REPORT

Key factors in screening for methicillin-resistant Staphylococcus aureus (MRSA): a narrative synthesis of current evidence

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Sammendrag

Baggrund

Methicillin-resistente *Staphylococcus aureus* (MRSA) er stafylokokker, som er resistente over for de mest anvendte antibiotika til behandling af infektioner med disse bakterier. De danske retningslinjer har ikke været revideret siden 2016 og de norske ikke siden 2015. Begge behøver en opdatering.

Dette litteratur-review er en del af en serie reviews, hvor målet er at opdatere screeningsanbefalinger for resistente mikroorganismer i Norge og Danmark. Formålet med dette review er at opdatere screeningsanbefalinger for MRSA.

Metode

Dette review blev designet som et review af systematiske reviews. Relevante data blev ekstraheret fra inkluderede studier, og hovedfund samt konklusioner præsenteret med det formål at give et opdateret overblik over nyere litteratur vedrørende screeningsanbefalinger for MRSA.

Der blev foretaget en bred, systematisk litteratursøgning. Søgeord for MRSA, kombineret med synonymer med passende ordvalg og forkortelser, blev brugt i søgning på nøgleord for titel, abstract og forfatter.

Der blev stillet to specifikke søgespørgsmål:

- Hvilke risikofaktorer (individuelle og risikosituationer) er der for infektion/bærertilstand/varighed af bærertilstand med MRSA/LA-MRSA?
- Hvor ses koloniseringssteder med MRSA/LA-MRSA?

De inkluderede fuldtekststudier blev slutteligt gennemgået individuelt. Der er ikke et diskussionsafsnit i dette review, da tolkning af resultaterne indgår i en samlet rapport for alle de resistente mikroorganismer.

Resultater

Den systematiske litteratursøgning identificerede i alt 6,522 studier, og samlet blev 23 systematiske reviews inkluderet. Hovedparten af de screenede personer var voksne patienter indlagt på hospital, nyfødte børn på neonatalafdelinger, sygehuspersonale, beboere på plejehjem og asylsøgere/flygtninge. De fleste blev screenet ved indlæggelse på hospital, herunder afdeling for intensiv terapi. Prævalensen af MRSA-bærertilstand var høj blandt flygtninge på asylcentre, ældre beboere på plejehjem, diabetespatienter, patienter i dialysebehandling samt blandt børn, særligt neonatale børn. Andre vigtige risikofaktorer for MRSA-bærertilstand: indlæggelse på hospital (i lang tid eller inden for de seneste 12 måneder), dialyseadgang, co-morbiditet (fx cancer, diabetes, lungesygdomme), tidligere antibiotikabehandling, kroniske sår, mænd er i højere risiko end kvinder og fremmedlegemer (især blandt ældre). Detektionen af MRSA er højere, når der undersøges for MRSA fra mere end et kropssted, og MRSA-screening af voksne på hospital fra andre steder end næsebor/nares forøgede detektionen med 33% i forhold til kun at undersøge for MRSA i næsebor/nares.

Konklusion

Der blev ikke fundet noget epokegørende nyt i dette review, hvad angår risikogrupper, screeningssteder, tidspunkt for screening eller risikofaktorer relateret til MRSA. To risikogrupper er dog værd at nævne, nemlig diabetespatienter og patienter i dialyse. Studier har vist, at diabetespatienter hyppigere er bærere af MRSA end patienter uden diabetes, uanset om de har sår eller ej, og at patienter i dialysebehandling har en signifikant høj risiko for MRSA-bærertilstand.

Summary

Background

Methicillin-resistant *Staphylococcus aureus* (MRSA) are staphylococci being resistant to the antimicrobial agents that are normally used to treat infections caused by these bacteria. The Danish guideline has not been revised since 2016 and the Norwegian guideline since 2015. Both need to be updated. This literature review is part of a series of reviews concerning screening of resistant microorganisms. The aim of this review is to update screening recommendations for MRSA in Norway and Denmark.

Method

This review was designed as a review of systematic reviews. Relevant data were extracted from the studies included in the review and the main findings and conclusions presented in order to give an updated overview of the recent literature concerning screening recommendations of MRSA.

A broad, systematic literature search was performed. Search terms for MRSA combined with synonyms with appropriate truncations and abbreviations, was used for searching title, abstract, author keywords, and controlled vocabulary.

There were two specific research questions:

- What are the risk factors (individual and risk situations) for infection/carrier status/length of carrier status with MRSA/LA-MRSA?
- What are colonization sites for MRSA/LA-MRSA?

The included studies for full text reading were finally reviewed individually. There is no discussion section in this review as interpretation of the results will be part of a comprehensive report for all the resistant microorganisms.

Results

The systematic literature search identified 6,522 records and in total 23 systematic reviews were included. The main part of screened persons were adult patients admitted to hospital, newborns in NICU, health care workers (HCWs), residents at nursing homes or long-term care facilities, and asylum seekers/refugees. Time of screening was mainly on admission to hospital/ICU. The prevalence of MRSA colonization was high among refugees at asylum centers, elderly people at nursing-homes and long-care facilities, diabetic patients (higher than among non-diabetics), patients in dialysis treatment, and children – especially neonatal children. Other important risk factors for MRSA-colonization were: hospitalization – prolonged or within the previous 12 months, dialysis access, comorbidities like cancer, diabetes and lung diseases, previous use of antibiotics, chronic wounds, male sex, and use of medical devices (elderly people). Regarding screening sites, more than one screening site increased detection of MRSA, and extra-nasal MRSA screening in adults at hospital increased MRSA detection by one-third compared with nares screening alone.

