

## 4.4 Questionnaire: Nursing home characteristics

### *Study population & recruitment*

Of the 30 approached nursing homes, 17 nursing homes participated in this study (7 cases and 10 controls), see also Figure 2. The ‘*Questionnaire: Nursing home characteristics*’ was filled out by respondents with knowledge of e.g. the capacity and the infection prevention policy of the nursing home for each nursing home. Typically, these respondents were elderly care physicians, nurses, managers or quality officers. In most cases, the infection prevention consultants who participated in the interviews of these study, approached the respondents of the case nursing homes. The infection prevention consultants received a letter with an explanation of this study, see also appendix V. The letter emphasized that this study was developed to support nursing homes in preventing MRSA transmission and certainly not to inspect the nursing homes. Furthermore, the letter emphasized that their response would be analysed anonymously. This letter was written to support the infection prevention consultant in informing the contact persons of the nursing homes about the study and convince them to take part in the research. This kind of approach was chosen because the RIVM already had established contacts with the infection prevention consultants across the Netherlands. If we would contact the respondents of the nursing homes directly, the contact persons might become cautious due to their anxiety for inspection instead of research.

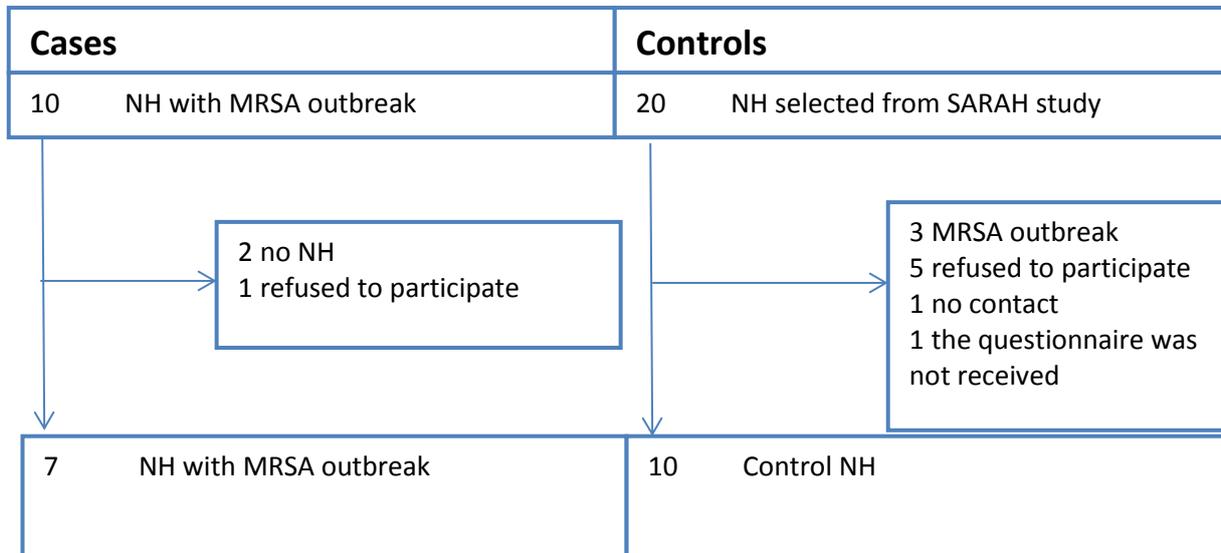


Figure 2: Flow chart inclusion and exclusion of nursing homes

### *Data collection*

The ‘*Questionnaire: Nursing home characteristics*’ was sent by e-mail to the respondents of the nursing homes in the period of 19 May till 13 July 2015. The full length questionnaire is added in appendix IV. As described above this questionnaire is based on the conceptual framework, consisting of literature and existing questionnaire ‘*General questionnaire incidence-measurement SNIV 2014*’ and findings of the interviews. The integration of the findings of the interviews with the conceptual framework is described in the results chapter. Not all the issues considered by the interviewees were questioned in the questionnaire because of methodological considerations. These are described in the following paragraph.

### *Methodological considerations*

Several methodological considerations were made during the development of the ‘*Questionnaire: Nursing home characteristics*’. These methodological considerations had to be made because if we included all the issues, the questionnaire would be too long for the respondents. The following residential related characteristics were not included in the questionnaire: influenza coverage, co-

morbidities, indwelling devices, wounds/skin lesions/ulcers pressures, needing more than moderate assistance by daily activities and being bedbound. In agreement with co-researchers of the RIVM, the influenza coverage and the dental hygiene was not considered as a predicting characteristic for MRSA outbreak and therefore not included in the questionnaire. The need for more than moderate assistance by daily activities can be derived from the CIP and therefore not asked separately. The other residential related characteristics mentioned above are confirmed in the interviews as risk factor for MRSA colonization. However these characteristics were not included in the questionnaire because the researchers estimated these residential related characteristics too time-consuming for the respondents to look up. The type of wards were included in the questionnaire. The type of wards may be linked to some of the risk factors or by all means to the kind of care provided at the ward and the intensity of contact between staff member and resident.

The influence of the antibiotic stewardship was considered as correlated with the infection prevention policy in agreement with one of the interviewees. In addition, antibiotic use was considered as too time-consuming for the respondents. Therefore the antibiotic stewardship was not assessed in the questionnaire.

As described in the results chapter, all the interviewees stressed importance of infection prevention policy and measures in order to prevent an MRSA outbreak and further transmission of MRSA. The questions from the existence SNIV-questionnaire about infection prevention policy were included in the questionnaire and in agreement with co-researchers of the RIVM a few additional questions about the infection prevention committee meetings (frequency and the use of notes) were included in the *'Questionnaire: Nursing home characteristics'*. Despite the great importance of the infection prevention measures the following measures were not assessed in the questionnaire: precautions, environmental cleaning and screening. The practice of infection prevention is judged by the health inspection every year and is not part of the jurisdiction of the RIVM. The time spend to infection prevention as mentioned in the conceptual framework was not questioned but the frequency of the meeting for the infection prevention committee was included.

#### *Measurements*

The *'Questionnaire: Nursing home characteristics'* is a result of integrating the conceptual framework, findings from interviews and methodological considerations. In Table 5 the concept 'Nursing home characteristics' is operationalised by subconcepts and their indicators. In this way, the following Table showed how the subconcepts are measured in the *'Questionnaire: Nursing home characteristics'*. These indicators were also the independent variables for the quantitative analyses.

Table 5: Operationalisation of the concept 'Nursing home characteristics'

Subconcepts	Indicator
<b>Capacity related factors</b>	<ul style="list-style-type: none"> <li>❖ Number of beds</li> <li>❖ Number of facility rooms</li> </ul>
<b>Resident related factors</b>	<ul style="list-style-type: none"> <li>❖ Care intensity package (4-10) of the residents</li> <li>❖ Age of the residents: &lt;60; 60-64; 65-74; 75-84; &gt; 85 yrs</li> <li>❖ Private room for residents: &lt;25%; 25-50%; 50-75%; &gt;75% of the residents per NH</li> <li>❖ Private bathroom for residents: &lt;25%; 25-50%; 50-75%; &gt;75% of the residents per NH</li> </ul>
<b>Staff related factors</b>	<ul style="list-style-type: none"> <li>❖ Use of flex personnel: <i>daily; weekly; monthly; never.</i></li> <li>❖ Use of temporary workers: <i>daily; weekly; monthly; never.</i></li> <li>❖ Exchange of nursing staff between wards: <i>none; incidental; regularly; exchange</i></li> <li>❖ Housekeeping employed by NH: <i>yes; no.</i></li> <li>❖ Nursing staff wear professional clothing: <i>yes; no</i></li> <li>❖ Rules for clothes and jewellery of volunteers: <i>uniforms; no jewellery; no clothes with long sleeves; other rules; no rules</i></li> </ul>
<b>Infection prevention related factors</b>	<ul style="list-style-type: none"> <li>❖ Infection control committee(ICC): <i>yes; no</i></li> <li>❖ Members of ICC: <i>medical manager; nurse manager; microbiologist hospital; infection prevention consultant; elderly care physician; others</i></li> <li>❖ ICC based on guidelines: <i>WIP; Vilans; LCHV; other</i></li> <li>❖ Frequency of ICC meetings: <i>weekly; monthly; every three months; every six months; once a year</i></li> <li>❖ Minutes during the ICC meetings: <i>yes; often; sometimes; no</i></li> <li>❖ Infection prevention consultant employed: <i>yes; no</i></li> <li>❖ Hours a week infection prevention consultant employed</li> <li>❖ Yearly infection control education for nursing staff: <i>yes; no</i></li> <li>❖ Infection control education for new employees: <i>yes;no</i></li> </ul>

The dichotomous outcome variable of this study is the status of the nursing home defined as case nursing home or control nursing home. The cases are nursing homes with a recent MRSA-t1081 outbreak registered at the RIVM in the period from 1 January 2014 until 1 March 2015. The control nursing homes were nursing homes participated in the SARAH study in 2013/2014 whereof no MRSA residents were found in the nursing homes.

#### Data analysis

The quantitative analyses were performed by using SPSS Statistics version 22.0. A descriptive analysis was conducted in order to get an overview of the characteristics of the nursing homes, with a distinction between the nursing homes with a recent MRSA outbreak and the control nursing homes. Pearson Fisher Exact test was used to demonstrate differences between the two groups. This test was chosen because of the small N of the two groups.

## 4.5 Ethical considerations

Ethical approval was not required because the data was anonymized prior to analysis and the staff members had to be over 18 years to participate in this research.

## 4.6 Validity

In this study, respondent bias could arise if the respondents of the nursing homes were suspicious of becoming controlled by the researcher, and therefore answered different to the questions. The respondent bias was minimized by sending a letter to the nursing homes, that emphasized that the purpose of this research is to help the nursing homes in preventing MRSA transmission instead of controlling the nursing homes in their application of infection prevention for instance.

Recall bias could play a role in case-control studies for example if the outbreak homes put more effort in remembering past risk factors than the control houses do. However, triangulation is used to reduce this recall bias. Namely, the past risk factors mentioned in the interviews were asked in the questionnaires to both the control and the outbreak houses. Another form of recall bias can occurred because the respondents of the questionnaire 'Nursing home characteristics' belonging to the outbreak nursing homes have to remember the characteristics of the situation from before the outbreak. Recall bias is minimized by selecting only nursing homes with an MRSA-t1081 outbreak in 2014-2015. In this way, the respondents did not have to go that long back in time and a part of the characteristics will be the same.

Researcher bias was reduced by consulting co-researchers at the RIVM by analysing the interviews and their involvement in deciding what questions had to be asked.

## 5. Results

This chapter is divided in two sections: staff exchange and nursing home characteristics. Each section will first discuss the findings of the interviews with key-experts in order to explain which questions are included in the questionnaires of this study. The questionnaires do however not contain all issues mentioned by the key-experts. These methodological considerations are further explained in the methods chapter. The second part of each section consists of the quantitative data collected by the questionnaires.

### 5.1 Staff exchange

#### Views of key experts

During the interviews, the key-experts reported their experience with recent MRSA-t1081 outbreaks in nursing homes. Most of the key-experts had developed maps of the colonized residents and staff members in order to identify the index person. Several interviewees had strong suspicions about the involvement of a staff member but were unable to detect the MRSA in this staff member by means of screening.

