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The prevalence of MRSA Colonization in Elderly Living in Geriatric Homes

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Introduction

Healthcare-acquired infections are considered one of the most significant patient safety issues facing hospitals today. Methicillin-resistant Staphylococcus aureus (MRSA), a major cause of healthcare-acquired infection, continues to become increasingly more prevalent ***(Tiemersma et al., 2004).***

And community-acquired methicillin-resistant Staphylococcus aureus (CA-MRSA) has emerged as a common pathogen causing skin and soft tissue infections (SSTI's). In many parts of North America CA-MRSA has now replaced methicillin-susceptible S. aureus (MSSA) as the primary cause of SSTIs. There are several commonly cited risks for CA-MRSA infection, yet little is known about colonization rates in high-risk individuals ***(Borgundvaag et al., 2008).***

So the growing threat of MRSA is becoming increasingly recognized by the public and health care providers. In 2008, MRSA has evolved to be common place in the community and hospital setting. So failure to act quickly can lead to increased morbidity and mortality for patients ***(*Corriere and Decker , *2008).***

It is known that Infections are very common in the setting of long-term care facilities and represent a major cause of morbidity and mortality among institutionalized elderly individuals. Some characteristics specific for the setting of a

nursing home favor the spread of infectious diseases. Residents are clustered in a confined living arrangement and daily activities often take place in groups. Some residents are cognitively impaired and unable to follow basic hygiene precautions ***(Catharina et al., 2007).***

MRSAS is commonly causes only asymptomatic colonization, Staphylococcus aureus is a highly pathogenic organism with the potential to cause serious infections, such as blood-stream infections, pneumonia, endocarditis, skin and soft tissue infections, and bone and joint infections, often associated with significant morbidity and mortality ***(Bradley, 2002).***

So MRSA represents an important burden on sub-acute and chronic care facilities. Epidemiologic surveys indicate that rates of MRSA cross-infection are increasing in these settings. Since MRSA carriers without symptomatic infection are an important reservoir and source of spread, risk profiles to identify elderly patients at high risk of MRSA carriage have been developed ***(Manian et al., 2002).***

Thus colonization of residents of long-term care facilities with (MRSA) is an important healthcare concern. MRSA colonization is prevalent; in two of the most common sites of colonization, nares and wounds, colonization rates range from 8% to 53%, and 30% to 82%, respectively. With such a large number of patients harboring the organism, it is imperative that

long-term care facilities are knowledgeable regarding the overall significance of MRSA, are aware of MRSA infection rates at their facilities, and have established a threshold above which outbreak precautions will be instituted. More importantly, facilities must ensure that appropriate precautions (e.g., hand washing, glove changes, and gowns) are utilized to prevent transmission of MRSA to noncolonized residents. If these basic measures are taken, MRSA-colonized residents of long-term facilities should be able to be fully integrated into the everyday activities within the long-term care environment ***(Suzanne, 2004).***

Manzur and his colleagues in 2010 found that prevalence of (MRSA) colonization among older residents of care homes in Leeds, United Kingdom Is 22%.And *(von Baum et al., 2000)* note that: during the past few years, several reports of outbreaks and high frequencies of (MRSA) colonization in nursing home residents have appeared and the prevalence of MRSA colonization in German nursing homes ranged from 0% to 18.2%.

And ***Von Baum in 2002*** found that numerous risk factors for MRSA colonization all these risk factors are mostly present in elderly living in geriatric homes like:

• Prolonged hospital stay

• Multiple hospitalizations

- Age over 65 years
- Invasive devices (e.g., catheters, gastric/endotracheal tubes, surgical drains)
- Open wound
- Severe underlying illness
- Treatment with multiple broad-spectrum antibiotics
- Close proximity to patients colonized or infected with MRSA

Also, ***Manzur and his colleges in 2010*** found that residence in a home with a low ratio of nurses to beds, residence in a care home in a deprived area, male sex, presence of an invasive device, and a hospitalization duration of more than 10 days during the previous 2 years were independently associated with MRSA colonization are more common for colonization with MRSA.

Aim of the Work

To evaluate the prevalence of MRSA colonization in elderly living in geriatric homes.

Infections in Nursing Homes Residents

Introduction:

As the world is aging, the absolute number of older people is increasing. The percentage of older people was 6.9% of the total population in Egypt according to the Egyptian census in 2004. The expected percentage of older people may reach 8.9% in 2016 and 10.0% in 2026 ***(Gad Allah, 2004).***

The populations of developed countries are becoming increasingly elderly. Aging is associated with an increased frequency of chronic diseases and declining functional status necessitating institutional care for at least some time, for a substantial proportion of the elderly (Nicolle et al, 1996). Currently, more than 1.5 million individuals reside in nursing homes in the United States. While less than 10% of the entire population over the age 65 years currently reside in nursing homes, it is estimated that 43% of the American population who turned 65 in 1990 will spend some period in a long-term care facility ***(Nicolle et al., 1996).***

As a result of the increase in numbers of elderly people in the population, nursing home (NH) and long-term care facilities

(LTCF) are becoming a major component of the healthcare delivery system ***(Eveillard and Joly-Guillou, 2009).***

The term LTCF refers to facilities that provide for the bio-psychological needs of people with sustained self-care deficits and includes NH, chronic disease hospitals, rehabilitation centres, institutions for the mentally retarded, etc. Therefore, the distinction between LTCF and NH is sometimes artificial. Moreover, definitions can be different from country to country, especially between the United States and Europe. In the following reviews, the terms LTCF and NH were used as they were named in the corresponding references ***(Miller et al., 2005).***

A variety of long-term care facilities provide services for many different elderly populations. These include adult day-care units, residential care facilities, rehabilitation facilities, long-term care facilities, nursing homes, chronic-disease hospitals, and Veteran's Affairs (VA) nursing home care units. However, the largest number of institutionalized individuals reside in nursing homes, and 90% of these are elderly. Nursing homes are residential facilities for persons who require care and related medical or psychosocial services; they may be hospital based or freestanding ***(Smith, 1994).***

This review will be largely restricted to considerations relevant to the nursing home setting as these facilities have the greatest number of residents, in addition, most information describing infections in long-term care facilities has been reported for the nursing home population. The patient population and environment of the nursing home provide a milieu that permits the development of infection and promotes transmission of infectious agents.

The nursing home population:

The nursing home population presents a wide spectrum of clinical disability. Patients may vary from the ambulatory, physically competent resident with Alzheimer's disease, to the comatosed bed-bound patient who is maintained with enteral feeding, an indwelling catheter, and a respirator. Different nursing homes frequently have vastly different populations of patients depending on their mission and patient referral patterns ***(Nicolle et al., 1996).***

Infectious diseases in nursing homes:

The clinical impact and significance of infections differ among nursing homes and within the population of an individual nursing home, depending on the associated comorbidities and functional status of the residents. Reports of

infections in nursing homes, however, usually do not stratify observations by functional status or other measures of disability. The heterogeneity of this population must be born in mind during interpreting the relevance of reports of infection. As nursing home population is primarily but not exclusively elderly, many aspects relevant to infections in this population reflect a contribution of both physiologic and pathologic aging-associated changes. An appreciation of infections occurring in this setting requires an understanding of these features ***(Nicolle et al., 1996).***

Infectious diseases are considered a very common occurrence in nursing homes. While the reasons for preventing infections are the same in nursing homes and in acute hospitals, several considerations relevant to prevention of infection differ in nursing homes ***(Mathei et al., 2007).***

Infections are very common in the setting of long-term care facilities and represent a major cause of morbidity and mortality among institutionalized elderly individuals. Some characteristics specific for the setting of a nursing home favor the spread of infectious diseases. Residents are clustered in a confined living arrangement and daily activities that often take place in groups. Some residents are cognitively impaired and unable to follow basic hygiene precautions. Caregivers are

often inadequately trained and may have little knowledge of the fundamental principles of infection control. Nursing home residents are particularly susceptible to infections because they are physiologically old and often have comorbid underlying diseases that predispose them to site-specific infections ***(Mathei et al., 2007).***

Why are infections problematic in nursing home residents?