Conclusion

In this review, we did not find anything epochal new regarding risk populations, equivalent screening sites, time for screening or risk factors related to MRSA. Two risk populations, however, are worth noting, namely that diabetic patients are more likely to be colonized with MRSA regardless wounds or not and dialysis treatment is associated with a significant high risk of MRSA-colonization.

Background

Methicillin-resistant *Staphylococcus aureus* (MRSA) are staphylococci being resistant to the antimicrobial agents that are normally used to treat infections caused by these bacteria. MRSA are resistant to all beta-lactam antibiotics, that means all penicillins, cephalosporins, and carbapenems. Infections caused by MRSA should therefore be treated with certain special antibiotics (broad-spectrum, often less effective with more side effects).

MRSA spreads like other staphylococci. The most important source of infection is close contact with other people who are carriers of MRSA. For livestock associated-MRSA, the source of infection is first and foremost daily and close contact with live animals carrying MRSA.

MRSA has been notifiable since 2006 in Denmark and since 2004 in Norway, and national guidelines to prevent the spread of MRSA have existed since then. Our guidelines have many similarities regarding screening recommendations, but also some minor differences, e.g. the risk period being 12 months in Norway and only six months in Denmark.

Both guidelines are old – the Danish guideline has not been revised since 2016 (1) and the Norwegian guideline since 2015 (2) – so they both need to be updated. Since Denmark and Norway had the same issue the National Institute of Public Health (NIPH) in Norway and Statens Serum Institut (SSI) in Denmark went into an agreement in 2023 on collaboration concerning literature search for screening programmes for MRSA, VRE, ESBL/CPO, and *Candida auris* in order to update the guidelines.

This evidence review is part of a series of reviews being the second one after the review on *Candida auris.*

Methods

This review was designed as a review of systematic reviews with two specific research questions which were asked before the literature search and with inclusion and exclusion criteria for both questions. The search was complemented by searching for grey literature and existing guidelines. Relevant data were extracted from the studies included in the review and the main findings and conclusions are presented in order to give an updated overview of the recent literature concerning screening recommendations of MRSA.

Literature search

A broad, systematic literature search was performed 4 and 5 December 2023 in Ovid MEDLINE, Ovid Embase, Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials, Web of Science core collection, and Epistemonikos. The searches were performed by a specialist librarian (RAT) at the Library for the Healthcare Administration, Norwegian Institute of Public Health, Oslo, Norway, after internal peer review by another librarian from the same library. Search terms for MRSA combined with synonyms with appropriate truncations and abbreviations, was used for searching title, abstract, author keywords, and controlled vocabulary. The search strategy was tailored to each database's search interface. No limits were applied. The complete search strategy can be found in Appendix.

All identified records were added, sorted, screened for duplicates (using different combinations of fields in preferences), and organized in the EndNote 20 software by Clarivate Analytics, Web of Science.

Inclusion/exclusion criteria research question 1

What are the risk factors (individual and risk situations) for infection/carrier status/length of carrier status with MRSA/LA-MRSA?

Inclusion criteria:

Population	Individuals tested/screened for MRSA/LA-MRSA
Outcome	1. Individual risk factors associated with MRSA/LA-MRSA 2. Situational risk factors (exposure*) associated with MRSA/LA-MRSA 3. Length of MRSA/LA-MRSA -carrier status 4. Reinfection with MRSA/LA-MRSA
Study design	1. Systematic reviews (with systematic literature search) 2. RCT and observational studies
Year of publications	2009
Country/context	Reviews: no filter Trials: limited to the Nordic countries and the Netherlands Step 3
Language	English, Norwegian, Swedish, Danish, German

* Both known exposure and stay in an environment with a high likelihood of infection transmission (e.g., countries with a high prevalence in the community or in departments with known cases without direct contact).

Exclusion criteria:

- Studies concerning environmental screening, nor studies regarding sampling in the environment during outbreaks
- Studies on treatment
- Studies on preventive measures (including screening) against postoperative wound infections
- Studies on laboratory methods (including sampling methods) for detecting MRSA
- Cross-sectional studies with aggregated data
- Case reports.

Inclusion/exclusion criteria research question 2

What are colonization sites for MRSA/LA-MRSA?

Inclusion criteria:

Population	Individuals tested/screened for MRSA/LA-MRSA
Outcome	Reported testing/screening results by location
Study design	1. Systematic reviews 2. Observational studies
Year of publications	2009
Country/context	Reviews: no filter Trials: limited to the Nordic countries and the Netherlands
Language	English, Norwegian, Swedish, Danish, German

Exclusion criteria:

- Studies concerning environmental screening, nor studies regarding sampling in the environment during outbreaks
- Studies on treatment
- Studies on preventive measures (including screening) against postoperative wound infections
- Studies on laboratory methods (including sampling methods) for detecting MRSA
- Case reports.

Study selection

EPPI-reviewer was used as a screening tool (3). After removal of duplicates researchers from SSI and NIPH piloted the inclusion and exclusion criteria in common on the first 50 studies based on title and abstract. Afterwards two researchers from SSI continued with title and abstract screening on the remaining studies. In case of uncertainty or disagreement on whether a study should be included or not the studies were marked “second opinion” and kept for a later review by two researchers from NIPH. The included studies for full text reading were finally reviewed individually by both researchers from SSI and compared for any disagreements. If there was a disagreement concerning inclusion of a study or not they had a discussion and came to a final agreement.

No formalised critical appraisal or quality assessment of the included studies was performed, nor graded certainty of evidence. Each study was assessed for overall relevance.

Data extraction and analysis

Relevant data from the included studies were extracted concerning screening sites, who to screen and when, prevalence of MRSA in different countries, populations/subpopulations and settings, risk factors for

MRSA colonization and infection, and finally secondary transmission. Data relevant to each aspect were presented in descriptive tables as shown in Results.