*R3: "One of our residents in our residential homes was found to have MRSA during hospitalisation. In this residential home, we started a "circle investigation", and much more MRSA positives were found. After that we tested the people in our nursing home (another institute than mentioned above) and again we found a fair amount of MRSA positives. In the time, we suspected an employee from the flexpool to be a very possible transmission factor. This employee worked both in the residential home and in our nursing home."*

From literature we know that in many cases, staff members who are positive for MRSA in the first place, lose the bacterium within a short time period even without the use of a decolonization therapy. Because of this, it is next to impossible to prove the MRSA positive history of staff members and the map of transmission routes cannot always be completed.

*R5: "Mapping an MRSA outbreak, I always try to direct the spreading to the index person. There was a gap in this map, that only could be filled by an employee, causing transmission between the two residents. However, this could not be pointed out by screening."*

More than half of the interviewees confirmed our expectations of the role in inter-institutional transmission by means of staff exchange. Because of the difficulty of proving the role of staff exchange, two key-experts wondered how strong the evidence has to be before guidelines for staff exchange will be introduced by the government. As an example, in a short period nursing staff trainees have to work in different health care institutes including nursing homes. The interviewee proposed to develop national guidelines for screening trainees to prevent inter-institutional transmission, which strongly indicates he underlined the risk of frequent staff exchange.

The interviewees addressed that not only the exchange between health care institutes is important to research but also the exchange of staff within a nursing home can serve as transmission pathway between wards. The role of staff members in transmission of MRSA within health care institutes is stressed by all key-members. Because of this finding, the 'Questionnaire: Staff exchange' was elaborated with a question on the number of wards the staff members worked in general in their nursing home.

R5: "Personnel can be an important factor by spreading MRSA, but also the transfer of patients from another nursing home, hospital or from homecare can be a factor. I think that there also should be more attention in exchange staff between units in one and the same nursing home. It is a fact that that occurs a lot."

During the interviews, the researcher aimed to identify which staff members are at risk for acquiring MRSA colonization in order to determine inclusion criteria for this study. The interviews made clear that during care contacts with MRSA positive residents contact precautions have to be taken not only by nursing staff, nurses and nursing assistants but also by the physiotherapist, sometimes the hairdressers (in one nursing home), and in some cases by volunteers (only if they have frequent intensive contact moments with residents). The dentist did not take extra precautions in the included nursing homes. Based on these findings, the inclusion criteria were developed, see also the methods chapter and different answer options for job functions were developed for the first question. As mentioned earlier in the conceptual framework, the explorative interviews suggested an interaction between nursing home staff and home care. These interviewees expected that staff does not only exchange with other nursing homes but also with residential homes, hospitals, revalidation clinics and home care. The question about exchange with nursing homes was therefore expanded to include also other health care institutes, see also methods chapter for the complete 'Questionnaire: Staff exchange'.

**Results of 'Questionnaire: Staff exchange'**

**Characteristics nursing home staff**

Of 520 staff members who filled in the questionnaire regarding staff exchange, 44 were excluded from analysis based on their job function. 301 staff members were affiliated to 9 control nursing homes and 173 staff members were employed in 6 nursing home with an MRSA outbreak. 63 percent of the staff members were nursing staff, 13 percent were nurses, see also Figure 3. Staff members indicated as "Other" were for example: assistants in nutrition or social workers. The mean working hours per week was 24.1 and the mean time of employment in work positions was 10.8 years.

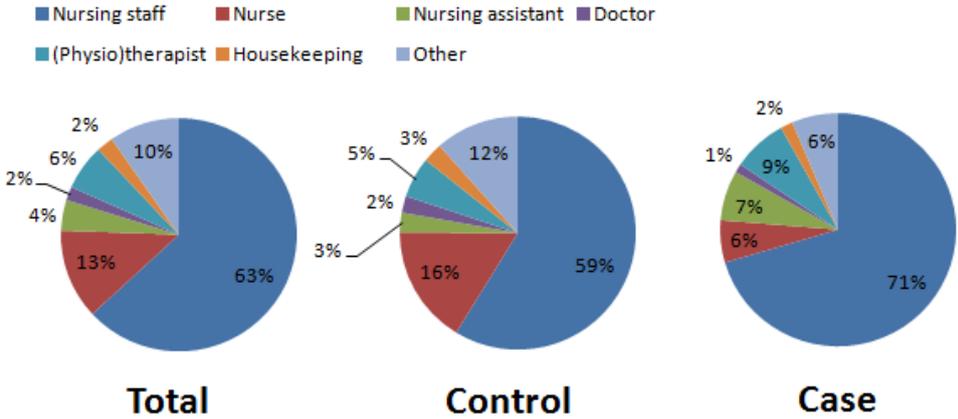


Figure 3: Job function of all staff members

Table 6: Characteristics of staff members

	All staff members	Staff members working in control NH	Staff members working in NH with MRSA outbreak
<b>N</b>	474	301	173
<b>Job type, n (%)</b>			
Nursing staff	299 (63.1)	177 (58.8)	122 (70.5)
Nurse	59 (12.4)	49 (16.3)	10 (5.8)
Nursing assistant	20 (4.2)	8 (2.7)	12 (6.9)
Doctor	9 (1.9)	7 (2.3)	2 (1.2)
(Physio)therapist	30 (6.3)	17 (5.6)	13 (7.5)
Housekeeping	11 (2.3)	8 (2.7)	3 (1.7)
Other	46 (9.7)	35 (11.6)	11 (6.4)
<b>Working hours per week</b>			
Mean <sup>a</sup> (sd)	24.1 (8.8)	24.2 (9.1)	24.0 (8.2)
Median (range)	24.0 (117)	24.0 (115)	24.0 (35)
<b>Time in position in years</b>			
Mean <sup>a</sup> (sd)	10.8 (10)	11.1 (10.2)	10.2 (9.8)
Median (range)	7 (66)	8 (65.9)	7 (60)

<sup>a</sup>Independent sample T-test: working hours per week,  $p = 0.805$ ; total years working in nursing home,  $p = 0,989$

#### **Staff exchange between nursing homes (and other health care institutes)**

In total, 13.1 percent of the staff members worked in more than one health care facility at the same time. For staff members of control nursing homes this was 15.3 percent and for staff members of nursing homes with an outbreak 9.2 percent. The number of health care institutes to which a staff member exchanged ranged from one to six health care institutes, most of the staff members were engaged in work at only one other health care institute at the same time (see also Figure 5). The staff members (59/474) reported to exchange with in total 87 health care institutes. Of these health care institutes, 63 percent were nursing homes (see also Figure 4).

Overall, 19 percent of the staff members worked in the past two years in one or more other health care institutes. A total number of 142 were measured in the questionnaire for health care institutes where the staff members worked, whereof 48 percent were nursing homes.

#### **Staff exchange between wards**

Overall, 45 percent of the staff members reported to work on more than one ward within a nursing home. Of the staff members of the control nursing homes, 49.1 percent worked on more than one ward and 51.1 percent of the staff members of nursing homes with an MRSA outbreak worked on more than one wards. After accounting for clustering factor 'nursing home' in a multilevel logistic regression, an odds ratio 0.863 was found with a non significant p-value of 0.971, see also Table 7.

Table 7: Exchange of nursing home staff within nursing homes and with other health care institutes

	All staff members	Staff members working in control NH	Staff members working in NH with MRSA outbreak
Having a job in HCI besides job in current NH <sup>a</sup> , n (%)	59 (13.1)	44 (15.3)	15 (9.2)
Having a job in HCI before job in current NH <sup>a</sup> , n (%)	85 (19.0)	57 (19.9)	28 (17.3)
Exchange with other wards <sup>b</sup> , n (%)	188 (45.0)	133 (49.1)	55 (37.4)

<sup>a</sup> Logistic regression: Work besides current job OR 1.78, p = 0.069 CI95% (0.957 – 3.309); Work before current job: OR: 1.191, p-value: 0.493 CI95 (0.722-1.964)

<sup>b</sup> Multilevel logistic regression: Work on more than one ward, OR= 0.863, p-value: 0.971 CI95 (5.869e-11;1.194e+10)

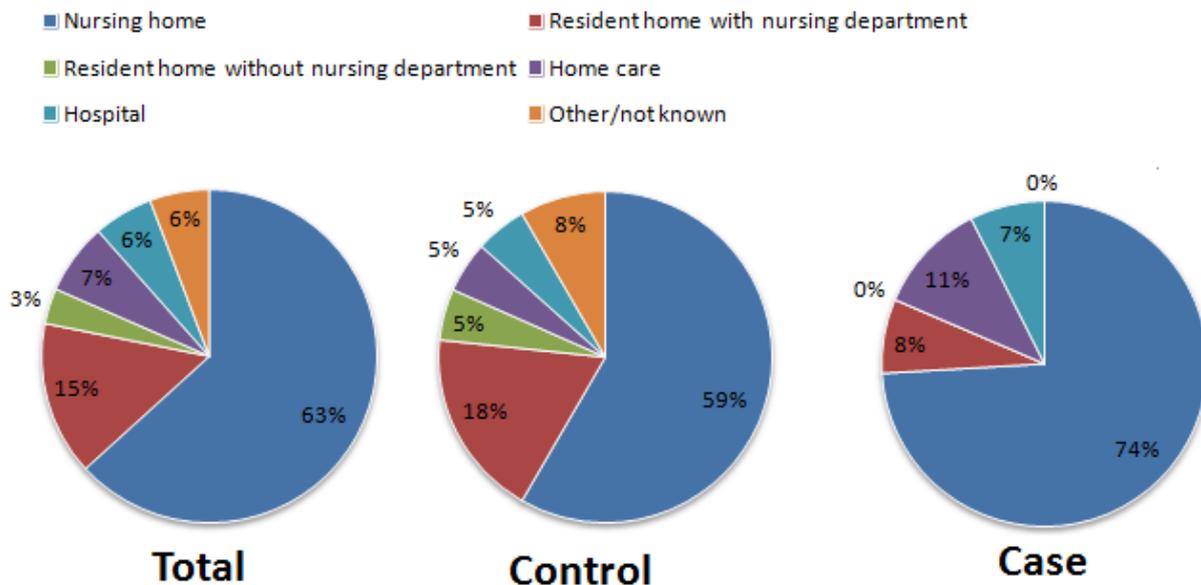


Figure 4: Types of health care institutes to which staff members exchanged, besides their current job in nursing home<sup>a</sup>.