The elderly institutionalized are particularly susceptible to infections because of the physiological changes that occur with ageing, underlying chronic disease and the institutional environment. Infections occurring in these institutions represent a major cause of morbidity and mortality among residents. Furthermore, in these settings infections may be more difficult to identify because of their subtle presentations and the lack of on-site diagnostic facilities ***(Eveillard and Joly-Guillou, 2009).***

The most common infections in nursing homes:

The most common endemic infections in nursing homes are respiratory, urinary, gastro-intestinal tract, skin and soft tissue infections ***(Garibaldi, 1999).***

1. Urinary tract infections:

Urinary tract infections are the most common in long-term care facilities for the elderly. Prevalence rates of bacteriuria range from 25% to 50%, though most patients remain asymptomatic ***(Nicolle, 2001).***

2. Respiratory tract infections:

Respiratory infections include upper and lower tract infections. It is estimated that approximately 60% of lower respiratory infections represent pneumonia, which is often fatal ***(Garibaldi, 1999).***

Influenza presents a major source of morbidity and mortality. Older adults are at particular risk, given that 90% of influenza deaths occur in those aged 65 years and older ***(Centers for Disease Control and Prevention (CDC), 2003).***

Nursing homes, which generally have older and frailer residents, can experience Influenza attack rates up to 60% and case fatality rates as high as 55% ***(Simor, 2007).***

3. Skin and soft tissue infections:

Skin and soft tissue infections include decubitus ulcers, infected vascular or diabetic foot ulcers, and other types of

cellulitis. Although scabies is endemic in impoverished communities, in industrialized countries outbreaks occur in well-confined settings such as kindergarten, acute-care facilities, and nursing homes ***(Hengge et al., 2006).***

4. Gastro-intestinal tract infections:

Gastro-intestinal tract infections primarily manifest as diarrhea. Many fungi, viruses, bacteria, and parasites have been found responsible for causing outbreaks in nursing homes. Diarrheal infections are common in nursing homes. The most commonly identified agent is Clostridium difficile ***(Laffan et al., 2006).***

A spectrum of disease has been associated with C. difficile, ranging from mild diarrhea to potential fatal complications. Besides pseudomembranous colitis and toxic megacolon, complications such as hypokalemia, gastro-intestinal bleeding, and bowel perforation occur in up to 10% of patients with C. difficile-associated diarrhea (CDAD) ***(Miller et al., 2002).***

More than 80% of reported C. difficile infections occur in hospitalized or institutionalized adults aged 65 and older ***(Hookman and Barkin, 2007).***

Infection with drug-resistant microorganisms:

Nursing home residents are at risk for colonization and infection with drug-resistant microorganisms, including methicillin-resistant Staphylococcus aureus (MRSA), vancomycin-resistant enteroccoccus, penicillin-resistant Streptococcus pneumoniae, and gram-negative microorganisms with extended- spectrum beta-lactamases ***(Mathei et al., 2007).***

Methicillin-Resistant Staphylococcus Aureus (MRSA)

Methicillin-resistant Staphylococcus aureus (MRSA) is a bacterium responsible for several difficult-to-treat infections in humans. It may also be called multidrug-resistant Staphylococcus aureus or oxacillin-resistant Staphylococcus aureus (ORSA). MRSA is, by definition, any strain of Staphylococcus aureus that has developed resistance to beta-lactam antibiotics which include the penicillins (methicillin, dicloxacillin, nafcillin, oxacillin, etc.) and the cephalosporins. Meticillin- (the International Non-proprietary Name, and British Approved Name) or methicillin- (the United States Approved Name) resistant Staphylococcus aureus (MRSA) has been recognised since the 1980s as a major nosocomial (hospital-acquired) pathogen that has caused problems in hospitals and other health care institutions worldwide ***(Simor, 2001).***

Organism:

MRSA is belongs to kingdom of bacteria, Firmicutes Phylum, Cocci Class, Order Bacillales, Family Staphylococcaceae, Genus Staphylococcus, Species S. aureus ***(Rosenbach, 1884).***

Risk Factors for infection with MRSA:

- Old age.
- People with weak immune system (people living with HIV/AIDS, cancer patients, transplant recipients, severe asthmatics, etc.).
- Diabetes mellitus.
- Intravenous drug users.
- Use of quinolone antibiotics.
- Young children.
- College students living in dormitories.
- People staying or working in a health care facility for an extended period of time.
- People who spend time in coastal waters where MRSA is present, such as some beaches in Florida and the west coast of the United States.

(McNeil et al., 2002)

When colonized residents have been compared with noncarriers, increased age, underlying chronic disease,

decreased mobility, impaired cognitive status, presence of intravenous, urinary, or enteral feeding devices, presence of wounds, recent use of antibiotics and recent hospital stay, were frequently associated with MRSA carriage ***(McNeil et al., 2002).***

People who spend time in confined spaces with other people, including prison inmates, soldiers in basic training, and individuals who spend considerable time in changerooms or gyms ***(Zinderman et al., 2004).***

All of these factors increase the risk of residents getting MRSA, and then the risk of death ***(Hughes et al., 2008).***

Sites of colonization and infection with Staph aureus:

Staph aureus most commonly colonizes the anterior nares (the nostrils), although the rest of the respiratory tract, opened wounds, intravenous catheters, and urinary tract are also potential sites for infection ***(Hughes et al., 2008).***

Clinical picture:

Healthy individuals may carry MRSA asymptomatically for periods ranging from a few weeks to many years. Patients with compromised immune systems are at a significantly

greater risk of symptomatic secondary infection. The initial presentation of MRSA is small red bumps that resemble pimples, spider bites, or boils that may be accompanied by fever and occasionally rashes. Within a few days the bumps become larger, more painful, and eventually open into deep, pus-filled boils. About 75 percent of community-associated (CA-) MRSA infections are localized to skin and soft tissue and usually can be treated effectively. However, some CA-MRSA strains display enhanced virulence, spreading more rapidly and causing illness much more severe than traditional healthcare-associated (HA-) MRSA infections.

Diagnosis of MRSA infection:

Diagnostic microbiology laboratories and reference laboratories are considered the key for identifying outbreaks of MRSA. The bacterium generally must be cultured via blood, urine, sputum, or other body fluid cultures, and grown up in the lab in sufficient numbers to perform these confirmatory tests first, so there is no quick and easy method to diagnose MRSA infection, therefore initial treatment is often based upon 'strong suspicion' by the treating physician, since any delay in treating this type of infection can have fatal consequences. New rapid techniques for the identification and characterization of MRSA have been developed. These techniques include Real-time PCR

and Quantitative PCR which are increasingly being employed in clinical laboratories for the rapid detection and identification of MRSA strains ***(Mackay, 2007).***

Another common laboratory test is the rapid latex agglutination test that detects the PBP2a protein. PBP2a is a variant penicillin-binding protein that imparts the ability of S. aureus to be resistant to oxacillin ***(Cuevas, 2003).***

Evaluation of Chromagr and Pastorex test in identification of Staphylococcu aureus:

Staphylococcus Aureus causes severe suppurative infection, so its isolation from infectious lesions is necessary but it may be missed when the clinical sample is mixed with flora or when its colony is masked by swarming proteus or pseudomonas colonies ***(Carricajo et al., 2001).***

Unlike the colonies of other staphylococcus species, Staph.aureus colonies that are grown on chromogenic medium such as CHROM agar Staph aureus (CSAM) (CHROM agar microbiology, Paris, France) are pink-colored, so they yield a higher detection rate with better sensitivity than conventional media ***(Gaoillo et al., 2000).***

Pink colonies grown on CSAM can be confirmed by agglutination kits such as Pastorex Staph plus agglutination,

which can simultaneously detect clumping factor, protien A and capsular antigen ***(Gaoillo et al., 2000).***

Staph aureus can be identified by coagulase test. Staph coagulase test is a flurogenic, based on human prothrombin and protease inhibitors that specifically detect Staph.aureus coagulase that increases the specificity of detection ***(Personne et al., 1997).***

Antimicrobial susceptibility testing can be performed by picking colonies directly from CSAM using disc diffusion method ***(Carricajo et al., 2001).***

Treatment of MRSA infection:

Both CA-MRSA and HA-MRSA are resistant to the traditional anti-staphylococcal beta-lactam antibiotics, such as cephalexin. CA-MRSA has a greater spectrum of antimicrobial susceptibility, including to sulfa drugs (like co-trimoxazole/ trimethoprim-sulfamethoxazole), tetracyclines (like doxycycline and minocycline) and clindamycin, but the drug of choice for treating CA-MRSA has is now believed to be Vancomycin, according to a Henry Ford Hospital Study. The study was presented on October 23, 2010, at the **48th annual meeting of the Infectious Diseases Society of America in Vancouver**. HA-MRSA is resistant even to these antibiotics and often is

susceptible only to vancomycin. Newer drugs, such as linezolid (belonging to the newer oxazolidinones class) and daptomycin, are effective against both CA-MRSA and HA-MRSA. Vancomycin and teicoplanin are glycopeptide antibiotics used to treat MRSA infections ***(Schentag et al., 1998).***

Prevalence and Risk Factor for MRSA in Nursing Home Residents

Introduction:

Numerous studies conducted in acute hospitals have identified admission from nursing homes as a major risk factor for MRSA carriage and vice versa ***(Bradley, 1999).***

The epidemiology of MRSA within nursing homes has received limited attention. The available data show prevalence rates of MRSA colonization varying between 0% to over 40% ***(Bradley, 2002).***

It was found that in high prevalence institutions, the proportion of isolated MRSA strains showing the same antibiogram was higher when compared with low prevalence nursing homes ***(Suetens et al., 2007).***

A 3-year follow-up study of Belgian nursing home residents noted no excess hospitalizations or mortality among MRSA carriers, except in nursing home residents with severe disorientation in time and space. It seems, based on the scarce data, that MRSA colonization as such is not harmful to residents in relatively good health ***(Suetens et al., 2006).***

Surveillance cultures to identify MRSA carriers are not warranted. Patients colonized with MRSA should not be excluded from activities or isolated, as long as the colonized site can be covered and the patients are capable of performing good hygiene ***(McNeil et al., 2002).***

When cultures are obtained for clinical purposes, infection and colonization rates seem to increase and an outbreak is possible, thus more intensive infection control measures should be implemented ***(Matheï et al., 2007).***

In the setting of an outbreak or high endemicity, survey of staff and residents for the presence of asymptomatic carriage and decolonization of asymptomatic carriers should be considered ***(Matheï et al., 2007).***

Nursing homes for older people provide an environment likely to promote the acquisition and spread of methicillin-resistant Staphylococcus aureus (MRSA), putting residents at increased risk of colonisation and infection ***(Hughes et al., 2008).***

It is likely that the prevalence of MRSA within nursing homes is increasing as a result of the increased prevalence of MRSA within hospitals ***(Trick et al., 2001).***

In 1994, a study in Birmingham reported a prevalence rate of 17% amongst 191 residents in 10 nursing homes ***(Fraise et al., 1997).***

Interestingly, phage-typing of the strains revealed similarities with those circulating in Birmingham hospitals, suggesting direct transfer from hospital to nursing home. A 1999 study in Northamptonshire reported a prevalence of 4.7% amongst 275 residents in 17 nursing homes, with six of the 17 homes having colonised residents ***(Cox et al., 1999).***

Similar studies in other countries have reported MRSA prevalence rates in nursing homes ranging from 1.1% in Germany ***(von Baum et al., 2002)*** to 4.9% in Belgium ***(Hoefnagels, 2002)***, 6.2% in Israel ***(Mendelson et al., 2003),*** 8.6% in Ireland ***(O'Sullivan, 2000)*** and 22.7% in the USA ***(Terpenning, 1994).***

There are no equivalent mortality data specifically for the nursing home population, but Capitano has reported that MRSA-colonised nursing home residents are up to six times more likely to develop infection than non-colonised patients, thereby potentially increasing the risk of mortality ***(Capitano et al., 2003).***

The greatest success in controlling MRSA transmission in healthcare facilities has been achieved by programs that rely on early recognition of infected and colonized patients followed by implementation of contact precautions designed to prevent transmission from such patients ***(Jernigan et al., 1996).***

The risk associated with methicillin-resistant Staphylo-coccus aureus (MRSA) has been decreasing for several years in intensive care departments, but is now increasing in rehabilitation and chronic-care-facilities ***(Dohen et al.,2003).***

During the past four decades, methicillin-resistant Staphylococcus aureus (MRSA) has spread in hospitals worldwide and is now endemic in many countries, particularly in Europe and the USA ***(National Nosocomial Infections Surveillance, 2003).*** Patients who have been colonized with MRSA in general hospitals may introduce the organisms into LTCF or NH, and these can become reservoirs for this pathogen. From the LTCF or the NH, MRSA can be transported back to the acute-care facility or can find their way into the community. In addition, new strains of MRSA termed communityassociated MRSA have appeared recently. They are distinct from usual healthcare-associated MRSA by several characteristics, including the carriage of the genes for the Panton-Valentine leucocidin (PVL) and are often responsible

for skin and soft-tissue infections ***(Miller et al., 2005).*** Strategies of MRSA control in the acute-care setting are controversial, especially those concerning the usefulness of screening cultures for identification of carriers (**Siegel et al., 2007).** Furthermore, it may not be possible to transfer such strategies directly to the NH or the LTCF environments that serve as both a healthcare setting and a resident's home ***(Miller et al., 2005).***

Epidemiology of MRSA in older people:

Prevalence of MRSA carriage in institutions for elderly people (NH and LTCF):

Initial studies of nursing homes focused on whether they serve as reservoirs for MRSA and other resistant organisms that were then introduced into acute care hospitals.15 However, it has also been shown that 25% of patients are already colonized with MRSA upon admission to the nursing facility, and that only 10% of residents acquire MRSA during their NH stay.

Therefore, a substantial proportion of patients never acquire MRSA while in the NH. Numerous studies reporting prevalence of MRSA in institutions for older patients have been conducted in various countries because such studies are relatively simple, not labour-intensive, and less costly than prospective surveillance done at frequent intervals over long

periods of time ***(Brugnaro et al., 2009).*** Reported prevalence of MRSA carriage varied greatly. In all studies, identification of MRSA carriers was based on screening all residents at least by nasal swabbing, and sometimes by rectal or decubitus ulcer cultures ***(Eveillard et al., 2008).***

In a study covering 45 NH in Northern Ireland the prevalence was 23.3% among the 1111 residents screened and 7.5% in the corresponding staff. There was an association between MRSA carriage in residents and carriage in staff. Indeed, residents were significantly more likely to be colonized if they lived in homes in which more than 12.5% of all screened healthcare workers were colonized with MRSA, and conversely healthcare workers were more often colonized when the MRSA prevalence was high in residents ***(Baldwin et al., 2009).*** High levels of MRSA carriage were also reported in staff (36.0%) and residents (67.0%) of a 120-bed LTCF near Paris in France ***(Eveillard et al., 2004).***

These results are consistent with the occurrence of MRSA circulation between residents and health care workers. In a subsequent prevalence study 5 years later in the same French LTCF, the prevalence of MRSA carriage, identified by nasal and rectal swabbing, was 37.6% ***(Eveillard et al., 2008).***

In a study based on two prevalence surveys performed approximately 3 months apart in a 351-bed community LTCF for elderly people in Slovenia, the prevalence of MRSA colonization was around 9% and was similar in the two surveys (9.3% in the first vs. 8.8% in the second) ***(Cretnik et al., 2005).***

Manzur et al. (2008) reported a prevalence of 16.8% in a group of several LTCF in Spain, but with a wide variation according to the institutions (varying from 6.7 to 35.8%).

In a study conducted in one LTCF in the United States ***(Stone et al., 2008)*** residents were screened weekly by nasal swabbing over 8 weeks to identify MRSA carriers. In addition, cultures were graded for growth on a semi-quantitative scale (from 0 to 6). During the study, 59% of the 83 residents included were found, in at least one sample, to be MRSA carriers. Among these 61.2% were persistent carriers (all cultures positive for MRSA), whereas 38.8% were intermittent carriers (at least one, but not all cultures, positive for MRSA). Persistent carriers and intermittent carriers differed in mean MRSA growth score (3.7 vs. 0.7; $P<0.001$).

The prevalence reported in a large study of 47 NH (3236 residents) in the Rhine-Neckar region of southern Germany was only 1.1% ***(von Baum et al., 2002).*** A low prevalence (6.3%) has also been identified in a large LTCF in Israel ***(Mendelson et***

al., 2003). However, in this study, the carriage state was defined when two consecutive cultures were positive for MRSA. As demonstrated by ***Stone et al. (2008)*** an important proportion of carriages are only transient. Therefore, the prevalence of MRSA carriage could have been underestimated in this study compared with other reports where only one positive sample assessed the carrier status.