Results

Included studies

The systematic literature search identified 6,522 records, where 5,044 records were excluded before screening, see Figure 1. The remaining 1,490 records were screened on title and abstract, and after exclusion of 1,434 records 43 studies were left for full text reading. Further 20 studies were excluded after full text reading mostly because they did not meet the inclusion criteria and a few because they were posters or abstracts. In total, 23 systematic reviews were included as they met the inclusion criteria and were relevant to the research questions.

An overview of the 23 included systematic reviews is shown in Table 1. The reviews were published between 2011 and 2023, and they were based on results from 922 primary studies from all over the world. The reviews were divided in three main groups according to the study outcome: 1) screening sites, who to screen and when (n = 7), 2) prevalence of MRSA in different populations and settings (n = 9), and 3) risk factors/associated factors for MRSA colonization and infection (n = 7). Detailed information on these study outcomes can be seen in Table 2, 3, and 4, respectively.

Grey literature

Guidelines from the other Nordic countries (Sweden (4), Finland (5) and Iceland (6)) were identified. Furthermore, guidelines from the Netherlands (7), UK (8) and US (SHEA (9)) were found. The most recent guidelines were from UK in 2021 (8) and US in 2023 (9).

Figure 1 Flow diagram of search strategy and study inclusion/exclusion

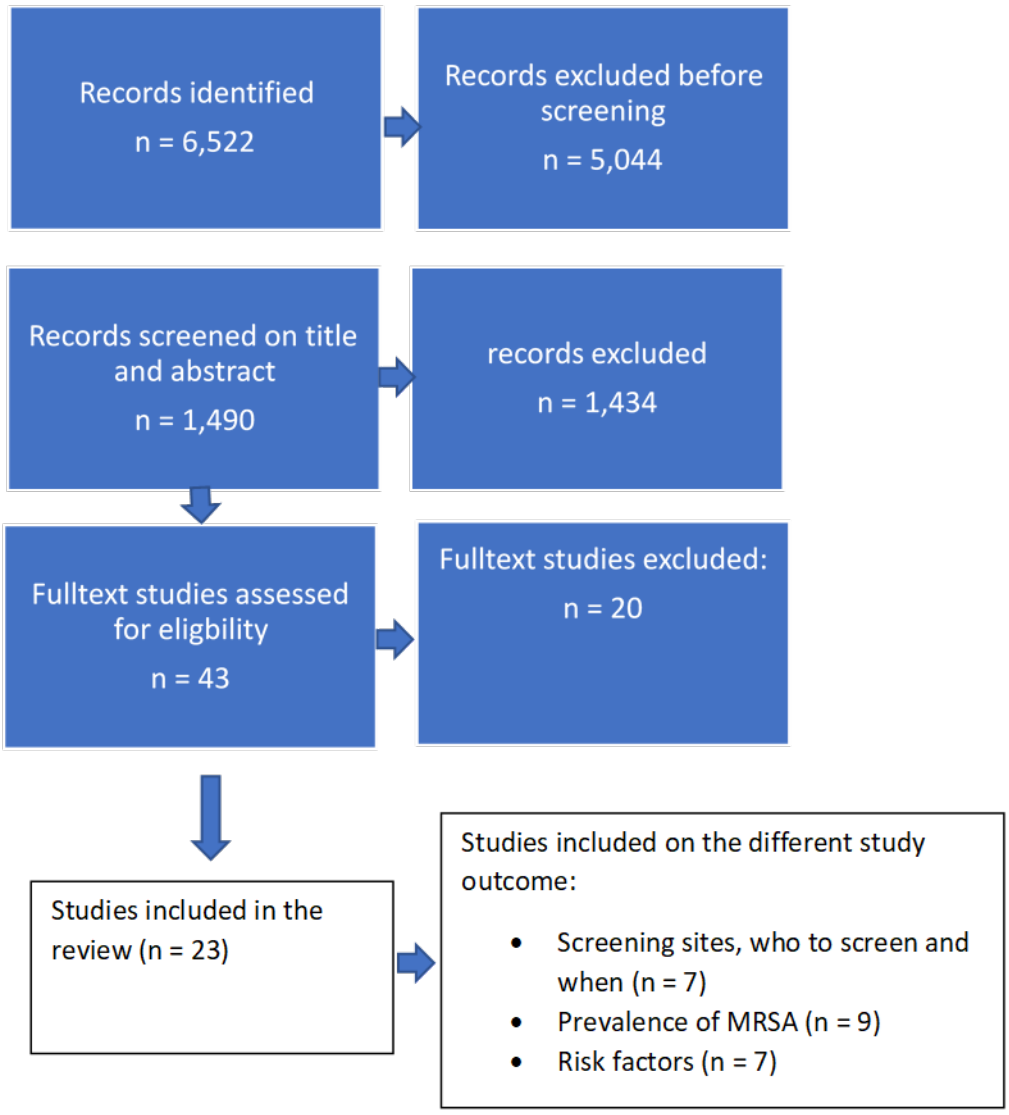

Table 1. Overview of included studies

First author/ year	Title	Country	Study design	Type and number of studies included	Outcome reported
Abdoli Oskouie/ 2020 (10)	Prevalence of *Staphylococcus Aureus* Nasal Carriage and Methicillin-resistant *S. Aureus* among Medical students: A Systematic Review and Meta-analysis	Iran	Systematic review and meta-analysis	n= 16 Cross-sectional: n = 13 Cohort study: n = 3	The identification of HCWs in outbreak settings colonized with MRSA is valuable in reducing the transmission and controlling the spread of MRSA
Chipolombwe J/ 2016 (11)	Methicillin-resistant *S. aureus* multiple sites surveillance: a systematic review of the literature	South Africa England	Systematic review	n = 17 Retrospective: n = 5 Descriptive analysis: n = 1 Prospective: 8 Active surveillance: n = 1 Case control: n = 1 Cross section: n = 1	A combination of three swabs from different sites provided the highest detection rate of MRSA colonization
Claassen-Weitz S/ 2016 (12)	Fecal carriage of *S. aureus* in the hospital and community setting: A systematic review	South Africa Nigeria Canada	Systematic review	n = 26 Type of studies not reported	Screening for *S. aureus* fecal carriage in populations at high risk could be an effective measure for the prevention of transmission and infection in healthcare and community setting
Coye TL/ 2023 (13)	Predictive value of MRSA nares colonization in	USA	Systematic review and meta-analysis	n = 6 Retrospective: n = 2	Nasal swab MRSA screen has a poor predictive value but an excellent negative

First author/ year	Title	Country	Study design	Type and number of studies included	Outcome reported
	diabetic foot infections: A systematic review and bivariate random effects meta-analysis			Prospective cohorts: n = 3 Cross-sectional: n = 1	predictive value in regions of low to moderate prevalence of diabetic foot infections
Dulon M/ 2011 (14)	MRSA prevalence in European healthcare settings: a review	Germany	Review	n = 31 All observational studies	For comparisons between different healthcare settings, surveillance methods and outcome calculations should be standardized
Dulon M/ 2014 (15)	MRSA carriage among healthcare workers in non-outbreak settings in Europe and the United States: a systematic review	Germany	Systematic review	n = 31 Study types not reported	MRSA prevalence among HCWs in non-outbreak settings was no higher than carriage rates estimated for outbreaks. Nursing staff had an increased risk for MRSA colonization