<sup>a</sup> The total number of health care institutes to which staff members exchanged was 87 (60 for staff members of control nursing homes and 27 for staff members of nursing homes with an outbreak). See for all the numbers, Table I in the Appendix VI

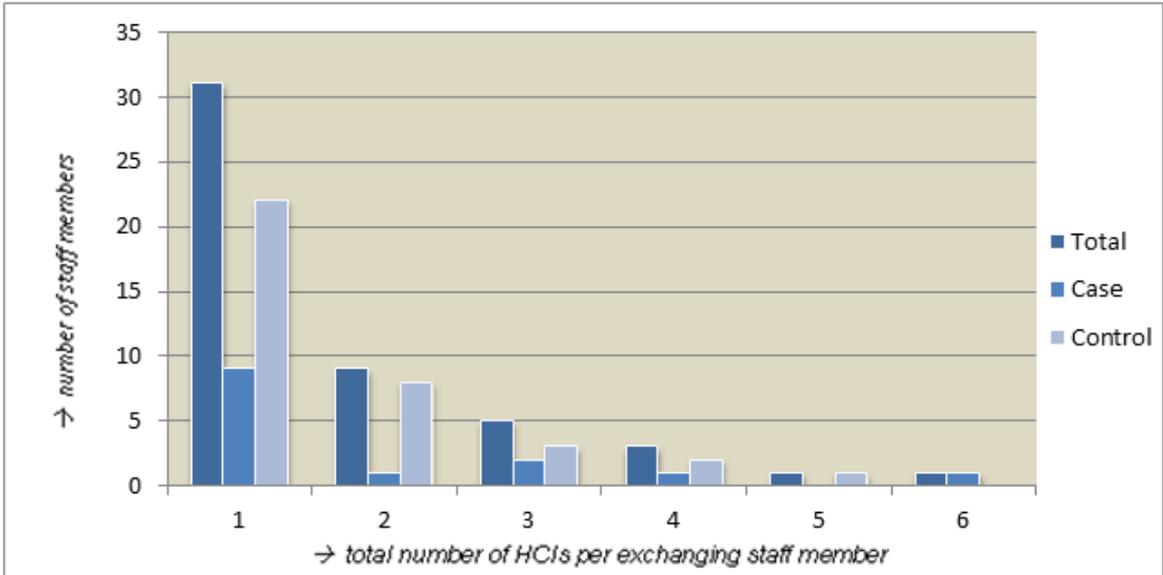


Figure 5: Histogram of the number of other health care institutes staff members work in, besides their current job in the nursing home.

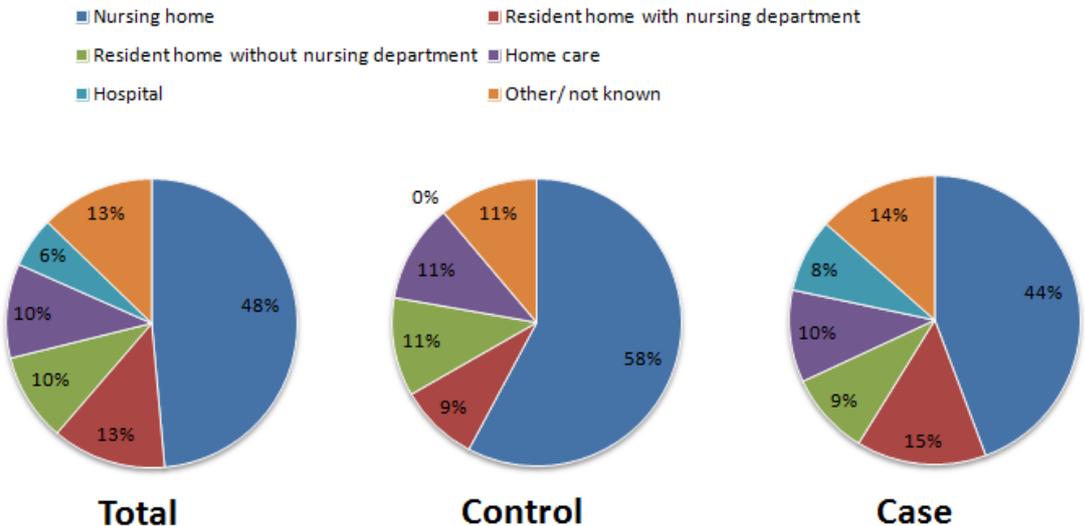


Figure 5: Types of health care institutes to which staff members exchanged, before their current job in nursing homes (in the past two years)<sup>a</sup>.

<sup>a</sup> The total number of health care institutes to which staff members exchanged was 142 (97 for staff members of control nursing homes and 45 for staff members of nursing homes with an outbreak). See for all the numbers, Table II in the Appendix VI

## 5.2 Nursing home characteristics

### Views of key-experts

Besides the possible role of staff exchange in MRSA transmission between nursing homes, several nursing home characteristics that might play a role in MRSA transmission and/or prevention were addressed in the interviews with key-experts. Based on their experience with e.g. MRSA-t1081 outbreaks, the following issues emerged from the interviews: infection control policy, resident characteristics, environmental cleaning and staff related characteristics.

#### **Infection control policy**

According to all key-experts, the practice of infection control in nursing homes is the most important tool in preventing MRSA outbreaks and further transmission. The practice of infection prevention control is very different between nursing homes which could have several reasons. In some nursing homes, the infection control policy is determined by an infection prevention committee. This committee has developed protocols for the prevention of infections; control of infections and outbreaks. These protocols are based on guidelines like the WIP (further described in the contextual background). One interviewee mentioned that although one nursing home had an infection control committee, the wrong measures were taken during an MRSA outbreak. It turned out that this infection control committee used their own developed guidelines instead of the WIP guideline. Because of this, not only a question on the presence of a committee is included in the *'Questionnaire: Nursing home characteristics'* but also questions on the guidelines the protocols are based on, the composition of the committee, the frequency of meetings and the use of notes were integrated. Additionally, one of the infection prevention consultants mentioned that only having an infection control committee in a nursing home does not ensure that all the plans developed by the committee will be carried out on the work floor. Which is again a strong indication that the existing question in the questionnaire *'General questionnaire incidence-measurement SNIV 2014'* on having an infection control committee or not have to be elaborated with additional questions.

R4: *"There was on an higher level, an infection committee and the medical staff, the understanding that this was not the way, changes were needed and there were some good ideas for new policies. However, it was only talking. We (infection preventive consultants) call it "sleeping infection committees": at the conference table, a lot of good things are put in the minutes of the staff meetings, but the succession to the work floor that has to be done are not filled in."*

He mentioned that an infection prevention consultant could act as a bridge between the committee and the staff members who have to perform the plans developed in the committee. Some nursing homes have an infection prevention consultant employed who gives advice about infection control. Other nursing homes do temporarily employ such a consultant in case of a calamity, like an MRSA outbreak. Therefore, the employment of an infection prevention consultant is included in the questionnaire.

One of the infection prevention consultants who are employed by the nursing homes addressed the difficulties with the interpretation of the protocols used for prevention MRSA transmission, which is illustrated by the following quote.

R6: *"I am a member of the infection prevention committee. We use the WIP or VILANS protocols, which in fact are the same. However, these protocols are difficult to work with, and are basically the same: hygiene of the hands, clothes conform the rules, and protective measures."*

This infection prevention consultant explained that infection control consists of hand hygiene in the first place. This should be applied in the right way, meaning washing hands on all the indication moments, using hand alcohol and no wearing of jewellery or nail polish. In case of intensive contact with an MRSA positive resident, contact precautions have to be taken including the use of protecting clothes (a mask and sleeve) during intensive contact moments. Additionally, area restrictions are imposed for MRSA residents. Although, according to the interviewees, the implementation of these protocols is very specific for each (of the residents of) nursing home. As illustrated by the following quote, some residents have compulsive behaviour and it is impossible and not preferable to break through this routine.

R7: *“There is a base protocol for MRSA prevention, made by the infection prevention committee, but our residents need individually tailored handling. Especially in nursing homes this is the case, because we have to deal with PG (psycho-geriatric) clients. For example, a PG patient is using the elevator every day to go out. It is impossible to cut this daily routine, because it is compulsive behavior. You have to deal with this and you cannot force this into protocols.”*

Due to methodological consideration, not all of the issues of infection prevention control mentioned above, were included in the ‘Questionnaire: Nursing home characteristics’, see methods chapter. Another issue that emerged from the interviews is the low education level of the nursing home staff to understand and apply the infection prevention measures. Rules and instructions regarding MRSA have to be given and repeated often as they are not common knowledge among staff. Education for nursing staff has to start immediately after an outbreak is detected to make clear and resident specific agreements. Education for hand hygiene has to be repeated to stay effective. Also new staff members have to know the arrangements and how to perform good hand hygiene, therefore education for new staff members is preferred in preventing MRSA transmission. Infection control education is therefore included in the questionnaire of this study.

R7: *“The MRSA issues in nursing homes needs much more tailor handling than in hospitals. Therefore the instruction must be implanted as soon as possible. Than one can explain that the mainline of the protocol is valid, except for some points, which one can explain further.”*

### **Environmental cleaning**

Several issues regarding environmental cleaning are mentioned by the interviewees in preventing transmission of MRSA. In the first place, the cleaning products have to be used in accordance with the WIP guidelines. The dilution of chlorine has to be sufficient for killing bacterium. According to an infection prevention consultant, the use of chlorine tablets makes the producing of the right dilution far more easy. Interviewees mentioned that in some nursing homes the surfaces were cleaned with hand alcohol, while cleaning with 70 percent alcohol is described in the guidelines. In one nursing home the room of an MRSA resident was thoroughly cleaned every day. The infection prevention consultant mentioned that this measure was useless, cleaning of the room is necessary before decolonization treatment and after treatment (six days later) or if the MRSA positive resident is moved out.

The devices such as lifters were often not cleaned after using. The same lifter was used for MRSA positive residents as negative residents what could be a risk factor for transmission. The interviewees addressed that after the outbreak the lifters get a label: MRSA+, so the lifters had to be only used for MRSA positive residents (the lifters still have to be cleaned between two residents). If this is not possible the lifter had to be thoroughly cleaned. In addition, the MRSA positive residents were helped at the end of the morning and sometimes by a specific team of staff members. Due to methodological considerations no questions were included in the questionnaire about environmental cleaning, see also methods chapter.

### ***Resident related characteristics***

As described in the conceptual framework, several resident characteristics have been identified as risk factors for acquiring MRSA. Interviewees confirmed the use of catheters, having pressure ulcers and having wounds as risk factors and explained that it is hard to decolonize these residents. In many cases, they become chronic carriers and additional measures and agreements then have to be taken within the nursing home. The key-experts linked the presence of residents with risk factors to the type of wards. On the revalidation ward, for instance, the MRSA was more difficult to control than on the psychogeriatric ward. Residents on the revalidation ward were probably at higher risk for carriage of MRSA due to the increased proportion of residents with wounds and the need for more intensive care compared to residents with, for example, dementia on a psycho-geriatric ward. However, nursing homes face another challenge in preventing the spread of transmission on psycho-geriatric wards. Because a high percentage of the residents at psycho-geriatric wards have compulsive behaviour or low cognitive status, which makes it difficult to make arrangements for contact precautions or impose restrictions for these residents in the way that they do not understand or forget the arrangements. Because of these findings, a question on the percentage of residents on different types of wards is included in the *'Questionnaire: Nursing home characteristics'*. The care intensity package (CIP) is an indicator of the intensity of care provided to residents and is therefore also related to the risk of acquiring MRSA. An interviewee stressed that a higher CIP not automatically means a patient receives more intensive care. For example, a psycho-geriatric resident with severe dementia has CIP 9 while a residents with invasive wounds has CIP 7. The CIP score is also included in the questionnaire of this study. More information on care intensity package can be find in the contextual background.

### ***Staff related characteristics***

The use of flex workers due to the increased staff shortage were already addressed in the explorative interviews. One of these interviewees expected that the use of flex workers in the more smaller regions is less compared with the big cities. Among the interviewees, the education level and the application of hygiene measures of the flex workers were differently judged. On one hand a manager told that flex workers have the same experience and skills as regular staff, see also the following quote. Additionally she stated that they are more cautious during contact moments with MRSA residents because they are aware of their role in transmission to other wards. On the other hand an infection prevention consultant of other nursing homes addressed that flex workers applied less hygiene measures. One interviewee from the explorative interviews added that it is sometimes hard to make agreements with staff in nursing homes because sometimes a whole new team of staff members is in place so the agreements have to be set up again. Based upon these findings the use of flex workers and temporarily workers were included in the *'Questionnaire: Nursing home characteristics'*.