Lastly, MRSA strains have been identified in NH or LTCF from Scandinavian countries in which MRSA prevalence is very low. For instance, among the 603 cases of MRSA registered in Norway during 2006, 108 (17.9%) were isolated in residents of LTCF ***(Sie et al., 2008).*** In Finland, another country with a low MRSA prevalence, 13 epidemic cases were identified in a NH during an outbreak involving this setting and the associated health centre ward ***(Kotilainen et al., 2001).*** Although most MRSA identified in NH and LTCF in Germany were hospital acquired strains, MRSA producing PVL (PVL+ MRSA) were isolated from three LTCF ***(Wagenlehner et al., 2007).*** They were initially isolated in six residents of those LTCFs. The investigation undertaken thereafter identified both resident carriage and healthcare worker carriage. The overall prevalence of PVL+ MRSA was 9.1% in the first period of the outbreak. The prevalence of PVL+ MRSA was more than 4 fold higher than the prevalence of other MRSA (PVL–). After an

intervention that included the implementation of decontamination procedures and barrier precautions, the prevalence of PVL+ MRSA carriage dropped to 3.3% ***(Wagenlehner et al., 2007).***

Risk factors of MRSA carriage in LTCF and NH:

Most of the preceding studies identified some factors independently associated with MRSA carriage in patients institutionalized in NH or LTCF. Among them, factors that were most often reported were recent hospitalizations (with variable delays from the hospital discharge to the admission to the institutions according to study protocol) ***(Brugnaro et al., 2009),*** invasive devices like urinary tract indwelling catheters and subcutaneous catheters ***(Eveillard et al., 2008).*** Wounds or decubitus ulcers ***(Manzur et al., 2008)*** and recent antimicrobial treatments (treatments were often included if they had been administered within the preceding year) ***(Barr et al., 2007).*** Differentiating carriage sites, a study identified an association between the use of enteral feeding tubes and MRSA colonization in the oropharynx, whereas there was not any association with MRSA carriage in the groin and perianal area ***(Mody et al., 2007).***

The associations between antimicrobial therapy and MRSA carriage were often characterized by odds ratios (OR) >4.0, showing strong association. In a recent study conducted in

a French 120-bed LTCF, fluoroquinolones and third-generation cephalosporins have been particularly strongly associated with MRSA carriage (OR=12.07 vs. 4.40 for other antimicrobial agents) ***(Eveillard et al., 2008).*** According to the data collected in 24 NH spread over northern Belgium, the prevalence of MRSA colonization among residents who had received fluoroquinolones or nitrofuran derivates (11.9 and 18.0%, respectively) was significantly higher than the prevalence measured in residents overall (4.7%) ***(Suetens et al.,2007).*** According to a study performed in a NH, the prescription of ciprofloxacin was appropriate in only 25% of the cases ***(Pickering et al., 1994).*** As in these studies, recent reports have demonstrated a strong and significant association between individual exposure to fluoroquinolones and MRSA carriage ***(Muller et al., 2006).*** Other characteristics associated with MRSA carriage like cancer the NH size, a low ratio of nurses to beds, and male sex have been identified less frequently ***(Barr et al., 2007).*** An association between MRSA carriage and at least one medical imaging session within the preceding year has been described in a LTCF. Among these patients, the prevalence of MRSA carriage was significantly higher when the number of sessions was above two than when it was one or two (61.5 vs. 34.3%) ***(Eveillard et al., 2008).***

Consequences of MRSA Carriage in Elderly People:

(A) MRSA colonization and subsequent MRSA infection:

In contrast to MRSA carriage, which is often encountered in LTCF or NH, MRSA infections are much less frequent. For instance, in a study performed by ***Bradley et al. (1991)*** in a LTCF, the proportion of residents colonized with MRSA was around 25%, whereas the MRSA infection rates were only 3%.

It is estimated that residents of LTCF who are colonized with MRSA have a 4- to 6- fold increase in infection rate. In a study including 197 patients from intermediate and long-term care units in a Veterans Affairs hospital, 25% of MRSA carriers had at least one episode of MRSA infection, *versus* only 4%of carriers of methicillin susceptible *S. aureus* (MSSA) ***(Eveillard and Joly-Guillou, 2009).***

In another study conducted in a skilled nursing facility, 15 residents out of 121 MSSA carriers were infected by MSSA, whereas 14 residents out of 38 MRSA carriers were infected by MRSA. Therefore, it seems that MRSA colonization might predict the development of staphylococcal infection in LTCF ***(Eveillard and Joly-Guillou, 2009).***

In a study conducted in a LTCF and several community-based NH, the prevalence of MRSA colonization was significantly higher in the LTCF, whereas a trend was noted toward higher rates of infection among colonized residents of the NH than among those in the LTCF ***(Mulhausen et al., 1996).*** However, this result has not been reported in other studies.

A recent meta-analysis underscored that the predictive effect of carriage is also encountered in various intensive care units, liver transplant units, and adult or paediatric wards.52 Indeed, according to this study, compared with patients colonized with MSSA, patients colonized with MRSA are four times more likely to develop MRSA invasive infections ***(Safdar and Bradley, 2008).*** Several studies53–57 indicated that among NH residents in the United States, who have *S. aureus* bacteraemia, methicillin-resistant strains now predominate. In the population of NH residents admitted to an acute geriatric ward ofa US hospital, the increase in the incidence of *S. aureus* bacteraemia over a 7-year period was entirely due to an increased incidence of MRSA bacteraemia ***(Lesse and Mylotte, 2006).***

(B) Older patients and reduced glycopeptides susceptibility in MRSA:

The emergence of clinical infection due to MRSA with decreased susceptibility to glycopeptides is a and worrying phenomenon. Indeed, since 1996, vancomycin-intermediate *S. aureus* (VISA) strains have been increasingly identified in Europe, Asia and the United States. Moreover, several vancomycin-resistant *S. aureus* (VRSA) strains have been reported from the United States since 2002, and recently from northern India ***(Tiwari and Sen, 2006).***

VISA and VRSA represent an important public health threat because they tend to be multidrug-resistantto a large number of currently available antibiotics, compromising treatment options and increasing the likelihood of inadequate antimicrobial therapy.VRSA acquire the vancomycin resistance gene *vanA* via interspecies transfer from vancomycinresistant enterococci (VRE). Although the main risk factor of VRSA acquisition is probably a recent history of heavy antibiotic use, residence in LTCF has been also associated with the development of this resistance ***(Appelbaum, 2007).***

MRSA and Mortality in Elderly People

Consequences of MRSA colonization or infection in terms of mortality for elderly people have also been reported. In a study conducted by Niclaes et al in NH residents, the relative risk of dying within 6 months was greater for MRSA carriers than that for non-carriers ***(Niclaes et al., 1999).***

During a seven-year period, 24 episodes of MRSA bacteraemia were identified in NH residents from 22 separate facilities.57 Hospital mortality was 33% among those patients, with all deaths occurring within 15 days of admission to the acute geriatric ward. Mortality was 24% in patients with MSSA bacteraemia. In this study, initial empiric antimicrobial therapy was appropriate in only 39% of the episodes and this was primarily related to ineffective empiric therapy for MRSA. NH residents tend to have multiple, significant chronic underlying diseases. A recent study that used the Charlson weighted index of comorbidity as a measure of chronic disease severity found that this index was an independent predictor of attributable mortality due to *S. aureus* bacteraemia ***(Lesens et al., 2003).***

Several studies have also identified older age as a significant independent predictor of mortality from *S. aureus* bacteraemia. Comparisons of mortality rates between 145 patients, aged 66– 99 years, and 240 patients, aged 18–60 years,

hospitalized in a university medical centre in North Carolina with *S. aureus* bacteraemia, indicate that, after adjusting for confounding variables, older patients had higher mortality from *S. aureus* bacteraemia. Moreover, infection with MRSA was associated with higher total mortality in elderly people (OR=2.59). Finally, it is often considered that older age accounts for the variation in mortality between MRSA and MSSA infections ***(Mylotte and Tayara, 2003).***

Prevention of MRSA Dissemination in Institutions for Elderly People

(A) Risks of transmission:

In NH and LTCF, two factors can favour the risk of MRSA transmission. First, the reservoir represented by colonized residents is often significant, as high prevalence is usually encountered in those institutions. The other factor potentially favouring transmission is that, once colonized, institutionalized residents appear to carry the same MRSA strain for prolonged periods of time. Indeed, the mean duration of asymptomatic colonization with MRSA has been reported variously to be 3 months to 3 years ***(Sanford et al., 1994)***. However, in the absence of a documented outbreak of infection, analyses of phage groups, comparisons of antibiotic susceptibility or pulsed- field gel electrophoresis (PFGE)

patterns suggest that multiple strains, rather than a single strain, circulate within NH and LTCF This concurrent circulation of multiple MRSA strains in the same institution was described in a French LTCF with high MRSA prevalence ***(Eveillard et al., 2008).***

Acquisition of MRSA from the environment should also be considered. Although no study has been performed specifically in LTCF or NH, several recent reports have demonstrated the importance of the environment in MRSA acquisition.72–74 The risk of MRSA acquisition from the environment seems to be particularly high when a resident colonized with MRSA and a noncolonized resident share the same bedroom and therefore the same bathroom (and wet towels) ***(Dancer et al., 2009).***

(B) Infection control strategies for preventing the transmission of MRSA in LTCF and NH:

A recent review failed to identify any research concerning infection control strategies for preventing the transmission of MRSA in LTCF or NH which fulfilled the following criteria: randomized and controlled clinical trials, or controlled before and after studies, or interrupted time series studies. However, it is apparent that some aspects of contact precautions that can be recommended in acute-care hospitals

require modification when applied to institutions for older people where rehabilitation, socialization, and long-term custodial care are primary goals ***(Eveillard and Joly-Guillou, 2009).***

In the absence of any documented outbreak, systematic confinement of MRSA-colonized residents to private rooms seems particularly difficult. It is usually considered that restriction to room is not necessary if colonized sites can be contained, and if the resident is capable of understanding and carrying out hand hygiene and correct general hygiene.16 Conversely, a private room may be required for residents with a productive cough, a tracheostomy, or large and often heavily colonized skin lesions that cannot be covered by dressings.16 Cohorting residents by unit or room is controversial because a significant proportion of them may carry more than one multiresistant bacteria,75,76 with an increase of multidrug-resistant gram-negative organisms, as has been recently demonstrated in a 750-bed LTCF ***(O'Fallon et al., 2009).*** Therefore, it seems that a strict compliance with standard precautions should be sufficient in most cases. Moreover, implementing more stringent policies including screening, contact precautions, and sometimes decolonization with mupirocin nasal ointment and/or topical antiseptics, seems to be unrealistic in facilities where a large proportion of long-term

residents harbour MRSA, because of the cost of such policies and the unavoidable occurrence of resident-to-resident direct transmission ***(Kotilainen et al, 2001).***

Finally, screening patients coming from NH or LTCF seems to be helpful to adapt surgical antibioprophylaxis.46 In circumstances of high prevalence of MRSA carriage in the institution from which the patient is coming, a systematic adaptation of the prophylaxis is possible without screening ***(Merrer et al., 2004).***

(C)Compliance with hand hygiene in institutions for elderly people:

In NH and LTCF, poor compliance with hand hygiene has usually been recorded in evaluation studies. In an Italian 50-bed NH, hand hygiene compliance was 17.5%. Contrary to most other reports, higher compliance was observed in physicians (30%), whereas it was 20.1% for nurses and 10.0% for nursing assistants. The compliance measured concurrently in a rehabilitation medicine unit was 15.8%, whereas it was 53.7% in an infectious disease unit ***(Pan et al., 2008).***

In another study conducted in three LTCF in Taiwan, 87 a hand-hygiene training programme that included 1 hour of in-service classes and 30 minutes of hands-on training, provided a

significant increase of hand hygiene compliance from 9.34 to 30.36%. In a French study performed in four NH and LTCF, and based on the observation of 760 hand hygiene opportunities, the overall prevalence of hand hygiene compliance was 61.2% ***(Eveillard et al., 2009).*** Authors differentiated inter-series opportunities (before or after a single contact with the resident or his environment, and before the first contact and after the last contact of a series of successive contacts) and intra-series opportunities (from the opportunity following the first contact to the opportunity preceding the last contact in a series of successive contacts). Hand hygiene compliance varied widely and significantly between extra-series opportunities (73.7%) and intra-series opportunities (19.0%). This poor compliance is a worrying observation. Indeed, according to certain authors, monitoring compliance should be performed during complete care episodes including successive contacts with patients or residents and their environment because patients or residents probably do not benefit from partial compliance ***(Haas and Larson, 2007).***

Subjects and Methods

Study Design:

A cross sectional study was conducted to assess prevalence of MRSA in elderly living in geriatric homes in Egypt.

Subjects:

The study sample comprised one hundred participants aged sixty years and above. Collected from geriatric homes in Cairo

Inclusion characteria:

All geriatric home residents.

Group A:

Fifty elderly patients (both males and females) above sixty years were recruited from geriatric homes with more than 50 beds.

Group B:

Fifty elderly patients (both males and females) above sixty years. Were recruited from geriatric homes with less than 50 beds.

Methods:

Data was collected regarding patients' age, sex, duration of previous hospitalization and duration stay, presence of invasive device, remote site infection and antimicrobial administration.

Each patient gave an oral consent then underwent:

(1) Comprehensive geriatric assessment in the form of:

a. History taking including personal history, demographic data, past medical history (including detailed history of DM and PAD).and risk factors of MRSA infection (e.g. presence of invasive device, previous hospitalization, use of antimicrobial,….).

b. Clinical examination with stress on lower limb examination for peripheral pulsations, color changes, coldness, trophic changes, capillary refill time and sensory affection.

c. Screening for dementia using the Arabic version ***(El Okl, 2002)*** of mini-mental state examination (MMSE) ***(Folstein et al., 1975)***.

The MMSE comprises 30 questions with 10 devoted to orientation, three items requiring registration of new

information, five questions addressing attention and calculation, three recall items, eight items assessing language skills, and one construction question ***(Folstein et al., 1975).*** The sensitivity of the MMSE in detecting dementia is 85.7% ***(Cossa et al., 1997).***

d. Screening for depression the Arabic version ***(Shehata et al., 1998)*** of geriatric depression scale (GDS) ***(Sheikh and Yesavage, 1986).*** GDS provides an acceptable, valid screening test for depression in elderly. It takes few minutes to be administered. Patients who scored more than 5 positive items or more were considered to be depressed.

e. Functional assessment using:

1. ADL (Activity of daily living) ***(Katz et al., 1963).***

The Katz Activities of Daily Living (ADL) scale was developed to measure functional status in the elderly and in those with chronic disease ***(Katz et al., 1963).*** The observer determines the level of independence on a three-point scale ranging from independent to dependent in each of the following six activities: bathing, dressing, toileting, transferring, continence, and feeding. It was initially designed for use by direct observation over a period of weeks but has been adapted for use in an interview setting) ***(Katz et al., 1963).***

Because it was used to identify impairments in basic skills, it may be most useful in populations with preexisting impairments (such as a nursing home setting) or to identify care needs after acute events such as hospitalization ***(Chang and Tamura, 2009)***.

2. IADL (Instrumental activity of daily living) ***(Lawton and Brady, 1969).***

The IADL scale evaluates skills necessary to live independently, including using the telephone, food preparation, handling finances, and taking medications. Compared with Katz's ADL scale, which assesses basic functions, it is probably more sensitive to early changes in functional status ***(Chang and Tamura, 2009).***

(2) Microbiological study:

The samples of present study was conducted at the Central Microbiology Laboratory, Clinical Pathology Department, Ain Shams University during the period from March 2011 to January 2012.

Samples:

Plain sterile cotton swabs were used. The patients' noses were disinfected from outside using 70% alcohol. Samples were taken from the anterior nares by gently rotating the swab over

the mucosal surface of nares .same swabs were submitted within one hour to the microbiology laboratory for culture.

Sample Processing:

At the microbiology laboratory, swabs were inoculated directly into 2 ml sterile physiological water, homogenized by vortexing and then 50µl was plated onto a chromID^{TM} MRSA plate .

Culture on ChromIDTM MRSA agar medium:

Principle:

The chromID^{TM} MRSA (bioMerieux, Marcy l'Etoile, France) is a chromogenic medium used for the detection of methicillin-resistant Staphylococcus aureus (MRSA) in screening samples. The chromID^{TM} MRSA agar consists of a rich nutrient base combining different peptones. It also contains a chromogenic substrate of α-glucosidase and an antibiotic (cefoxitin) which favor:

- The growth of MRSA including hetero-resistant strains.
- The direct detection of MRSA strains by revealing α-glucosidase activity: green colonies.

The selective mixture inhibits most bacteria not belonging to the genus Staphylococcus, as well as yeasts.

Procedure:

1. Plates were allowed to come to room temperature.
2. Specimens were directly inoculated onto the chromID MRSA plates.
3. Inoculated plates were then incubated with cover bottomside at 35°C under aerobic conditions for 18h. If a negative result is obtained (no growth or coloration), the medium was reincubated for additional 24 hrs.

Limitations of the method:

- Certain strains of Staph. aureus which have the mecA gene but a low MIC in relation to cefoxitin (≤ 4 mg/l) may not develop on this type of medium.
- Certain strains of Staph. aureus which do not have the mecA gene may develop characteristic colonies on this type of medium after 24 or 48 hours of incubation.
- Certain coagulase negative Staphylococci may develop a pale green color.