Fatkenheuer G/ 2015 (16)	Screening and isolation to control methicillin-resistant *S. aureus*: sense, nonsense, and evidence	Germany Switzerland	Review and viewpoint	n = 9 RCT: n = 4 Observational studies: n = 2 Prospective interventional cohort study: n = 2 Hybrid prospective interventional cohort study and RCT: n = 1	In view of the uncertainties about the efficacy of screening and the negative effects of contact isolation the strategy of screening and isolation cannot be regarded as a gold standard to prevent the spread of MRSA in all healthcare settings
Forster AJ/ 2013	Patient-level factors	Canada	Systematic review	n = 27	The existing literature cannot be used to

First author/ year	Title	Country	Study design	Type and number of studies included	Outcome reported
(17)	associated with methicillin-resistant *S. aureus* carriage at hospital admission: A systematic review			Retrospective cohort studies: n = 2 Prospective cohort studies: n = 18 Case control: n = 6 Cross-sectional: n = 2	identify risk factors for MRSA colonization at the time of hospitalization
Fulchini R/ 2019 (18)	Antibiotic-resistant pathogens in different patient settings and identification of surveillance gaps in Switzerland – a systematic review	Switzerland	Systematic review	n = 32 Admission screening: n = 10 Cohort: n = 1 Discharge: n = 1 Other screening: n = 5 Cross-sectional: n = 13 RCT: n = 1 Mixed: n = 1	The prevalence of MRSA was high among refugees at asylum centers – 16% in 2015. Among pig farmers the MRSA-prevalence was 6.6% in 2008 and 12% in 2015
Gagnaire J/ 2017 (19)	Epidemiology and clinical relevance of *S. aureus* intestinal carriage: a systematic review and meta-analysis	France	Systematic review and meta-analysis	n = 95 Type of studies not reported	Overall, *S. aureus* intestinal carriage prevalence is app. 25%. Among these carriers, one third have exclusive intestinal carriage. At individual level, a sample from rectum, stool or perianal, has the same sensitivity

First author/ year	Title	Country	Study design	Type and number of studies included	Outcome reported
Gesualdo F/ 2013 (20)	MRSA nasal colonization in children: Prevalence meta-analysis, review of risk factors and molecular genetics	Italy	Meta-analysis and review	n = 50 Cross-sectional design: n = 40 Cohort studies: n= 4 Case control: n = 6	The pooled MRSA-prevalence in children: Overall: 2.7% Underlying conditions: 5.2% Recruited in hospital: 5.4% Recruited in community: 3%
Glick SB/2014 (21)	Screening for methicillin-resistant *S. aureus*: A comparative effectiveness review	USA	Review A meta-analysis was not performed due to heterogeneity of the data and weaknesses in study design	n = 48 RCT: n = 1 Quasi-experimen-tal: n = 47	Compared with no screening, screening of all hospitalized patients for MRSA carriage (universal screening), decreases the rate of healthcare associated MRSA infection, but the evidence is low. There is also insufficient evidence concerning the effectiveness of other screening strategies
Hasanpour AH/ 2023 (22)	The global prevalence of methicillin-resistant *S. aureus* colonization in residents of elderly care centers: a systematic review and meta-analysis	Iran USA	Systematic review and meta-analysis	n =116 Cross-sectional: n = 88 Prospective cohort: n = 21 RCT: n = 7 Case control: n = 3	High prevalence of MRSA in residents of elderly care centers, especially in nursing homes (14%) and long-term care facilities (16%). Screening programs and preventive measures are important these places
Hawkins G/ 2011 (23)	Should healthcare workers be screened routinely for	Scotland	Review	n = 74 Prevalence studies, observational studies,	There is some evidence to suggest that HCW screening is acceptable to both patients and NHS staff.