R8: *"The flex working employee is a separate factor in handling the MRSA problem. When everything cooled down on the ward (the problem of MRSA had been diminished), the flex employees were allowed to return to their work on this ward, but they were not allowed to help residents which were MRSA positive. However that raised a problem, because in many cases (nightshifts for example) there are only two employees on the unit. When there are two persons needed for helping a resident, it is almost impossible for the flex employee to refuse and say: no I don't do that [...]. I think that flex working employees are more alert then others because they are more aware that they probably spread MRSA from one unit to the other."*

## Results of 'Questionnaire: Nursing home characteristics'

A total of 17 nursing homes participated in the study. Of 10 long term care facilities that were identified with an MRSA-t1081 outbreak in 2014-2015, 7 nursing homes participated in our study. Of the three others, two were not nursing homes, but long term care facilities who did not deliver nursing home care and were therefore excluded. In the last nursing home the manager did not agree to participate in this study. Of the 20 nursing homes who participated earlier in the SARAH study, 10 nursing homes participated as controls in this study. Three nursing homes were excluded because they had an MRSA outbreak after their participation in the SARAH study, from one nursing home the filled-in questionnaire was not received and one nursing home could not be reached. Five nursing homes declined to participate in this study.

### *Differences between nursing homes in characteristics*

In Table 8 the nursing home characteristics of the nursing homes are presented with a distinction between nursing homes without an MRSA outbreak and nursing homes with an MRSA outbreak. No significant differences in nursing home characteristics were found between groups. Nursing homes had a median of 96 beds (range 18-453), 3 facility rooms (range 2-9) and 6 wards (2-24). Most patients had a care intensity package of five. More than half of the residents of a nursing home had a private room in 75 percent (12/16) of the nursing homes. The type of wards in nursing homes were gathered for ten nursing homes, every nursing home had a psycho-geriatric ward. Three nursing homes deliver only psycho-geriatric care. Five nursing homes more than half of the residents stay on a psycho-geriatric ward. In one nursing home more residents stay on a somatic ward than psycho-geriatric wards. The remaining nursing home had psycho-geriatric ward, a somatic ward and a revalidation ward and a other ward, see also Table 9.

In 11 of the nursing homes (64.7 percent), the nurses and nursing staff on more than one ward. The cleaning staff worked on more than one ward in 53.4 percent of the nursing homes. Across all nursing homes, 76.5 percent (13/17) of the nursing homes did use weekly or daily flex personnel. In 52.9 percent of the nursing homes, nursing personnel wore professional clothes. 18.8 percent of the nursing homes had rules according clothes and jewelry for volunteers. Only one nursing home did not have an infection control committee, this was a case nursing home. Four nursing home employed an infection prevention consultant, with an average of 7.5 working hours a week. Ten nursing homes had yearly infection control education for nursing staff and five nursing homes trained new employees.

Table 8: Nursing home characteristics

Characteristics	Total (n = 17)	NH with no MRSA outbreak (n =10)	NH with MRSA outbreak (n = 7)
Number of beds, median (range)	96 (18-453)	98 (18-232)	80 (18-435)
Number of facility rooms , median (range)	3 (2-9)	3 (2-5)	5 (3-9)
Number of wards, median (range)	6 (2-24)	8 (2-24)	6 (2-17)
<i>Resident related characteristics</i>			
Care intensity package, as % of all residents	n =13 missing = 4	n = 8 missing = 2	n = 5 missing = 3
% CIP 4 median (range)	0.8 (0.0-33.3)	0.9 (0.0-4.1)	0 (0.0-33.3)
% CIP 5 median (range)	57.8 (0.0-80.0)	65.6 (44.7-91.5)	35.0 (28.6-72.2)
% CIP 6 median (range)	12.3 (0.0-41.8)	3.8 (0.0-36.5)	28.0 (0.0-41.8)
% CIP 7 median (range)	10.5 (2.5-27.8)	9.5 (5.6-25.5)	10.5 (2.5-27.8)
% CIP 8 median (range)	0 (0-6.3)	0 (0.0-12.5)	1.8 (0.0-6.3)
% CIP 9 median (range)	0 (0-15.5)	0 (0.0-15.5)	0 (0.0-21.0)
% CIP 10 median (range)	0 (0-2.7)	0 (0.0-3.1)	0 (0.0-1.4)
Age, as % of all residents	n = 14 missing = 3	n = 8 missing = 2	n = 6 missing = 1
% < 60 yrs median (range)	0 (0.0-5.8)	0 (0.0-5.8)	0 (0.0-5.6)
% 60 – 64 yrs median (range)	1.5 (0.0-4.3)	1.5 (0.0-3.9)	1.7 (0.0-4.3)
% 65 – 74 yrs median (range)	11.1 (0.0-29.4)	12.2 (4.1-29.4)	7.3 (0.0-17.3)
% 75 – 84 yrs median (range)	37.7 (8.0-50.0)	34.8 (22.2-39.4)	37.7 (8.0-50.0)
% > 85 yrs median (range)	42.9 (32.7-72.2)	42.7 (32.7-72.2)	44.0 (38.9-56.4)
Private room <sup>a</sup> , n (%)	n = 16 missing = 1	n = 10	n = 6 missing = 1
> 50 %	12 (75)	7 (70)	5 (83.3)
Private bathroom <sup>a</sup> , n (%)	n = 16 missing = 1	n = 10	n = 6 missing = 1
> 50 %	7 (43.8)	3 (30)	4 (66.7)
<i>Staff related characteristics</i>			
Use of flex personnel, n (%)			
Weekly or more	13 (76.5)	8 (80)	5 (71.4)

Monthly or less	4 (23.5)	2 (20)	2 (28.6)
Use of temporary workers, <i>n</i> (%)			
Weekly or more	4 (25)	4 (40)	0 (0)
Monthly or less	12 (75)	5 (50)	7 (100)
Exchange of nurses and nursing staff between wards, <i>n</i> (%)	11 (64.7)	7 (70)	4 (57.1)
Exchange of cleaning staff between wards, <i>n</i> (%)	9 (52.9)	6 (60)	3 (42.9)
Housekeeping personnel is employed by the nursing home, <i>n</i> (%)	<i>n</i> = 15 missing = 1	<i>n</i> = 10	<i>n</i> = 6 missing = 1
yes	13 (86.7)	8 (80)	6 (100)

*Infection prevention related characteristics*

Nursing personnel wear professional clothing, <i>n</i> (%)	9 (52.9)	4 (40)	4 (57.1)
Rules for clothes and jewelry of volunteers <sup>a</sup> , <i>n</i> (%)	<i>n</i> = 16 missing = 1	<i>n</i> = 9 missing = 1	<i>n</i> = 7
Yes	3 (18.8)	2 (22.2)	1 (14.3)
Presence of infection control committee, <i>n</i> (%)	16 (94.1)	10 (100)	6 (85.7)
Composition of infection control committee, <i>n</i> (%)	<i>n</i> = 16 missing = 1	<i>n</i> = 9 missing = 1	<i>n</i> = 7
Medical manager	7 (43.8)	4 (44.4)	3 (42.9)
Nurse manager	10 (62.5)	6 (66.7)	4 (57.1)
Microbiologist hospital	7 (43.8)	3 (33.3)	4 (57.1)
Infection prevention consultant	10 (62.5)	5 (55.6)	5 (71.4)
Elderly care physician	14 (87.5)	8 (88.9)	6 (85.7)
Others	9 (56.3)	9 (100)	5 (71.4)
Infection control committee protocols are based on guidelines, <i>n</i> (%)	<i>n</i> = 15 missing = 2	<i>n</i> = 8 missing = 2	<i>n</i> = 7
WIP	13 (87.6)	6 (66.7)	7 (100)
Vilans	8 (53.3)	4 (44.4)	4 (57.1)
LCHV	4 (28.6)	3 (37.5)	1 (14.3)
Other	4 (28.6)	3 (37.5)	2 (28.6)
Frequency of meeting with infection control committee <sup>a</sup> , <i>n</i> (%)		<i>n</i> = 9	
Monthly or more	5 (31.3)	3 (33.3)	2 (28.6)
Every three months or less	11 (68.8)	6 (66.6)	5 (71.4)
Minutes during the meeting <sup>a</sup> , <i>n</i> (%)	<i>n</i> = 16 missing = 1	<i>n</i> = 9 missing = 1	<i>n</i> = 7
Yes	13 (81.3)	9 (100)	4 (57.1)
Often or sometimes		0 (0)	3 (42.9)

Infection prevention consultant employed <sup>a</sup> , <i>n</i> (%)	4 (23.5)	2 (20)	2 (28.6)
Hours a week mean (sd) median (range)	7.5 (6.2) 6 (2-16)	3 (1.4) 3 (2-4)	12 (5.7) 12 (8-16)
Yearly infection control education for nurses and nursing staff, <i>n</i> (%)	10 (58.8)	5 (50)	5 (71.4)
Infection control education for new employees, <i>n</i> (%)	5 (29.4)	4 (40)	1 (14.3)

<sup>a</sup> Fisher's Exact Test: private room, *p* = 1.000 ; private bathroom, *p* = 0.302 ; use of flex workers, *p* = 1.000 ; use of temporary workers, *p* = 0.088 ; exchange of nurses and nursing staff between wards, *p* = 0.644 ; exchange of cleaning staff, *p* = 0.637 ; use of professional clothing, *p* = 0.637 ; infection prevention committee, *p* = 0.412 ; rules for volunteers, *p* = 1.000 ; frequency of IPC meeting, *p*-value: 1.000 ; taking notes during IPC meeting, *p*-value: 0.063 ; infection prevention consultant employed, *p* = 1.000

Table 9: Type of wards per nursing home, viewed by percentage of residents per type of ward

<i>% of residents stay per type of ward</i>	Psycho-geriatric	Somatic	Rehabilitation	Other
<b>Controls</b> <i>n</i> = 6 missing = 4				
NH1	100	0	0	0
NH2	100	0	0	0
NH3	65.4	34.6	0	0
NH4	35.2	64.8	0	0
NH5	100	0	0	0
NH6	60	30	10	0
<b>Cases</b> <i>n</i> = 4 missing = 3				
NH7	60.9	39.1	0	0
NH8	40.6	35.0	14.7	9.8
NH9	58.2	41.8	0	0
NH10	100	0	0	0

## 6. Discussion

The aim of this study was to gain more insight in the transmission of MRSA between and within nursing homes by making an analysis of the transmission related factors. We focused on staff exchange: “What is the extent of staff exchange between nursing homes and based upon this, how likely is this to play a role in inter-institutional MRSA transmission?”, and on relevant nursing home characteristics: “Which nursing home characteristics can predict an MRSA outbreak in a nursing home?”.