- Certain organisms other than Staph. aureus produce green colonies which have a different appearance, enabling them to be differentiated from MRSA (Bacillus spp., Gram-negative bacilli, Enterococci, and extended spectrum beta-lactamase strains).
- If small green colonies are obtained after 18-24 hours, prolong incubation for an additional 24 hours.
- If a susceptibility test is performed using colonies from chromID™ MRSA agar, the results obtained for the glycopeptides will not be interpretable. A tendency towards too many resistant results has been observed for these antibiotics

After overnight incubation in ambient air at 35°C, plates were examined for signs of positivity:

- Plates were examined for the presence of bacterial growth and the appearance of the colonies. Colonies having a intense green color were considered characteristic of MRSA colonies (Photo 1).
- The presence of at least one green colony was considered a positive result (i.e., presence of MRSA).

Colonies suspected of being MRSA growing on chrom ID were further e subcultured on blood agar plate and incubated in ambient air at 35°C for another 24hrs in order to obtain fresh and pure isolates

Colonies growing on blood agar were further confirmed by latex agglutination.

Detection of PBP2a (the product of mecA gene) by the SlidexR MRSA detection:

Principle:

The Slidex® MRSA Detection (bioMerieux, Marcy l'Etoile, France) is a rapid latex agglutination test for the detection of MRSA by detecting PBP2a (penicillin-binding protein 2a). The test consists of Latex particles sensitized with a monoclonal antibody directed against PBP2a that specifically react with MRSA to cause agglutination visible to the naked eye. Methicillin-susceptible Staph. aureus (MSSA) does not agglutinate the latex particles.

Procedure:

Colonies identified as Staph. aureus were taken from blood agar plates after growth for 18-24 hours at 33-37°C were used.

PBP2' extraction procedure:

1. Four drops of Extraction reagent 1 (R3) were placed in a microcentrifuge tube.
2. The inside of three 1 µl loops was completely filled with isolated colonies and the excess material was removed by rubbing against the surface of the agar. Each loopfull of bacteria was placed into the microcentrifuge tube containing R3 reagent and vortexed vigorously until all the cells are removed from the loop.
3. The tube was caped and placed in boiling water (95-100°C) for 3 minutes.
4. The microcentrifuge tube was removed and allowed to cool to room temperature.
5. One drop of Extraction reagent 2 (R4) was added into the tube and vortexed well.
6. Centrifugation was done at 1500 g for 5 minutes. The supernatant was used as specimen.

Latex agglutination procedure:

1. Reagents were allowed to come to room temperature (18-25°C) before use.

2. The latex reagents were resuspended and the bubbles remaining in the dropper were removed.

3. For each specimen to be tested, one circle of the test card for testing with Sensitized latex (R1) and another for testing with Negative control latex (R2) were selected and labeled.

4. One drop of Sensitized latex (R1) and 50 µl of specimen were added to the test circle. They were mixed together well with the mixing stick and spread over the total surface of the circle.

5. Similarly, one drop of Negative control latex (R2) and 50µl of specimen were added to the control circle. They were mixed together well with the mixing stick and spread over the total surface of the circle.

6. The test card was rotated by hand for 3 minutes and the start of agglutination reaction was observed.

Precautions:

- Only specimens identified as Staph. aureus should be used for the test.
- Only use colonies isolated from blood agar.

- Only take colonies from a pure culture.
- Respect the heating time (3 minutes) and temperature (95-100°C). Heating for more than five minutes may lead to a decrease in sensitivity and heating for only one minute or less may lead to non-specific agglutination.
- When removing the supernatant after centrifugation for use as specimen, remove carefully and avoid pipetting material which has precipitated as this may lead to nonspecific agglutination.
- Mix the latex reagents thoroughly (R1 and R2) to form a homogenous suspension before use.

Reading and interpretation:

The strain was considered positive for the PBP2a (MRSA) when agglutination was observed with the Sensitized latex (R1) but not with the Negative control. If no agglutination or very fine granulation is observed with either latex reagents, the strain was considered PBP2a negative (MSSA).

Statistical Methods:

Analysis of data was done by IBM computer using SPSS (statistical program for social science version 12) as follows:

- **Description** of quantitative variables as mean, SD and range.
- **Description** of qualitative variables as number and percentage.
  - ✓ **Chi-square** test was used to compare qualitative variables between groups.
  - ✓ **Fisher exact** test was used instead of chi-square when one expected cell <5.
  - ✓ **Unpaired t-test** was used to compare quantitative variables, in parametric data (SD<50% mean).
  - ✓ **Mann Whitney test** was used instead of unpaired t-test in non parametric data (SD>50% mean).
  - ✓ **Binary logistic regression** model was used to find out the independent t predictors of outcome using backward likelihood technique.

P value >0.05 insignificant
P<0.05 significant
P<0.01 highly significant

Results

Table (1): Distribution of the studied group as regard general demographic data.

Variables	No	%
Age		
60-69	38	38%
70-79	41	**41%**
80-89	16	16%
>90	5	5%
Gender		
Female	50	50%
Male	50	50%
Marital status		
Divorced	13	13%
Married	20	20%
Single	24	24%
Widow	33	**33**%
Education		
Illiterate	38	**38%**
Can read and write	11	11%
Below high school	21	21%
High school	12	12%
University	18	18%
Smoking		
Ex-smoker	22	22%
No smoking	69	**69%**
Current smoker	9	9%

This figure shows that the majority of the studied cases were aged 70-79 years, 50% were males and 50% were females, most of them widowed and illiterate and 69% of them non smokers.

Table (2): Distribution of the studied group as regard positive and negative for MRSA colonization in nares.

Variables	No	%
Negative	87	87%
Positive	13	**13**%

This table shows that the prevalence of MRSA colonization in nares among the studied group was 13%.

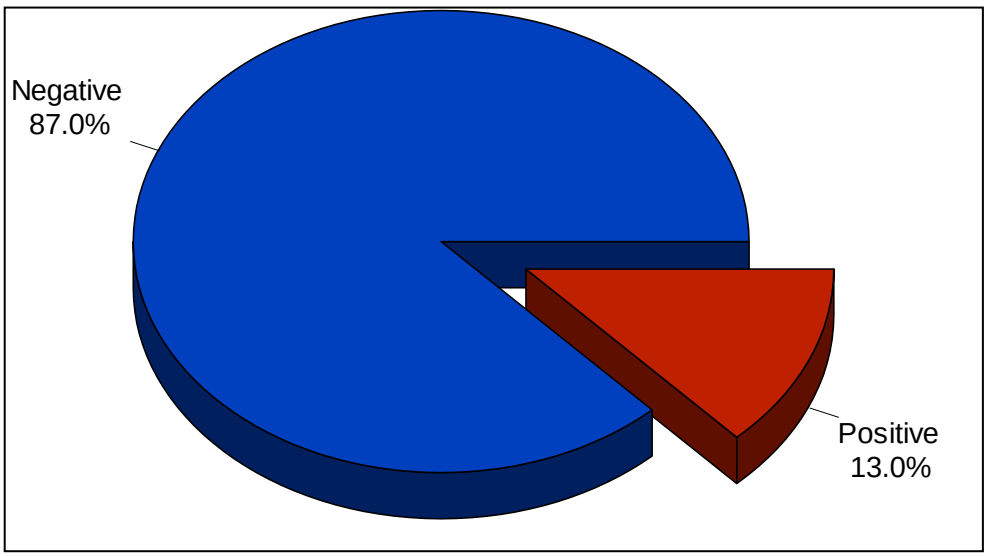

Figure (1): Distribution of the studied group as regard positive and negative for MRSA colonization in nares.

Table (3): Comparison between the negative and positive MRSA groups as regard demographic data.

Variables	MRSA Negative	Positive	X^2	P
Age				
60-69	35(40.2%)	3(23.1%)	2.5	>0.05 NS
70-79	34(39.1%)	7(53.8%)		
80-89	13(14.9%)	3(23.1%)		
>90	5(5.7%)	0		
Gender				
Female	43(49.4%)	7(53.8%)	Fisher	>0.05 NS
Male	44(50.6%)	6(46.2%)		
Marital status				
Divorced	10(11.5%)	3(23.1%)	2.6	>0.05 NS
Married	28(32.2%)	2(15.4%)		
Single	20(23%)	4(30.8%)		
Widow	29(33.3%)	4(30.8%)		
Education				
Illiterate	32(36.8%)	6(46.2%)	2.3	>0.05 NS
Can read and write	9(10.3%)	2(15.4%)		
Below high school	19(21.8%)	2(15.4%)		
High school	10(11.5%)	2(15.4%)		
University	17(19.5%)	1(7.7%)		
Smoking				
Ex-smoker	20(23%)	2(15.4%)	0.8	>0.05 NS
No smoking	59(67.8%)	10(76.9%)		
Current smoker	8(9.2%)	1(7.7%)		

This table shows no statistically significant difference between the negative and positive groups as regard general demographic data by using chi-square test.