First author/ year	Title	Country	Study design	Type and number of studies included	Outcome reported
	methicillin-resistant *S. aureus*? A review of the evidence			outbreak reports, review articles, and case reports	Evidence regarding its effectiveness in the prevention and control of MRSA in the endemic setting is limited. Further research is required before a recommendation could be made concerning routine MRSA screening of HWCs in Scotland
Karanika S/ 2015 (24)	Risk factors for methicillin-resistant *S. aureus* colonization in dialysis patients: a meta-analysis	USA	Systematic review and meta-analysis	n = 10 All prospective studies	Risk factors for MRSA colonization in hemo-dialysis patients: • Hospitalization within the previous 12 months • Temporary dialysis access Active surveillance is suggested in hemo-dialysis patients with the above mentioned risk factors
Liu Y/ 2020 (25)	Relationship between livestock exposure and methicillin-resistant *S. aureus* carriage in humans: A systematic review and dose-response meta-analysis	China	Systematic review and meta-analysis	n = 25 Cross-sectional: n = 21 Longitudinal: n = 4	A positive association between livestock exposure and human MRSA carriage was found with a higher risk in farm personnel and workers with occupational pig or poultry exposure
McKinnell JA/ 2013 (26)	A systematic literature review and	USA	Systematic review and meta-analysis	n = 29	MRSA colonization on hospital admission was associated with:

First author/ year	Title	Country	Study design	Type and number of studies included	Outcome reported
	meta-analysis of factors associated with MRSA colonization at time of hospital or ICU admission			Type of studies not specified	• Recent prior hospitalization • Nursing home exposure • Exposure to health-care-associated pathogens • Select comorbidities, e.g. diabetes, lung disease IPC-programs utilizing targeted MRSA screening may use the results to define patients at risk for MRSA colonization
McKinnell JA/ 2013 (27)	Quantifying the impact of extranasal testing of body sites for methicillin-resistant *S. aureus* colonization at the time of hospital or intensive care unit admission	USA	Review	n = 23 Type of studies not specified	Extranasal MRSA screening at hospital or ICU admission in adults increased MRSA detection by one-third compared with nares screening alone. The yield was similar at ICU admission and hospital admission in high-prevalence and low-prevalence populations
Nellums LB/ 2018 (28)	Antimicrobial resistance among migrants in Europe: a systematic review and meta-analysis	UK Denmark	Systematic review and Meta-analysis	n = 23 Observational studies	The pooled prevalence of MRSA carriage or infection in migrants was 7.8%. There was no evidence of high rates of transmission of AMR from migrants to host populations

First author/ year	Title	Country	Study design	Type and number of studies included	Outcome reported
Rodriguez-Villodres A/ 2021 (29)	Prevalence and risk factors for multidrug-resistant organism colonization in long-term care facilities around the world: A review	Spain	Review	n = 134 Cross-sectional: n = 99 Observational prospective: n = 28 Observational retrospective: n = 3 Case-control: n = 4	The prevalence of MDRO and MRSA is high among residents in nursing homes or LTCFs. Risk factors among elderly people: • Male sex • Diabetes and cancer • Chronic wounds • Use of medical devices • Previous antibiotic use
Stacey HJ/ 2019 (30)	The prevalence of methicillin-resistant *S. aureus* among diabetic patients: a meta-analysis	Scotland	Meta-analysis	n = 68 Cross-sectional: n = 4 Prospective cohort: n = 37 RCT: 1 Retrospective: n = 25 Mixed: n = 1	The prevalence of MRSA colonization was high among diabetics and higher than among non-diabetics. Targeted screening for MRSA in this group of patients is recommended, but stigmatization must be avoided
Washam M/ 2017 (31)	Risk factors for methicillin-resistant *S. aureus* colonization in the neonatal intensive care unit: A systematic review and meta-analysis	USA	Systematic review and meta-analysis	n = 11 Retrospective cohort: n = 5 Prospective cohort: n = 4 Case control: n = 1 Cross-sectional: n = 1	MRSA colonization was associated with gestational age < 32 weeks and birth weight < 1,500 g. Multifaceted IPC-strategies should target these infants in order to reduce MRSA colonization rates in neonatal ICUs
Zervou FN/ 2014	MRSA colonization	USA	Meta-analysis	n = 18 Prospective:	There was an overall prevalence of MRSA

First author/ year	Title	Country	Study design	Type and number of studies included	Outcome reported
(32)	and risk of infection in the neonatal and pediatric ICU: A meta-analysis			n = 11 Retrospective: n = 7	colonization of 1.9% on admission to NICU or PICU. The pooled acquisition rate of MRSA colonization was 4.1% during stay in NICU and PICU. There was a relative risk of 24.2% that colonized patients developed an infection during stay at hospital

Screening sites and who/when to screen

Seven systematic review studies were included reporting on screening sites, who to screen and when to screen, for details see Table 2. These reviews were based on 292 primary studies from all over the world. The populations and settings were: adult patients admitted to hospitals (mainly acute care, including ICU), newborns in NICU, hospitalized children, health care workers (HCWs), outpatients, residents at nursing homes or long-term care facilities (LTCFs), healthy persons in the community setting (adults, children, pregnant women, mothers and children (including newborns).

Time of screening was mainly on admission to hospital/ICU but some studies also focused on screening after admission to hospital, including weekly screening in high risk wards. Two reviews discussed universal screening versus targeted screening or no screening but the strength of evidence was low, so no conclusions could be made (16,21). One review pointed out that screening was one of the factors in the IPC-bundle so the effect of screening alone could not be evaluated (16). Another review focused on HCWs and the relevance of routinely screening of these for MRSA in an endemic setting (23). The conclusion was that the evidence for screening of HCWs was limited and therefore not implemented in Scotland.