The extent of staff exchange was assessed in this study. The findings strongly support our hypothesis that there is staff exchange of nursing home staff between nursing homes and with other health care institutes. Altogether, 59/474 nursing home staff members (13.1%) worked at the same time in another health care institute. The number of health care institutes to which a staff member exchanged ranged from one to six health care institutes. Most connections reported were to nursing homes (63%). For the 15 nursing homes, in total 59 staff members reported to work on 87 other health care institutes (including nursing homes) besides their current job in the nursing home. As some of these respondents may work on the same institutes, the absolute number of individual health care institutes reported may be lower, but a large number of connections between the nursing homes and other health care institutes is clearly demonstrated. Taking into account the response rate of 49 percent, the total number of personnel connections to other health care institutes for these 15 nursing homes is likely to be twice as high as reported. Thus, we have substantial evidence a nursing home is not separated from other health care institutes but part of a larger health care network. Therefore, it is possible that staff exchange is responsible for MRSA transmission between nursing homes. Key-experts in the field of infection prevention and who had experience with MRSA outbreaks also had clear suspicions about the role of staff exchange in MRSA transmission. Only one of the key-experts was able to prove a staff member as transmission vector between two nursing homes. The other key-experts had strong indications about the involvement of staff members in transmission of MRSA within and between nursing homes but they were not able to prove these suspicions.

Furthermore, this study aimed to identify nursing home characteristics that could predict MRSA outbreaks in nursing homes: capacity, resident related, staff related and infection prevention related characteristics. However, no significant differences between case nursing homes and control nursing homes were found. Whether this is because there are no differences between case and control nursing homes and having an outbreak or not is purely chance-dependent or because the numbers in our study are too small and therefore an effect cannot be determined. However, the interviews with our key experts suggested there are substantial differences between nursing homes in infection prevention that are important for MRSA transmission.

### 6.1 Comparison with literature

To the author’s best knowledge, this is the first study looking into staff exchange of nursing homes in the Netherlands. In literature, a study in Oslo showed that 18 percent of 299 nursing home staff (corresponding with 42 nursing homes) worked in another health care institute at the same time, defined as: ‘Did you work in the last year in another health care institute?’ (Sie, Thorstad, & Andersen, 2008). In our study, we found that 13.1 percent of the nursing home staff worked in other health care institutes besides their current job. For control nursing homes this was 15.3 percent of the staff members and 9.2 percent of staff members of nursing homes with an MRSA outbreak. In the past two years, 19 percent of the staff members have worked in another health care institute. Thus, despite the small difference in questioning, the results of 13 and 19 percent of staff exchange

found in the current study seem to be consistent with the findings of 18 percent staff exchange in the study of Sie et al. The review of Cimolai indicates that staff does commonly rotate between health care institutes, which is especially the case for trainees. The review discussed several literature studies in which a health care worker may be the link in MRSA transmission between health care institutes. Also the review of Albrich found some indications of introduction of MRSA in health care institutes by new employees (Albrich & Harbarth, 2008). The studies of these reviews were not able to show a causal relationship between staff exchange and MRSA transmission between health care institutes but only indications, which is in line with the suspicions of the key-expert in the current study. An explanation for this could be that MRSA carriage is asymptomatic which means health care workers did not notice that they were colonized and could easily spread the MRSA to patients (Albrich & Harbarth, 2008). Furthermore, health care workers are often transiently colonized so carriage could often not be determined in a screening afterwards. Although, the key experts noticed that some MRSA outbreaks could only be explained by interfering with an MRSA positive health care worker.

Several studies have implied a health care worker as the cause of transmission between wards of a health care institute (Albrich & Harbarth, 2008). In our study, altogether 46.2 percent of the health care workers worked on more than one ward. Contrary to our expectations, this study showed a higher percentage of health care workers working on more than one ward in control nursing homes (51.1%) compared with case nursing homes (35.6 %). The odds for working in a nursing home with an MRSA outbreak for staff members who do exchange with other wards is found to be 0.863 the odds as for staff members who do not exchange with other wards. Suggesting that working on more than one ward is protecting for an MRSA outbreak in a nursing home. However, this odds ratio was not significant ( $p = 0.917$ ), so no differences were found between the two groups. A possible explanation for the lower percentage of the case nursing homes could be made based on the interviews with the key informants, might be that case nursing homes changed their policy for staff exchange between wards in response to the earlier MRSA outbreak to diminish further transmission risk within the nursing home.

Few studies researched nursing home characteristics in relation to MRSA transmission. To refer back to the conceptual framework of this study, the study of Murphy et al. discussed the environmental contamination between nursing homes with a high and a low MRSA prevalence and studied the practice of infection control and cleaning quality (Murphy et al., 2012a). One the conclusions of the study of Murphy was that the practice of infection control is very different between the (US) nursing homes. The results of the current study supports that also in the Netherlands there are differences between infection prevention practice in nursing homes. The components of infection prevention studied by Murphy et al. were restrictions for common areas, contact precautions, decolonization treatment, screening for MRSA carriers, time for infection control and prevention education for management staff. All these components were mentioned by key-experts as essential tools to prevent MRSA transmission in nursing homes. In addition, the study of Cohen et al. concluded that the current guidelines for infection prevention control are not specific enough to ensure consistent practices between nursing homes and at the same time provided good care to the MRSA positive residents. Furthermore, the possibilities for isolation or private rooms for residents are limited in the nursing homes. Nursing home staff was interviewed about isolation-based infection prevention and control practices in US nursing homes. Additional infection prevention and control education may be required for nursing home staff (Cohen et al., 2015). Although, this study was done in the US the findings are quite in line with the findings of the interviews in the current study. In the current study the key-experts also had their doubts about the protocols and guidelines used nowadays in nursing homes for infection prevention control of MRSA and also recommended more education for nursing home staff on how to handle MRSA positive residents to ensure infection prevention control.

Another study of Murphy et al. concluded that MRSA prevalence in patients upon admission was a strong predictor of MRSA prevalence and MRSA burden and transmission was related to client related factors (residents with chronic illnesses, indwelling devices) (Murphy et al., 2012b). From the bivariate models used in the study of Murphy, the resident characteristic 'age of 85 and over' was found associated in predicting MRSA transmission. The current study also included age of residents in their analyses but no differences between case and control nursing homes were found. In a German study, a room with 3 or more beds is a risk factor for transmission in nursing homes (Wendt, Svoboda, Schmidt, Bock-Hensley, & Von Baum, 2005). In comparison, the current study also measured the rate of private beds and other client related factors like age which is a known risk factor for acquiring MRSA, but this study could not demonstrate differences between outbreak and control nursing homes. Probably this was due to the small sample size of our study. The above mentioned studies are mostly point prevalence studies looking at the prediction of MRSA prevalence on resident level instead of nursing home level.

## 6.2 Limitations

A few limitations of the current study have to be kept in mind. First, researcher bias could have occurred during the analysis of the interviews because the interviews were not verbally transcribed and no member check was done. This choice was made because the interviews were used in the first place as input for the questionnaire and the key members helped the researcher to select the right questions. The outcomes of the interviews and the developed questionnaires were consulted with co-researchers at the RIVM. Furthermore, one of the key-experts did look at the final questionnaires but send feedback just one day after the questionnaires were send out to the responders. Nevertheless, this feedback was used by analyzing the findings from the questionnaires.

A limitation of the study is the small size of groups. Of 17 nursing homes, 7 nursing homes had an recent outbreak and 10 nursing homes were control nursing homes. In advance, we expected that more nursing homes had an MRSA-t1081 outbreak in 2014-2015. During this study, we could have decided to also include nursing homes which had an outbreak in 2013 to enlarge the sample size, because we wanted to compare nursing home characteristics from before the outbreak and we supposed there would be considerable recall bias if we went further back in time. Of the 8 nursing homes with an MRSA-t1081 outbreak in 2014-2015 in the Netherlands, 7 participated in this study. In addition, 17 nursing homes of the SARAH study met the inclusion criteria for participating as control nursing home in the current study. Of these 17 nursing homes, 10 nursing homes participated in this study.

Furthermore, although during the interviews the respondents underlined the importance of infection prevention control in limiting transmission of MRSA, this study did not include all infection prevention control characteristics of the nursing homes because this was difficult to measure in a questionnaire. Moreover, inspection of the practices of infection prevention is conducted by the health inspectorate. Although it was not the subject of our study, we considered to look into their inspection reports for comparing infection prevention practices between the nursing homes in our study. Unfortunately, not all participating nursing homes were visited by the health inspectorate and with respect to the time available we decided not to include these reports in our analysis.

### 6.3 Strengths

This study used triangulation to get an insight in MRSA transmission. The use of triangulation (interviews and questionnaires) enlarged the external validity, and provided more valid results and convergent validation compared with only conducting questionnaires or holding interviews. The weaknesses of every single method is in this way counter-balanced with the strength of the other method. The use of questionnaires makes it more easy to generalize the findings on MRSA transmission to other nursing homes, because the influence of researcher bias, which could have play a part in the interviews, is decreased in the way that the questions were identical for every participating nursing home. By doing interviews, a more holistic and complete contextual background and, even more important, conceptual framework were created. Because the questionnaires were complementary to the interviews, the findings of this study are also more complete and realistic than using only one method (Jick, 1979).

Another strengths of this study were the high response rate of staff members (49%) and the high number of responders (474) for the '*Questionnaire: Staff exchange*'. How higher the response rate the better we get insight in the network where nursing homes were linked to by their staff members. Additionally, sample bias, meaning nonresponse was unequal between staff members of nursing homes with an outbreak and staff members of control nursing homes, is minimized with a high response rate. This is preferable especially by comparing the extent of staff exchange between nursing homes with an outbreak and control nursing homes. From each nursing home with an MRSA-t1081 outbreak in 2014-2015 one or more key-experts were represented in the study population. Therefore, a holistic overview was presented for the challenges in managing MRSA-t1081 in Dutch nursing homes and preventing MRSA outbreaks in other nursing homes.

### 6.4 Implications & recommendations

The present study shows the possibility that staff exchange between nursing homes plays an important role in MRSA transmission. Although the role of staff exchange in inter-nursing home MRSA transmission has not yet been proven, the findings should raise awareness. Implications for nursing homes could be to consider changes in the policy regarding staff exchange especially in an outbreak situation. Suggestions for measures could be: screening of new employees and trainees, education for awareness of the staff, stricter hygiene measures for flex workers and temporary workers. Besides the role of staff exchange in MRSA transmission, staff members could also spread other infectious diseases between health care institutes. The extent of staff exchange is in this way also relevant for developing policy in preventing the spread of other even more harmful infectious diseases.

Furthermore, according to the key-experts interviewed in this study, one of the most important factors in preventing MRSA transmission in nursing homes was the performance of infection prevention which was very different between nursing homes. As explained in the methods chapter, this study only looked at a few infection prevention aspects. The performance of infection prevention is partly determined by the interpretation of the protocols used during an outbreak by nursing homes. Based on the view of the key-experts, the MRSA protocols are hard to use, especially in a situation with chronic carriers. The protocols are developed for the traditional nursing homes but nowadays the nursing homes differ a lot from these traditional nursing homes. A large part of the long term care facilities now have nursing departments and residents with a nursing home indication living next to a residents of a residential care home. A revision of the protocols is recommended and an advice for a direct start of education for the staff members in an outbreak situation on how to handle MRSA clients and which infection prevention measures is needed.

## 6.5 Future research

As mentioned before, our study shows staff exchange forms substantial links between nursing homes via which MRSA could potentially spread. However, additional studies are necessary to investigate the precise role of staff exchange and MRSA transmission between nursing homes. For example, a detailed investigation of an outbreak is needed to unravel the transmission tree, or the use of a modeling study to investigate the likely impact of staff exchange on MRSA transmission.