Table (4): Comparison between the negative and positive MRSA groups as regard of the size of geriatric homes.

Variables	MRSA		P
	Negative	Positive	
>50 bed	40(46%)	9(69.3%)	<**0.05** **S**
<50 bed	47(53%)	4(30.8%)	

This table shows statistically significant difference between the negative and positive MRSA groups as regard number of beds using Fisher exact test.

Table (5): Comparison between the negative and positive MRSA groups as regard previous hospitalization.

Variables	MRSA		P
	Negative	Positive	
No	35(40.2%)	6(46.2%)	<**0.05** NS
Yes	52(59.8%)	7(53.8%)	

This table shows no difference between the negative and positive MRSA groups as regards previous hospitalization by using Fisher exact test.

Table (6): Comparison between the negative and positive MRSA groups as regard duration of stay in the geriatric homes and hospital.

Variables	Duration of stay		Z	P
	-ve MRSA	+ve MRSA		
Nursing home stay (months)	23.4±10	15.9±8	1.5	>0.05 NS
Hospital stay (days)	8.8±5	7.3±4	0.8	>0.05 NS

This table shows no statistically significant difference between the negative and positive groups as regard the duration of stay by using Mann Whitney test.

Table (7): Comparison between the negative and positive MRSA as regard insertion of Ryle or cannula (invasive devices).

Variables	Invasive devices		X^2	P
	-VE MRSA	+VE MRSA		
Ryle				
No	76(86.4%)	7(53.8%)	**9**	**<0.001 HS**
Yes	11(12.62%)	6(46.2%)		
Cannula				
No	66(75.9%)	10(76.9%)	0.7	>0.05 NS
Yes	21(24.1%)	3(22.1%)		

This table shows that subjects with Ryle tube had a higher incidence of MRSA colonization (P<0.001).

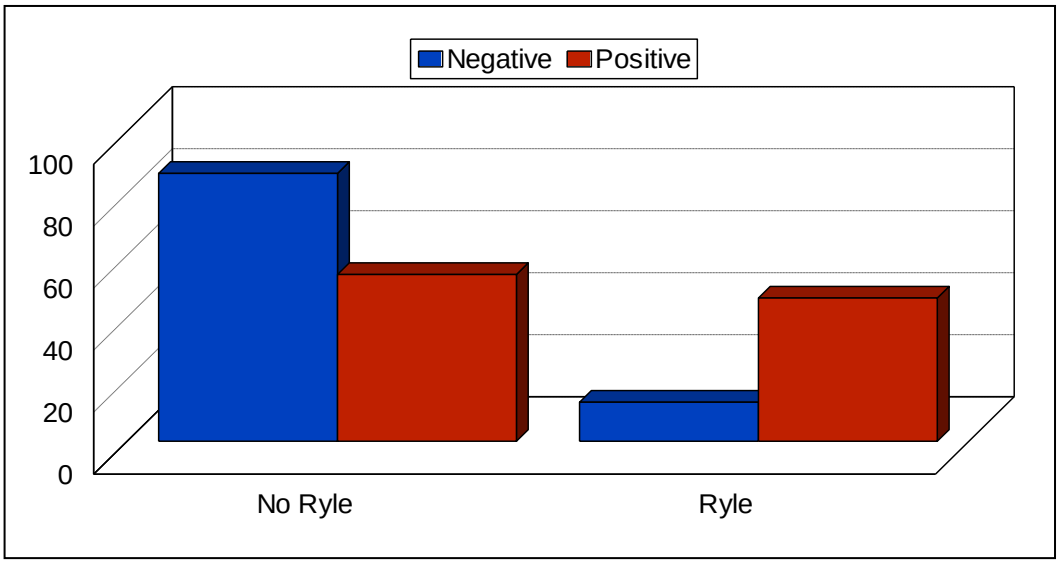

Figure (2): Comparison between the negative and positive MRSA as regard insertion of Ryle or cannula (invasive devices).

Table (8): Comparison between the negative and positive MRSA groups as regard medical conditions.

Variables	No.of patient	MRSA Negative(87)	Positive (13)	P
Diabetes mellitus	35	31(35.6%)	4(30.8%)	>0.05 NS
HTN	55	48(55.2%)	7(53.8%)	>0.05 NS
Stroke	42	35(40.2%)	7(53.8%)	>0.05 NS
COPD	22	21(24.1%)	1(7.7%)	>0.05 NS
IHD	23	21(24.1%)	2(15.4%)	>0.05 NS
Renal imperment	15	9(10.3%)	6(46.2%)	**<0.001 HS**
CLD	12	12(13.8%)	0	>0.05 NS
Parkinsonism	9	9(10.3%)	0	>0.05 NS

DM: diabetes mellitus, **HTN**: hypertension , **COPD**: chronic obstructive lung disease, **IHD**: ischemic heart disease , **CLD**: chronic liver disease.

This table shows that the positive cases had higher frequency of renal troubles compared to the negative group with statistically significant difference by using Fisher exact test. On the other hand there is no significant difference as regard other variables.

46.1% of participants who are carriers for MRSA have renal impairment and stroke, while 23% have DM and HTN.

Table (9): Comparison between negative and positive MRSA groups as regard open wounds and the use of broad spectrum antibiotics during the last month.

Variables	MRSA		P
	Negative	Positive	
Open wound (4)	4(4.6%)	0	>0.05 NS
Broad spectrum antibiotic use (47)	41(47.1%)	6(46.2%)	>0.05 NS

This table shows no statistically significant difference between both groups as regard open wound or the use of broad spectrum antibiotics by using Fisher exact test.

Table (10): Comparison between the negative and positive MRSA groups as regard MMSE , GDS, ADL and IADL

Variables	MRSA		X^2	P
	Negative	Positive		
GDS				
Depressed	35(40.2%)	3(23.1%)	Fisher	>0.05 NS
Not depressed	52(59.8%)	10(76.9%)		
ADL				
Assisted	38(43.7%)	2(15.4%)	**4.5**	NS
Dependent	25(28.7%)	7(53.8%)		**S<0.05**
Independent	24(27.6%)	4(30.8%)		NS
IADL				
Assisted	42(48.3%)	4(30.8%)	1.7	>0.05 NS
Dependent	31(35.6%)	7(53.8%)		
Independent	14(16.1%)	2(15.4%)		

This table shows that participants who were dependant in ADL were at a higher risk of MRSA colonization. MMSE (of the participants who are negative for MRSA was 22.9+4.5 and who are positive for MRSA was 21.8+5).

Also was of no significant difference between the negative and positive group.

Table (12): Comparison between different risk factors of MRSA among the studied groups by logistic regression analysis.

Variables	Beta co efficient	P	Odd's (95%CI)
Use of Ryle	1.4	**<0.05 S**	3.2(1-6.9)
Renal troubles	1.2	**<0.05 S**	2.2(0.8-5.5)
ADL(dependent)	0.9	**<0.05 S**	1.9(0.4-8.8)

CI= confidence interval

Logistic regression analysis showed that participants with Ryle had an increased risk (3.2 times more) than participants without and it was the greatest risk factor among studied risk factors followed by renal troubles and finally participants dependant in ADL.

Discussion

The populations of developed countries are becoming increasingly elderly. Aging is associated with an increased frequency of chronic diseases and declining functional status necessitating institutional care.

The Methicillin-resistant *staphylococcus areus* colonization according to many studies is associated with higher mortality in nursing home residents especially those with impaired cognitive status. A study by Seutens and colleagues in 2006 found that the 36-month mortality remained significantly higher in MRSA carriers (hazard ratio 1.4) than in non-carriers. The effect of MRSA on mortality was dependant on the degree of cognitive impairment where the highest effect was on those with severe cognitive impairment (adjusted HR=1.8) and absence of effect in residents with good mental status (adjusted HR=0.8). Deaths were more frequently reported to be infection-related in MRSA carriers ***(Seutens et al., 2006).***

These results were supported by a study by Oliver and colleagues in 2009 which stated that MRSA colonization in NH residents is associated with an increased mortality, particularly in individuals with severe impairment of cognitive functions ***(Oliver et al., 2009).***

The purpose of our study was to determine the prevalence of MRSA colonization in elderly living in geriatrics homes in Cairo, Egypt.

Many researchers studied the prevalence of MRSA colonization in nursing homes, and the results ranged from 0% to 52%.