Concerning screening sites there were some primary studies that only screened from the nose/nares but most studies screened from this location in combination with two or more body sites e.g. oropharynx, throat/sputum, skin, perineum, rectum, feces, wounds, devices etc. Two reviews reported results from screening of feces, rectal swabs, and perianal swabs, and pointed out that this was an important site for MRSA carriage that should be screened for (12,19).

Comparison of screening sites was done in two reviews (11,27). Extranasal screening improved MRSA detection and could be valuable in controlling outbreaks and in settings of persistant MRSA-disease among vulnerable patients.

Table 2. Summarizing the findings in studies of screening sites, who to screen and when

First author/year	Study period/search period	Countries	Setting	Population	Time of screening	Screening sites	Total positive persons (n/%)	Positive body sites (%)
Chipolombwe J/ 2016 (11)	1996-2014/1966-2014	17 studies South America: 7/17 Europe: 6/17 Asia: 4/17	Hospital: General wards (7/17) ICU (6/17) Both (3/17) Outpatients (1/17)	Adult patients (high risk for MRSA, ICU and other surgical and medical wards) n = 52,642	• At time of admission • 24/36/48 hours after admission • Weekly	Nares Oropharynx Throat/sputum Axilla Skin (axilla and groin) Perineum Rectum Wounds	_	Nares alone: 68.2% Nares + one body site: 89.6% Nares + two body sites: 94.2%
Claassen-Weitz S/ 2016 (12)	1998-2015/1920-2015	26 studies Italy Mozambique Nigeria Spain Sweden, UK, USA, India, Jordan, Saudi Arabia, France, Germany	Hospital Community setting	Healthy participants in community setting: • Pregnant women • Newborns and mothers • Mothers and infants • Outpatients Healthcare setting: • Inpatients • HCWs	_	Feces	_	Pooled estimate for MRSA fecal carriage: 10% (both community and healthcare setting)

First author/year	Study period/search period	Countries	Setting	Population	Time of screening	Screening sites	Total positive persons (n/%)	Positive body sites (%)
Fatkenheuer G/ 2015 (16)	2008-2014	9 studies, large world-wide RCT studies (4), prospective interventional cohort stu-dies (3), and observational studies (2)	Hospital setting: ICUs Hospital wide Surgical wards	Patients at hospitals, mainly at ICUs	Mostly at hospital admission	Not reported	_	Universal versus targeted screening is discussed. The authors address the problem of IPC-bundles with screening as one of the factors together with hand hygiene and isolation so it is not possible to evaluate the effect of screening alone
Gagnaire J/ 2017 (19)	2002-2017/2002-2017	95 studies USA: 31, Canada: 6, UK, England, and Wales: 9 Sweden: 25 Denmark: 5 Other coun-tries in Eu-rope: 22 Africa: 11 Asia: 10 Australia: 2	Community Hospitals Nursing homes LTCFs	Healthy adult volunteers (20 studies) Healthy children (14 studies) Healthy newborns (14 studies) Hospitalized adult patients (acute care, ICU, surgical dpt.,	Not reported	Stool Rectal swab Perianal swab Rectovaginal swab	Most studies were mixed with both *S. aureus* and MRSA data, only 25 were only MRSA-studies. In these studies 38,327 persons	Pooled analysis of intestinal carriage for MRSA was 4.7%. Subgroup analysis of intestinal carriage of MRSA: Healthy adults: 1.4% Healthy newborns: 7.3% Healthy child-ren: 3.1% Hospitalized ptt: 5.3%

First author/year	Study period/search period	Countries	Setting	Population	Time of screening	Screening sites	Total positive persons (n/%)	Positive body sites (%)
				transplantation dpt., hemodialysis etc.) (33 studies) Newborns in NICU (3 studies) Hospitalized children (3 studies) Non-hospitalized persons at risk of MRSA (19 studies), of these 9 studies were in residents at nursing homes or LTCFs			were screened, and 1,199 (3.1%) had MRSA intestinal carriage	Among intestinal carriers, app. one-third was exclusive *S. aureus* or MRSA intestinal carriers, and this carriage can be associated with infection
Glick SB/2014 (21)	Not reported/1990-2012	48 studies, and 14 of these were selected for the GRADE analysis.	Hospital setting	Hospitalized patients	Universal screening or targeted screening versus no screening	Not reported	Not reported	Two large quasi-experimental studies found reductions in healthcare-associated MRSA-infection with universal screening

First author/year	Study period/search period	Countries	Setting	Population	Time of screening	Screening sites	Total positive persons (n/%)	Positive body sites (%)
		No information concerning the countries, where the studies were performed						for MRSA carriage compared to no screening, but the strength of evidence was low. There was insufficient evidence to determine the effectiveness of other screening strategies
Hawkins G/ 2011 (23)	Not reported/1980-2010	74 studies 70% of pa-pers were from USA or Western Europe	Endemic and non-endemic MRSA settings	HCWs	To explore whether routine screening of HCWs should be performed in Scotland, three key questions were asked, the last one being most important: What is the evidence for routine screening of HCWs in the	Not reported	Not reported	Evidence regarding the effectiveness of routine screening of HCWs in the prevention and control of MRSA in the endemic setting is limited. In non-endemic countries as the Netherlands screening of HCWs has been successfully implemented as part of the “search and destroy” MRSA policy