Future research could be helpful to accomplish the recommendation of revising the current protocols on MRSA for nursing homes made in this study. The difficulties in interpretation and practices of these protocols, which do exist according to the current study, should be further studied. We recommend to do this by holding interviews with elderly care physicians of nursing homes and infection prevention consultants to clarify the uncertainties and the possible improvement for the protocols. Although the health inspection is responsible for controlling the performance of infection prevention in nursing homes, research into the difficulties and possible improvements will contribute to better application of infection prevention measures in nursing homes.

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## Appendix I – SNIV nursing home questionnaire

### Algemene gegevensvragenlijst incidentiemeting SNIV 2014 -Surveillance Netwerk Infectieziekten Verpleeghuizen-

datum:.....

#### Algemene gegevens

Naam zorggroep:.....

Naam locatie deelnemend verpleeghuis: .....

(n.b. per deelnemende locatie apart een formulier invullen)

Post adres verpleeghuis:.....

Postcode:.....

Plaatsnaam:.....

Bank/giro-rekening nummer: .....

Tenaamstelling: .....

(n.b. nodig voor overmaken van de bijdrage voor deelname)

Contactpersoon SNIV (inhoudelijk verantwoordelijke) naam:.....

e-mail.....

Telefoonnummer:.....

Contactpersoon OSIRIS (verantwoordelijke registratie in OSIRIS)

naam:.....e-mail.....

Telefoonnummer:.....

De vragenlijst bevat items over de volgende zes hoofdcategorieën:

- (1) Capaciteitsgegevens
- (2) Informatie over cliëntenpopulatie
- (3) Infectiepreventiebeleid
- (4) Antibioticabeleid
- (5) Mondzorg
- (6) Samenwerkingsverbanden
- (7) Automatisering

**Bedankt voor het invullen!**

**U kunt het formulier invullen in OSIRIS of met de bijgevoegde antwoordenvolop (kosteloos) terugsturen.**

*Secretariaat SNIV, RIVM - Centrum Infectieziektebestrijding Epidemiologie en Surveillance (interne postbak 75) Postbus 1, 3720 BA Bilthoven.*

**(1) Capaciteitsgegevens**

1. Totaal aantal bedden (volgens productieafspraken) in het verpleeghuis: \_\_\_\_\_
  2. Totaal aantal dagen met zorg en verblijf in 2013: \_\_\_\_\_
  3. Totaal aantal gemeenschappelijke ruimten (kantine, restaurant, recreatieruimte, enz) in het verpleeghuis die door alle zorgeenheden gebruikt (kunnen) worden: \_\_\_\_\_ ruimten
  4. Aantal zorgeenheden: \_\_\_\_\_ (gedefinieerd als functionele eenheid met een vaste groep personeelsleden die gezamenlijk 24-uurs verzorging regelen voor een vaste groep patiënten, fysiek gescheiden van andere eenheden; ook vaak aangeduid als afdeling, unit, etage, locatie, leefgroep, en dergelijke)
- Indien bij U een zorgeenheid anders gedefinieerd is, gaarne toelichting:

- 
5. Hoeveel bewoners zijn er per zorgzwaarte pakket:  
Pakket 4: \_\_\_\_\_ Pakket 5: \_\_\_\_\_ Pakket 6: \_\_\_\_\_  
Pakket 7: \_\_\_\_\_ Pakket 8: \_\_\_\_\_ Pakket 9: \_\_\_\_\_  
Pakket 10: \_\_\_\_\_

6. Werkt het **verzorgend/verplegend** personeel op één zorgeenheid?

Ja

Ja, maar er vindt incidenteel uitwisseling van verzorgend/verplegend personeel plaats

Ja, maar er vindt regelmatig uitwisseling van verzorgend/verplegend personeel plaats

Nee

7. Wordt er door het verzorgend/verplegend personeel dienstkleiding gedragen? ja nee

**(2) Informatie over cliëntenpopulatie**

8. Welk deel van de cliënten is gevaccineerd tegen influenza in najaar 2013? \_\_\_\_\_ %
9. Welk deel van het personeel is gevaccineerd tegen influenza in najaar 2013?? \_\_\_\_\_ %
10. Heeft u campagne gevoerd om de influenza-vaccinatiegraad onder het personeel het afgelopen seizoen te verhogen? Ja Nee
11. Uit welke gemeenten (max. 3) komen het grootste deel van de cliënten? .....
- .....
12. In hoeverre hebben de bewoners van het verpleeghuis beschikking over:

	<25%	25-50%	50-75%	>75%
Eigen kamer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eigen toilet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eigen badkamer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

13. Kunt u per zorgeenheid (ZE) aangeven welk type zorgeenheid dit is (somatisch, psychogeriatrisch, revalidatie, palliatief, anders), hoeveel bewoners, verzorgende/verplegende personeelsleden en gemeenschappelijk ruimten (eetzalen, gezamenlijke woonkamers, recreatieruimten, enz) er zijn:

Naam zorgeenheid	Type zorgeenheid	Aantal bewoners	Aantal verzorgenden / verplegenden	Aantal gemeenschappelijke ruimten*	Frequentie bezoek van buiten (zelden / regelmatig / vaak)
ZE 1					
ZE 2					
ZE 3					
ZE 4					
ZE 5					
ZE 6					
ZE 7					
ZE 8					
ZE 9					
ZE 10					
ZE 11					
ZE 12					

\*mochten gemeenschappelijke ruimten (deels) gedeeld worden door meerdere zorgeenheden, wilt u dit dan duidelijk vermelden.

14. Globale leeftijdsrange van de bewoners in het verpleeghuis:

- Aantal bewoners <60 jaar :.....
- Aantal bewoners 60-64 jaar:.....
- Aantal bewoners 65-74 jaar:.....
- Aantal bewoners 75-84 jaar:.....
- Aantal bewoners ≥ 85 jaar:.....

### (3) Infectiepreventiebeleid

15. Heeft uw verpleeghuis een infectiepreventiecommissie?

- Ja  
 Nee

Zo ja, wat is de samenstelling van de commissie?

- |                            |                             |                              |
|----------------------------|-----------------------------|------------------------------|
| Medisch manager            | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |
| Verpleegkundig manager     | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |
| Microbioloog ziekenhuis    | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |
| Infectiepreventie adviseur | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |
| Specialist ouderenzorg     | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |

Anderen: \_\_\_\_\_

16. Heeft het verpleeghuis een eigen infectiepreventieadviseur in dienst? Ja Nee

Indien ja, voor hoeveel uur per week? \_\_\_\_\_

Indien nee, met wie wordt overlegd in geval van vragen op het gebied van infectiepreventie

- |                                       |                             |                              |
|---------------------------------------|-----------------------------|------------------------------|
| Specialist ouderenzorg                | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |
| Infectiepreventie adviseur ziekenhuis | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |
| Microbioloog ziekenhuis               | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |
| GGD                                   | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |
| RIVM-CIB                              | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |

Anderen \_\_\_\_\_

17. Welke testen gebruikt u bij bewoners met klachten of verschijnselen, die door een UWI veroorzaakt kunnen zijn\*:

Leukotest Nitriettest Dipslide Kweek anders, nl .....

.....

\*meerdere antwoorden mogelijk

### (4) Antibioticabeleid

18. Heeft het verpleeghuis een antibiotica- of geneesmiddelencommissie? Ja Nee

Zo ja, wat is de samenstelling van de commissie?

- |                            |                             |                              |
|----------------------------|-----------------------------|------------------------------|
| Apotheker ziekenhuis       | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |
| Specialist(en) ouderenzorg | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |
| Microbioloog ziekenhuis    | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |

Anderen \_\_\_\_\_

19. Heeft het verpleeghuis een antibioticaformularium? Ja Nee

Zo ja, is dit formularium gebaseerd op de richtlijnen van:

- |            |                             |                              |
|------------|-----------------------------|------------------------------|
| SWAB       | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |
| NHG        | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |
| Ziekenhuis | <input type="checkbox"/> Ja | <input type="checkbox"/> Nee |

Anders, t.w. \_\_\_\_\_

**(5) Mondzorg**

20. Wordt er in het verpleeghuis professionele mondzorg verleend door een mondhygiënist of tandarts?

- Ja, door een tandarts voor ..... uur per week
- Ja, door een mondhygiënist voor ..... uur per week
- Nee

21. Is in het verpleeghuis de Verenso richtlijn: 'Mondzorg voor zorgafhankelijke cliënten in verpleeghuizen' vertaald naar een protocol en wordt deze toegepast in de dagelijkse praktijk?

- Ja  Nee

**(6) Samenwerkingsverbanden**

22. Medisch Microbiologisch Laboratorium (MML) voor diagnostiek:.....

Contactpersoon:.....e-mail.....

Telefoonnummer:.....

23. Medisch Microbiologisch Laboratorium (MML) voor influenza diagnostiek: .....

Contactpersoon:.....e-mail.....

Telefoonnummer:.....

24. GGD .....te .....

Contactpersoon:.....e-mail.....

Telefoonnummer:.....

\*SNIV maakt afspraken met uw MML over het insturen van monsters bij uitbraken en informeert uw GGD over deelname aan SNIV.

25. Deelname in academisch netwerk? Ja / Nee

Zo ja, welk academisch netwerk? .....

**(7) Automatisering**

26. Gebruikt u een elektronisch systeem voor de registratie van patiëntgegevens? Ja / Nee

Zo ja, wie is de leverancier van dit systeem?

**Tenslotte**

27. Opmerkingen die voor deze surveillance van belang kunnen zijn: .....

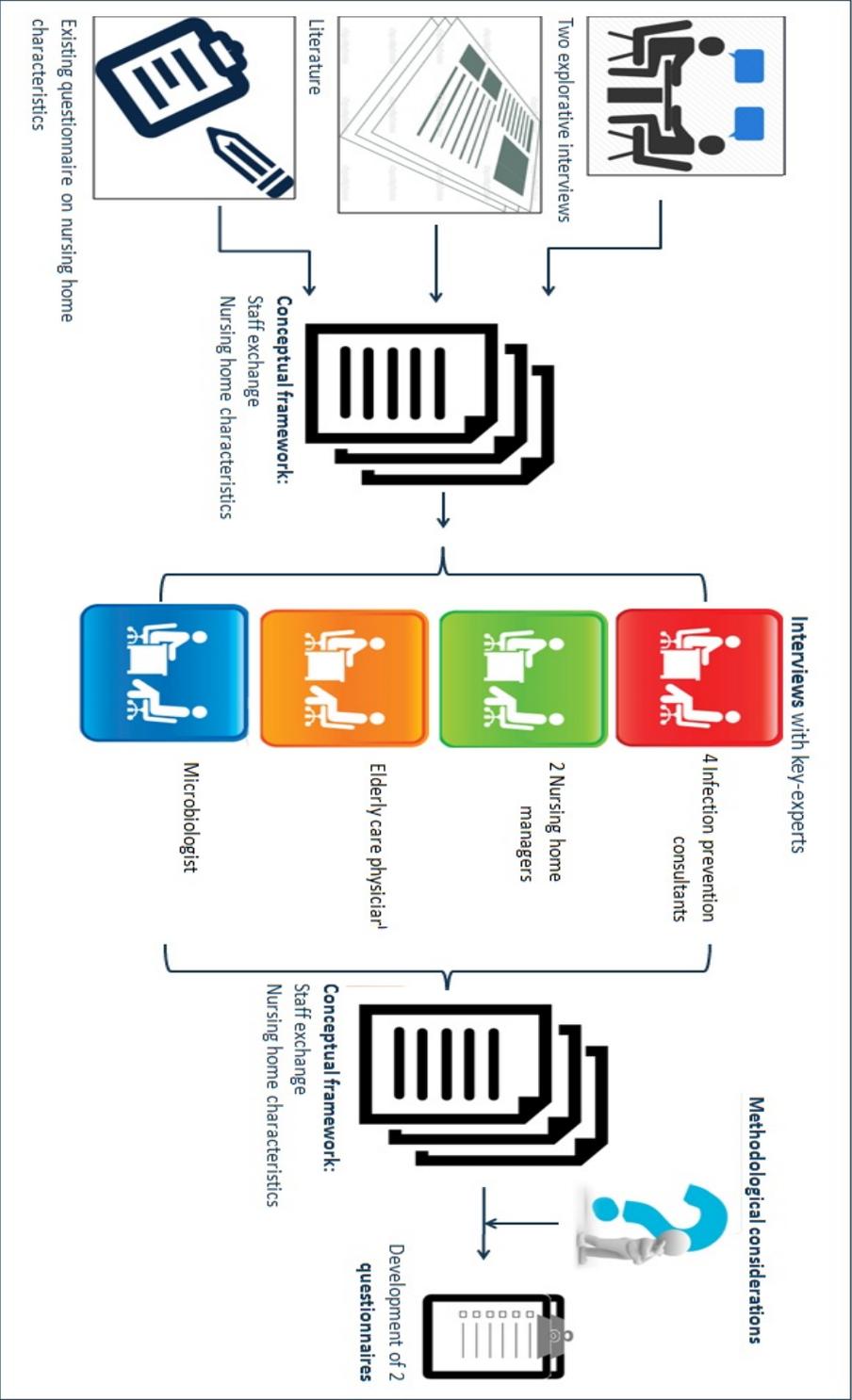
.....