Low prevalence was reported by many studies as Von Baum and colleagues in 2002 in a study in German NHs in Rhine-Neckar and in Heidelberg regions. After excluding nursing homes that housed handicapped children and young adults, 47 NHs participated with 3,236 residents with a prevalence of 1.1% ranging from 0-18.2%. Swabs from the nares of the residents were examined for growth of MRSA and the isolates underwent oxacillin susceptibility testing and polymerase chain reaction for the presence of mec A gene ***(Von Baum et al., 2002).***

Similarly, Seutens and colleagues in a study in 2007 on 24 NHs in Belgium on 2908 geriatric residents the prevalence was 4.7% ranging from 0-12.5% ***(Seutens et al., 2007).*** In Israel the Mendelson study in 2005 showed a slightly higher prevalence of 6.3%. This could be as the population was different; it was from subacute geriatric residents in intermediate care wards. Inclusion criteria were absence of

active infection and non usage of antibiotics in the preceding month. The carrier state was defined when two cultures were positive. The samples were from the nares ***(Mendelson, 2005).***

Another study showed a similar prevalence, it was by ***Brugnaro and colleagues*** in ***2009*** in two long term institutions in Italy including 551 residents from 15 wards. The prevalence was 7.8% ranging from 0-18%. The samples were from the nares ***(Brugnaro et al., 2009).***

On the other hand higher prevalence was also reported by many studies as in the study by ***Pop-Vica et al., 2008*** in a long term institution in the U.S.A, were the prevalence was 28%. The study included 84 elderly living in one long term facility ***(Pop-Vica et al., 2008).*** An even higher prevalence of 36.1% was found in the study by ***Stone and coworkers*** in ***2008*** of one long term facility including 83 participants ***(Stone et al., 2008).***

Unfortunately the studies with high prevalence were done in single facilities and hence it is difficult to conclude that these numbers actually present the general prevalence in NHs of that area or country. This fact was also concluded by ***Reynolds et al. (2011)*** who studied all of the nursing homes in Orange County, California. This included 10 different nursing homes between October 2008 and November 2009 and found the prevalence of MRSA ranged from 7%-52% ***(Reynolds et al., 2011).*** Hence

studying one or a low number of homes in either the high or low prevalence rates can give the wrong idea.

The population studied consisted of 100 subjects 60 years and older both males and females, recruited from four nursing homes in Cairo, Egypt.

The prevalence of MRSA colonization according to our study is 13%. A similar prevalence was found by Cretnik and colleagues in 2005 in a study done in long term institutions in Slovenia on 351 elderly revealing prevalence of 9% ***(Cretnik et al., 2005). Petra*** *and Team* in ***2005*** studied 102 participants and found only 12 to be positive ***(Petra et al., 2005).*** Another study showing similar results of 16.8% was by Mazur and colleagues in 2008. It was performed for residents of nine community long term facilities including 1377 elderly ***(Mazur et al., 2008).***

In a study by Barr and his colleagues in 2007 the prevalence was slightly higher. The study was on 715older residents of 39 homes in Leeds, United Kingdom revealing a prevalence rate 22 % ***(Barr et al., 2007).***

Another study was done by ***Oliver and colleagues*** in ***2009*** on NH residents in Belgium, 2953 residents were screened in 60 NHs, 587 (19.9%) were MRSA carriers. The residents were accommodated in rooms with one to four beds. Swabs

from the residents' anterior nares, throats, chronic wounds and urinary meatus if catheterized were subcultured onto selective chromogenic agar. Colonies suspected to be *staphylococcus areus* were identified by the coagulase test and then PCR ***(Oliver et al., 2009).***

The majority of our studied cases were aged 70-79 years (41%).Half of them were males and half were females, most of them widowed (33%) and 69% of them were non smokers.

According to our study there was no significant difference between the positive and negative groups as regard these general demographic data. This was supported by Jone and colleagues in 2003 who found that there is no correlation between age, sex and MRSA colonization ***(Jone et al., 2003).***

In our study we took the samples from 4 geriatric homes 2 from homes that had more than 50 beds and 2 from homes had less than 50 beds. The results showed a significant difference between the two groups; MRSA colonization was common in the geriatric homes that were more crowded.

This agrees with the study by Von Baum and his colleagues in their study in 2002 that included 46 homes in Germany, 16 small nursing homes and 16 medium sized homes and 14 large homes. Analysis showed that the size of the

nursing home was a potential risk factor for MRSA colonization with a positive correlation between them ***(Von Baum et al 2002).***

The study by ***Manzur et al.*** in ***2008*** disagreed showing that residents in long term facilities with beds fewer than 150 had at least a two-fold higher probability of being MRSA carriers ***(Manzur et al., 2008)***. The knowledge of the surface area on which a specific number of beds existed could probably give us a better prospective of the actual density of beds for comparison between the studies.

Our study showed no significant difference between both groups (positive and negative) as regard the use of broad spectrum antibiotics during last month and number of hospitalizations in the last 2 years. This was supported by ***Jone et al. (2003)*** in his study that found no significant difference between positive and negative groups as regard usage of anti biotic in last 3 months or total number of hospitalizations in the last 5 years ***(Jone et al., 2003).***

Others as Von Baum found that both factors significantly affected the prevalence of MRSA colonization ***(Von Baum et al., 2002).*** This could be explained by the different populations in each study and duration of antibiotic usage, as our study antibiotic usage was less than five days in elderly with good overall functionality.

Our study showed that subjects that having ryle tube insertion were (11%) and that having a cannula were (21%), and showed that subjects with Ryle had a higher incidence of MRSA colonization. Von Baum and colleagues similarly found that a gastrostomy tube is a risk factor increasing the prevalence of MRSA colonization ***(Von Baum et al., 2002).***

The present study also found that participants who were dependant in ADL were more likely to be colonized with MRSA concluding that dependency is a risk factor. This agrees with the guidelines of the CDC that stated that risk factors for MRSA colonization and infection in LTCF residents include dependence on healthcare personnel for activities of daily living ***(Centers for Disease Control and Prevention, 2007).***

According to this study participants with renal troubles were of higher risk to have MRSA colonization. Other medical conditions were insignificant. It is worth mentioning that MRSA positive cases had the following combination of comorbidities; 46.1% had CVS and renal troubles, 38.4% had CVS and HTN, and 23% had DM and HTN. García-García et al also stated that significant risk factors for MRSA carriers were recent antibiotic use, previous hospital admission in the last three months, a high comorbidity measured by Charlson index and a history of colonization by MRSA.

Summary

Older people make up a large and increasing percentage of the population. As people grow older they are increasingly at risk to be admitted to geriatric homes.

It is known that Infections are very common in the setting of long-term care facilities and represent a major burden. MRSA is commonly causes only asymptomatic colonization, Staphylococcus aureus is a highly pathogenic organism with the potential to cause serious infections, such as blood-stream infections, pneumonia, endocarditis, skin and soft tissue infections, and bone and joint infections, often associated with significant morbidity and mortality.

MRSA carriers without symptomatic infection are an important reservoir and source of spread.

Risk factors that mostly present in elderly living in geriatric homes are: prolonged hospital stay, multiple hospitalizations, age over 65 years invasive devices (e.g., catheters, gastric/endotracheal tubes, surgical drains) open wound, severe underlying illness, treatment with multiple broad-spectrum antibiotics and close proximity to patients colonized or infected with MRSA.

This thesis was conducted to determine prevalence of MRSA colonization in elderly living in geriatric homes.

It was a cross sectional study conducted on 100 elderly subjects; 60 years and older; both males and females living in four geriatric homes in Cairo, of which two homes had more than 50 beds and the other two homes had less than 50 beds. The majority of the studied cases were aged 70-79 years.

The study showed that the prevalence of MRSA colonization in nares in geriatric homes in Cairo is 13%.

46.1% of participants who are carriers for MRSA have renal impairment and stroke, while 23% have DM and HTN.

No statistically significant difference was found between the negative and positive MRSA groups as regard open wound or the use of broad spectrum antibiotics.

We found statistically significant difference between the negative and positive MRSA groups as regard number of beds. Geriatric homes with more than 50 beds had higher prevalence of MRSA colonization.

There was no difference between the negative and positive MRSA groups as regards history of previous hospitalization.

Also there was no statistically significant difference between the negative and positive groups as regard the duration of stay in geriatric home.

Risk factors of MRSA colonization in our study included participants with ryle who had an increased risk (3.2 times more) than participants without and it was the greatest risk factor among studied risk factors followed by renal troubles and finally participants dependant in ADL.

Conclusion

1. MRSA in geriatric homes is a complex problem.
2. Prevalence of MRSA colonization in nares in geriatric homes in Cairo is 13%.
3. Risk factors of MRSA colonization in our study included participants with ryle (and it was the greatest risk factor among studied risk factors) followed by renal troubles and finally participants dependant in ADL.
4. Geriatric homes with more than 50 beds had higher prevalence of MRSA colonization.

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