First author/year	Study period/search period	Countries	Setting	Population	Time of screening	Screening sites	Total positive persons (n/%)	Positive body sites (%)
					prevention and control of MRSA in the endemic setting?			
McKinnel JA/ 2013 (27)	1996-2010/ 1966-2012	23 studies Europe: 13 North America: 6, Asia: 3, Australia: 1	Hospital setting (19 studies); low MRSA prevalence population (9 studies), and high MRSA prevalence population (10 studies) ICU (4 studies)	Patients admitted to hospital/ICU	On admission to hospital/ICU	Multiple extra-nasal body sites, as oropharynx, rectum, wounds, axilla.	MRSA colonization prevalence (all studies): 1.3-69.1% (average: 5%)	Testing the oropharynx increased MRSA detection by 21% over nares alone, rectum by 20%, wound by 17%, and axilla by 7%. Extra-nasal testing could be valuable for control of disease out-breaks or in settings of persistent disease among vulnerable patients

Prevalence of MRSA worldwide in different populations and settings

Nine systematic review studies were included reporting on prevalence of MRSA worldwide in different populations, subpopulations, and settings, for details see Table 3. These reviews were based on 344 primary studies from all over the world. The settings were: medical education (one review), medical conference, hospital setting (acute care for adults, acute care for children (PICU, NICU), pediatric wards etc.), nursing homes, LTCFs, outpatients, asylum seeker center/refugee center and high-migrant community setting as refugee camps and transit centers (one review). Most of the studies were performed in non-outbreak settings. Populations and subpopulations: medical and other students, HCWs (nurses, physicians, laboratory employees etc.), patients (adult and pediatric), diabetic patients including patients with diabetic foot infections, residents, elderly, refugees and migrants etc.

Time of screening was reported in six of the nine systematic reviews. Three of the six reviews performed screening for MRSA in non-outbreak situations – in one review this was not further specified (10), in the two others different time points were mentioned for screening in acute care settings and long-term care (14,15). Two reviews reported screening on admission to hospital (28,32) and one of these also on arrival to asylum seeker center/refugee center. In a review with mixed populations (patients, outpatients, elderly) screening was performed as universal screening on admission to hospital or targeted screening (high-risk patients). Outside hospital there were no specific time points (18).

Screening sites were mainly nose/nares alone in more than half of the primary studies. Extranasal screening sites were wounds (e.g. diabetic foot wounds), oropharynx, throat/sputum, skin, perineum etc.

There were large differences in MRSA prevalence rates among the examined subpopulations as shown In Table 3. The lowest MRSA prevalence was found among medical students (2%) (10) and neonates and small children admitted to NICU or PICU (1.9%) (32).

Diabetic patients had high MRSA prevalence rates and higher than non-diabetic patients. In one review study the MRSA prevalence among diabetics was 8.9-29.9% (13), and in another study comparing diabetic with non-diabetic patients, the diabetics had a 4.75% greater MRSA-colonization rate (30).

Among elderly at nursing homes or LTCFs there were high MRSA prevalence rates around the world with a pooled global prevalence of 14.69% (22). The highest MRSA prevalence rates were seen in USA (23.78%) and The Americas (22.27%), and the lowest in Europe (10.93%) although some countries in Europe had high prevalences, e.g. Poland, UK, Italy, and Spain.

A review study reported on high MRSA-prevalence in different subpopulations in Switzerland, e.g. refugees (21%), pig farmers (12%), and nursing homes (9%) (18). Another study on migrants and refugees in different countries in Europe found that high-migrant community settings as refugee camps and transit centers had a high MRSA-prevalence rate of 9.8% (28).

In non-outbreak settings at hospitals with acute care and at institutions with long-term care in Europe there was a large range in MRSA-prevalences from less than 1% to 24% (14), and among HCWs in the same settings from Europe and USA, the nurses had highest MRSA-prevalence of 6.9% (15).

Table 3. Prevalence of MRSA in different countries, populations, subpopulations and settings

First author/year	Study period/ Search period	Countries	Setting	Population or subpopulation	Time of screening	Screening sites	Number of MRSA patients/residents colonized or infected	MRSA prevalence (%)
Abdoli Oskouie/ 2020 (10)	1994-2019/1967-2020	16 studies: Table 3. Prevalence of MRSA in different countries, populations, subpopulations and settings Nepal, Columbia, India, Iran, Madagascar, Portugal, Malayasia, Saudi Arabia, Poland, Australia, Austria, Canada	Medical education setting (university and hospital)	Medical students: • Preclinical • Clinical Other students: • Nursing • Non-medical • Interns	Non-outbreak Non-endemic Not further specified	Nares	_	Pooled MRSA prevalence among medical students: 2%
Dulon M/ 2011 (14)	Long-term-care: 1997-2006 Acute care: 1999-2008	31 studies: Long-term-care: Ireland, UK, Germany, Italy,	Long-term care (11/31) Acute care (20/31)	Residents Patients	Non-outbreak Different time points: Acute care • On admission	Long-term-care: Nose/nares (2/11) Two or more	_	Long-term-care: 1-23% Acute care: 0.1% - 24%

First author/year	Study period/ Search period	Countries	Setting	Population or subpopulation	Time of screening	Screening sites	Number of MRSA patients/residents colonized or infected	MRSA prevalence (%)
	Search period: 2000-2010	Slovenia, Belgium. Acute care: Germany, France, Ireland, UK, Netherlands			(24-48 hours) • During hospital stay (1-3 weeks after admission) • Weekly • 3 days before discharge Long-term-care Non-selective (11)	swabbing sites (9/11) Acute care: Nose/nares (4 studies) Two or more swabbing sites (14 studies)		
Coye TL/ 2023 (13)	2007-2020/up to May 2020	6 studies: England, USA (3), Iraq, Taiwan	Hospital setting (4/6) Outpatient setting (1/6) Both (1/6)	n = 8,706 diabetic patients Colonization with MRSA in diabetic foot infections	_	Nares Diabetic foot wounds	_	Prevalence of MRSA from the included studies ranged from 8.9-29.9%.
Dulon M/ 2014 (15)	1995-2010/Jan 2000 – Dec 2013	31 studies: Northern Ireland (1), Ireland (2), UK (2), Italy (3), Nether-lands (2),	Non-outbreak settings in Europe and USA: Hospital (19/31)	n = 23.337 HCWs: Nurses Physicians Laboratory employees	Non-outbreak Different time points according to a screening strategy, e.g. twice a year, routine screening,	Nose alone (21 studies) Two or more swabbing sites (10 studies)	n = 419	Prevalence of MRSA from the included studies ranged from 0.2% - 15.0%. Pooled MRSA colonization