.....

**Bedankt voor het invullen!**

**U kunt het formulier ook invullen in OSIRIS .**

Appendix II – Research approach



## Appendix III - Questionnaire: Staff exchange

**Wat is de naam van uw verpleeghuis?**

\_\_\_\_\_

**Wat is uw functie?**

- Verpleegkundige
- Verzorgende
- Afdelingsassistent
- Huishoudelijk medewerker
- Fysiotherapeut
- Tandarts
- Anders, namelijk: \_

**Hoeveel uren in de week werkt u meestal bij dit verpleeghuis\*?**

\*met verpleeghuis wordt ook de verpleegafdeling van een verzorgingstehuis bedoeld.

\_\_\_\_\_

**Hoe lang bent u al in dienst bij dit verpleeghuis\*? (in jaren, indien u korter dan één jaar werkzaam bent bij dit verpleeghuis gelieve dit in maanden te noteren)**

\*met verpleeghuis wordt ook de verpleegafdeling van een verzorgingstehuis bedoeld.

\_\_\_\_\_

**Op hoeveel zorgeenheden\* werkt u standaard?**

\*gedefinieerd als functionele eenheid met een vaste groep personeelsleden die gezamenlijk 24-uurs verzorging regelen voor een vaste groep patiënten, fysiek gescheiden van andere eenheden; ook vaak aangeduid als afdeling, unit, etage, locatie, leefgroep, en dergelijke.

Indien bij u een zorgeenheid anders gedefinieerd is, gaarne toelichting.

\_\_\_\_\_

**Werkt u naast dit verpleeghuis\* nog bij een andere zorginstelling\*\*?**

\*hiermee wordt ook werken op de verpleegafdeling van het verzorgingstehuis bedoeld.

\*\* hiermee wordt zowel werken op een andere locatie als het verlenen van zorg aan verzorgingstehuisbewoners op dezelfde of andere locatie bedoeld.

- Ja
- Nee

**Wat voor zorginstelling(en) is/zijn dit?**

	Verpleeghuis of verpleegafdeling binnen een verzorgingstehuis	Verzorgingstehuis met verpleegafdeling (waar u zorg verleent aan verzorgingstehuisbewo- ners)	Verzorgi- ngstehui- s zonder verpleeg- afdeling	Thui- szor- g	Rev- alid- atie klini- ek	Ziek- enhuis
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Kunt u de naam/namen van de zorginstelling(en) hieronder invullen. En daarnaast hoeveel uur per week u hier werkzaam bent.**

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Heeft u in de afgelopen twee jaar naast bovengenoemde nog bij één of meerdere andere zorginstelling(en) gewerkt?

- Ja
- Nee

Wat voor zorginstelling(en) was/waren dit?

	Verpleeghuis of verpleegafdeling binnen een verzorgingstehuis	Verzorgingstehuis met verpleegafdeling (waar u zorg verleent aan verzorgingstehuisbewo- ners)	Verzorgings- stehuis zonder verpleeg- afdeling	Thuis- zorg	Revalidatie- kliniek	Ziekenhuis
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Kunt u de naam/namen van de zorginstelling(en) hieronder invullen. En daarnaast hoeveel uur per week u hier werkzaam was.

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Mocht u nog opmerkingen hebben die voor dit onderzoek van belang kunnen zijn, zou u die dan hieronder willen invullen.

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## Appendix IV - Questionnaire: Nursing home characteristics

### 1. Totaal aantal bedden (volgens productieafspraken) in het verpleeghuis\*:

\*Als uw huis een verzorgingstehuis is, zou u dan voor de gehele vragenlijst alleen de gegevens voor de verpleegafdeling in willen vullen.

\_\_\_\_\_

### 2. Totaal aantal gemeenschappelijke ruimten (kantine, restaurant, recreatieruimte, enz) in het verpleeghuis die door alle zorgeenheden gebruikt (kunnen) worden:

\_\_\_\_\_

### 3. Aantal zorgeenheden:

(gedefinieerd als functionele eenheid met een vaste groep personeelsleden die gezamenlijk 24-uurs verzorging regelen voor een vaste groep patiënten, fysiek gescheiden van andere eenheden; ook vaak aangeduid als afdeling, unit, etage, locatie, leefgroep, en dergelijke)  
Indien bij u een zorgeenheid anders gedefinieerd is, gaarne toelichting.

\_\_\_\_\_

### 4. Hoeveel bewoners zijn er per zorgzwaarte pakket:

Pakket 4:	_____
Pakket 5:	_____
Pakket 6:	_____
Pakket 7:	_____
Pakket 8:	_____
Pakket 9:	_____
Pakket 10:	_____

### 5. Globale leeftijdsrange van de bewoners in het verpleeghuis\*:

\*Als uw huis een verzorgingstehuis is, zou u dan voor de gehele vragenlijst alleen de gegevens voor de verpleegafdeling in willen vullen.

Aantal bewoners <60 jaar:	_____
Aantal bewoners 60-64 jaar:	_____
Aantal bewoners 65-74 jaar:	_____
Aantal bewoners 75-84 jaar:	_____
Aantal bewoners ≥ 85 jaar:	_____

### 6. In hoeverre hebben de bewoners van het verpleeghuis\* beschikking over:

\*Als uw huis een verzorgingstehuis is, zou u dan voor de gehele vragenlijst alleen de gegevens voor de verpleegafdeling in willen vullen.

	<25%	25-50%	50-75%	>75%
Eigen kamer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eigen toilet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eigen badkamer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**7. Kunt u per zorgseenheid (ZE) aangeven welk type zorgseenheid dit is (somatisch, psychogeriatrisch, revalidatie, palliatief, verzorgingstehuisbewoners, anders), hoeveel bewoners, verzorgende/verplegende personeelsleden en gemeenschappelijk ruimten (eetzalen, gezamenlijke woonkamers, recreatieruimten, enz) er zijn:**

(gedefinieerd als functionele eenheid met een vaste groep personeelsleden die gezamenlijk 24-uurs verzorging regelen voor een vaste groep patiënten, fysiek gescheiden van andere eenheden; ook vaak aangeduid als afdeling, unit, etage, locatie, leefgroep, en dergelijke)

Indien bij u een zorgseenheid anders gedefinieerd is, gaarne toelichting:

---

ZE	Type zorgseenheid	Aantal bewoners	Aantal gemeenschappelijke ruimten*	Frequentie bezoek van buiten (zelden / regelmatig / vaak)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

\*mochten gemeenschappelijke ruimten (deels) gedeeld worden door meerdere zorgseenheden, wilt u dit dan duidelijk vermelden met een (\*) bijvoorbeeld.

*Als u in de afgelopen 2 jaar een MRSA-uitbraak heeft gehad in uw verpleeghuis, zou u de volgende vragen dan in willen vullen voor de situatie van vóór de uitbraak.*

**8. Hoe vaak maakt u gebruik van flexwerkers?(verplegend/verzorgend flexpersoneel)**

- Dagelijks
- Wekelijks
- Maandelijks
- Nooit
- Anders, namelijk: \_\_\_\_\_

**9. Hoe vaak maakt u gebruik van uitzendkrachten?(verplegend/verzorgend uitzendpersoneel)**

- Dagelijks
- Wekelijks
- Maandelijks
- Nooit
- Anders, namelijk: \_\_\_\_\_

**10. Werkt het verzorgend/verplegend personeel op één zorgeenheid?**

- Ja
- Ja, maar er vindt incidenteel uitwisseling van verzorgend/verplegend personeel plaats.
- Ja, maar er vindt regelmatig uitwisseling van verzorgend/verplegend personeel plaats
- Nee

**11. Werkt het huishoudelijk personeel op één zorgeenheid?**

- Ja
- Ja, maar er vindt incidenteel uitwisseling van huishoudelijk personeel plaats.
- Ja, maar er vindt regelmatig uitwisseling van huishoudelijk personeel plaats
- Nee

**12. Is het huishoudelijk personeel in dienst van het verpleeghuis\*?**

\*Als uw huis een verzorgingstehuis is, zou u dan voor de gehele vragenlijst alleen de gegevens voor de verpleegafdeling in willen vullen.

- Ja
- Nee

**13. Wordt er door het verzorgend/verplegend personeel dienstkleiding gedragen?**

- Ja
- Nee

**14. Gelden er voor vrijwilligers regels voor het al dan niet dragen van bepaalde kleding en sieraden\*?**

\*inclusief trouwringen

- Ja, vrijwilligers dragen dienstkleiding
- Ja, vrijwilligers mogen geen sieraden dragen
- Ja, vrijwilligers mogen geen kleding met lange mouwen dragen
- Ja, namelijk: \_\_\_\_\_
- Nee

**15a. Heeft uw verpleeghuis een infectiepreventiecommissie?**

- Ja → Indien ja, ga naar vraag 15b-15e
- Nee → Indien nee, ga naar vraag 16a

**15b. Wat is de samenstelling van de commissie?**

- Medisch manager
- Verpleegkundig manager
- Microbioloog ziekenhuis
- Infectiepreventie adviseur
- Specialist ouderenzorg
- Anderen: \_\_\_\_\_

**15c. Op welke richtlijnen zijn de protocollen van de infectiepreventiecommissie gebaseerd?**

- WIP, Werkgroep Infectiepreventie
- Vilans: Voorbehouden handelingen & WIP
- LCHV, Landelijke Centrum Hygiëne & Veiligheid
- Anders, namelijk: \_\_\_\_\_

**15d. Hoe vaak komt deze commissie bijeen?**

- wekelijks
- één keer per twee weken
- één keer per maand
- eens in de 3 maanden
- één keer per half jaar
- één keer per jaar

**15e. Worden er notulen gemaakt tijdens de vergadering van deze commissie?**

- Ja
- Vaak wel
- Soms
- Nee

**16a. Heeft het verpleeghuis een eigen infectiepreventieadviseur in dienst?**

- Ja → Indien ja, ga naar vraag 16b en sla 16c over.
- Nee → Indien nee, ga naar vraag 16c.

**16b. Voor hoeveel uur per week is de infectiepreventieadviseur in dienst?**

\_\_\_\_\_

**16c. Met wie wordt overlegd in geval van vragen op het gebied van infectiepreventie?**

- Specialist ouderenzorg
- Infectiepreventie adviseur ziekenhuis
- Microbioloog ziekenhuis
- GGD
- RIVM-CIB
- Anderen: \_\_\_\_\_

**17. Wordt er jaarlijks scholing op het gebied van infectiepreventie aangeboden aan het verzorgend/verplegend personeel?**

In de vorm van bijvoorbeeld klinische les.

- Ja
- Nee

**18. Wordt er scholing op gebied van infectiepreventie aangeboden voor nieuwe medewerkers?**

Binnen 2 maanden na het in dienst treden.

- Ja
- Nee

*Als uw verpleeghuis in de afgelopen 2 jaar te maken heeft gehad met een MRSA-uitbraak kunt u dan bij onderstaande vragen aangeven of er naar aanleiding van deze uitbraak dingen veranderd zijn in uw verpleeghuis.*

**19. Heeft uw verpleeghuis een MRSA-uitbraak in 2014/2015 meegemaakt?**

- Ja
- Nee

**20. Zijn de protocollen die gebruikt worden door de infectiepreventiecommissie veranderd tijdens/na deze MRSA-uitbraak?**

- Ja → Indien ja, ga naar vraag 20a.
- Nee → Indien nee, ga naar vraag 21.

**20a. Op welke richtlijnen zijn de protocollen van de infectiepreventiecommissie tijdens/na deze MRSA-uitbraak gebaseerd?**

- WIP, Werkgroep Infectiepreventie
- Vilans: Voorbehouden handelingen & WIP
- LCHV, Landelijke Centrum Hygiëne & Veiligheid
- Anders, namelijk: \_\_\_\_\_

**21. Is het beleid voor vrijwilligers met betrekking tot kleding en sieraden ten tijde van/na de MRSA-uitbraak veranderd?**

Ja blijvend veranderd, namelijk:

Ja alleen ten tijde van de uitbraak veranderd, namelijk:

Nee dat is hetzelfde gebleven.

**Mocht de huidige capaciteit van uw verpleeghuis nou erg veranderd ten opzichte van de situatie tijdens de MRSA-uitbraak, zou u dit dan hieronder willen aangeven.**

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**Mocht u nog opmerkingen hebben die voor dit onderzoek van belang kunnen zijn, zou u die dan hieronder willen invullen.**

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Hartelijk dank voor het invullen en uw medewerking aan het onderzoek!

## Appendix V – Letter to inform nursing homes

Bilthoven, 12 mei 2015

Betreft: onderzoek naar MRSA-uitbraken in verpleeghuizen

Geachte heer/mevrouw,

Via deze brief willen wij u graag verder informeren over het onderzoek naar MRSA-uitbraken in verpleeghuizen uitgevoerd door het RIVM. In Nederland komen elk jaar verscheidene MRSA-uitbraken voor. Op dit moment is MRSA-t1081 één van de meest voorkomende types, dit type wordt voornamelijk aangetroffen in verpleeghuizen. De eerste uitbraken werden gevonden in verpleeghuizen in het westen van het land en vervolgens leek MRSA-t1081 zich te verspreiden naar het oosten van het land. Bijzonder aan MRSA-t1081 is dat bij uitbraken zowel een groot gedeelte van het personeel als de bewoners gekoloniseerd blijken te zijn. Ondanks het verhogen van hygiënemaatregelen en de behandeling van gekoloniseerde bewoners en personeel, blijkt dit type MRSA zich na enige tijd toch weer te verspreiden.

De komende twee maanden zal het RIVM proberen om meer inzicht te krijgen in de verspreiding van MRSA-t1081 in en tussen verpleeghuizen, met als doel deze verspreiding in de toekomst zoveel mogelijk te voorkomen. Zowel huizen waar een uitbraak van MRSA-t1081 heeft plaatsgevonden (uitbraakhuis) als controlehuizen worden benaderd om mee te werken aan dit onderzoek. Tijdens het onderzoek zijn er een aantal interviews gehouden met hygiënist, kwaliteitsfunctionarissen, specialisten oudergeneeskunde en personeelsmanagers die aangesloten zijn bij verpleeghuizen. Op deze manier heeft de onderzoeker een breed inzicht gekregen in zaken die belangrijk zijn bij een uitbraak en wat aspecten kunnen zijn om een uitbraak te voorkomen. Daarnaast zijn er gesprekken gevoerd met personeelsmanagers om inzicht te krijgen in de mate van personeelsuitwisseling tussen verpleeghuizen. De verwachting is namelijk dat personeelsuitwisseling tussen verpleeghuizen een rol kan spelen bij de verspreiding van MRSA.

Op basis van deze oriënterende interviews zijn er twee vragenlijsten opgesteld en deze worden verspreid onder verpleeghuizen in Nederland. De eerste vragenlijst bevat vragen over de algemene karakteristieken van een verpleeghuis. Elk deelnemend verpleeghuis krijgt één vragenlijst welke ingevuld kan worden door bijvoorbeeld de verpleeghuisarts, (medisch) secretaresse of de hygiënist. Door te kijken of er verschillen te vinden zijn in de karakteristieken tussen uitbraakhuis en controlehuizen, kan wellicht een uitspraak gedaan worden over eigenschappen die beschermend kunnen werken tegen een MRSA-uitbraak dan wel een groter risico geven op een uitbraak. De tweede vragenlijst bevat vragen over de mate van personeelsuitwisseling en dient ingevuld te worden door het personeel van de verpleeghuizen. Deze korte vragenlijst kan online ingevuld worden door het personeel. Onder personeel wordt bedoeld: het verzorgend/verplegend personeel, de huishoudelijke medewerkers, de afdelingsassistenten, de fysiotherapeut en de tandarts. Wij zullen u dan ook vragen of het mogelijk is om de link voor deze korte vragenlijst via de e-mail door te sturen naar de personeelsleden. Het is ook mogelijk om een printbare versie mee te sturen voor de personeelsleden die liever een papieren versie invullen.

Om meer inzicht te krijgen in de verspreiding van MRSA-t1081 in en tussen verpleeghuizen is het belangrijk dat zoveel mogelijk verpleeghuizen mee doen aan dit onderzoek. Alle gegevens worden anoniem verwerkt. De intentie van dit onderzoek is om met dit inzicht bij te dragen aan een oplossing voor deze uitbraken en de verpleeghuizen te helpen bij het tegengaan van verspreiding in

de toekomst doormiddel van een terugrapportage. Er is dus geen sprake van het controleren van de verpleeghuizen. Mocht u nog vragen hebben over het onderzoek neem dan vooral contact op met Hester Hopman door een mail te sturen naar [hester.hopman@rivm.nl](mailto:hester.hopman@rivm.nl) of telefonisch via 030-2743868.

Met vriendelijke groeten,

Hester Hopman  
Stagiaire RIVM, Centrum Infectieziektebestrijding  
Epidemiologie en Surveillance  
Afdeling Antimicrobiële resistentie en zorggerelateerde infecties  
Tel. 030 274 38 68  
Mob. 06 13 45 73 43  
Email: [hester.hopman@rivm.nl](mailto:hester.hopman@rivm.nl)

# Appendix VI - Additional Tables and Graphs

Table I: Number and type of health care institutes corresponding to the jobs of staff members who had one or more jobs in HCI besides their current job in the nursing home.

	Total	Current job is in a control nursing home	Current job is in a case nursing home
<b>Number of jobs in health care institutes</b>	87	60	27
<b>Type of health care institute</b>			
Nursing home	55	35	20
Residential care home with nursing department	13	11	2
Residential care home without nursing department	3	3	0
Home care	6	3	3
Hospital	5	3	2
Other/not known	5	5	0

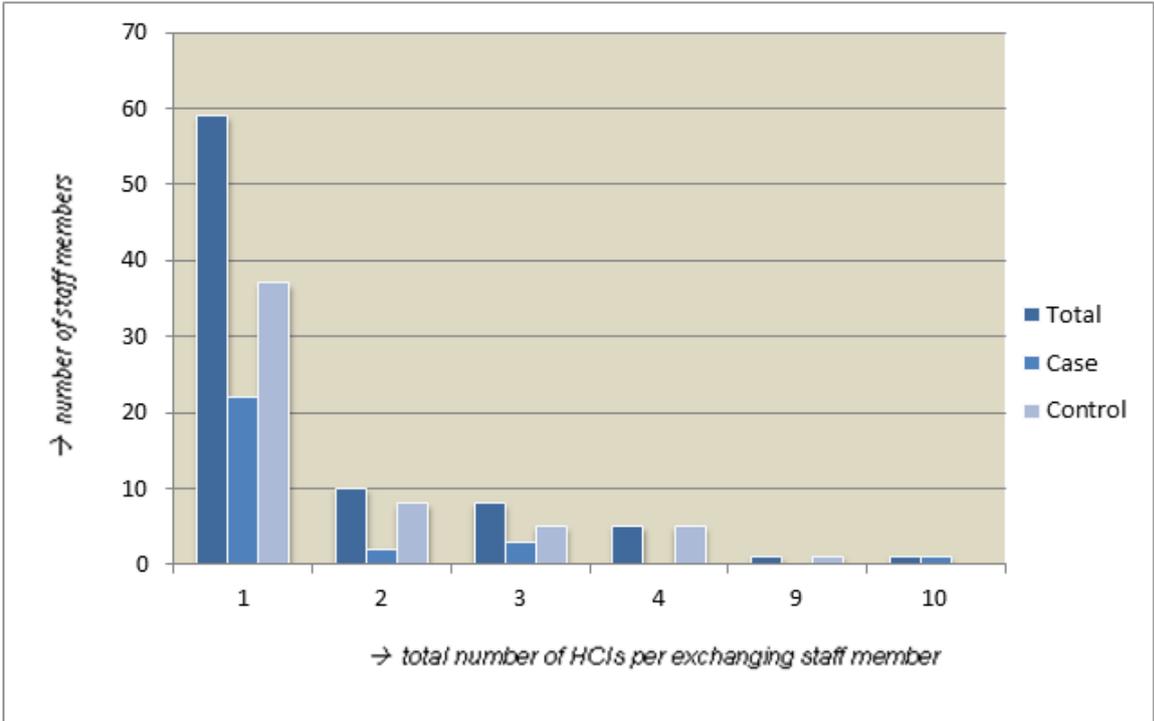


Figure I: Histogram of the number of other HCIs staff members work in, before their current job in the nursing home (in the past two years)

Table II: Number and type of health care institutes corresponding to the jobs of staff members who had one or more jobs in HCI before their current job in the nursing home (in the past two years)

	Total	Current job is in a control nursing home	Current job is in a case nursing home
<b>Total number of health care institutes</b>	142	97	45
<b>Type of health care institute</b>			
Nursing home	69	43	26
Residential care home with nursing department	18	14	4
Residential care home without nursing department	14	9	5
Home care	15	10	5
Hospital	8	8	0
Other/not known	18	13	5