First author/year	Study period/ Search period	Countries	Setting	Population or subpopulation	Time of screening	Screening sites	Number of MRSA patients/residents colonized or infected	MRSA prevalence (%)
		France (5), Germany (8), Portugal (1), Spain (1), USA (6)	Nursing home/LTCF (6/31) Mixed (2/31) Medical conference (4/31)	Others (technicians, therapists etc.) Nursing staff (nursing home/LTCF)	once a month etc. (15 studies) No screening strategy (15 studies) At a medical conference (self-swabbing, one study)			rate: 1.8%; highest among nursing staff: 6.9%.
Fulchini R/ 2019 (18)	2001-2016/2000-2017	32 studies concerning MRSA from Switzerland	Acute care Pediatric wards Others: IVDU, HCWs, veterinarians, dental care patients, SHWs, refugees, pig farmers Outpatients LTCFs	n = 42.580 Mixed population of patients in hospitals Outpatients Elderly in nursing homes (see setting)	Universal hospital admission screening (all patients) Targeted screening upon hospital admission (high-risk patients, mostly those transferred from abroad). Outside hospitals some specific studies have been performed in nursing homes/LTCFs, among pig farmers etc. in a certain	Nose: 14/32 Two or more sites: 16/32 Unknown: 2/32	n = 1782	Overall: 0-21.0% Acute care: Mixed: 3% (2003) Surgical ptt.: 5% (2004-06) Internal medicine: 2% (2010) Nursing home: 9% (2010/11) 5% (follow up in 2015) Pig farmers: 6.6% (2008) 12% (2015) Refugees: 21% (2014/15)

First author/year	Study period/ Search period	Countries	Setting	Population or subpopulation	Time of screening	Screening sites	Number of MRSA patients/residents colonized or infected	MRSA prevalence (%)
					not specified time period.			IVDUs: 10% (2000) 1% (2008/9)
Hasanpour AH/ 2023 (22)	1990-2022/1980-2022	119 studies from 29 countries worldwide	Type of elderly care centers and number of studies per-formed: Nursing homes: 71 LTCFs: 41 Residential care homes: 7	n= 164,717 Risk factors in the elderly (prevalence ratio): Male gender: 1.55 Prior antibiotic use: 1.97 Prior MRSA infection: 3.71 Hospitalization in past year: 1.32 Wound: 2.38 Urinary catheter: 2.24 Any device: 1.78 Diabetes: 1.55	Not reported	Nose alone: 34 studies Only inguinal: One study Only oral: One study Only blood: Two studies Two or more samples: 81	n = 16,793	Pooled global prevalence of MRSA: 14.69%. Pooled prevalence rates in WHO-defined regions: The Americas: 22.27% Western Pacific: 16.57% Europe: 10.93% Eastern Mediterranean: 8.55% Africa: 9.04% USA: 23.78% China: 18.07% UK: 18.66% Poland: 22.18% Italy: 16.34% Spain: 15.45% France: 13.89% Switzerland: 13.15%

First author/year	Study period/ Search period	Countries	Setting	Population or subpopulation	Time of screening	Screening sites	Number of MRSA patients/residents colonized or infected	MRSA prevalence (%)
								Israel: 14.82%
Nellums LB/2018 (28)	2006-2016/2000-2017	23 studies: Italy: 2 Spain: 6 Germany: 7 Greece: 1 Sweden: 2 Netherlands: 2 Austria: 1 Switzerland: 2	Hospital (17) Asylum seeker center/refugee center High-migrant community setting (refugee camps and transit centers) (6)	Migrants/refugees	On admission to hospitals On arrival to asylum seeker center/refugee center	19/23 screened for MRSA Only nasal screening: 1/19	_	Asylum centers/refugee centers: 8,2% High migrant community setting: 9,8% Hospitals: 7,4%
Stacey HJ/ 2019 (30)	1993-2016/up to May 2018	68 studies: USA: 18 China: 3 Taiwan: 5 Australia: 2 Saudi Arabia: 2 Iran: 1 India: 4 Pakistan: 1 Sri Lanka: 1 Singapore: 2 Nepal: 1 Mexico: 1 Costa Rica: 1 Algeria: 1 Egypt: 1	Inpatients Emergency departments Outpatients Mixed in- and outpatients Nursing homes Community	Diabetic patients (n = 11,577) Diabetic foot infection patients (n = 10,994) Diabetic patients with non-foot skin and soft-tissue infections (n = 2,147) Diabetic HCWs (n = 10; only one small study) Non-diabetic patients (38,976)	Not reported	Colonized in nose alone: 19 studies Colonized in two or more sites: 4 studies Infections: DFI: 41 studies Other infections: 10 studies	n = 3,031	Data sets were divided into three groups: 1. The prevalence of MRSA colonization among 11,577 patients with diabetes was 9.20% (based on 23 data sets)

First author/year	Study period/ Search period	Countries	Setting	Population or subpopulation	Time of screening	Screening sites	Number of MRSA patients/residents colonized or infected	MRSA prevalence (%)
		Ethiopia: 1 Turkey: 3 UK: 4 Ireland: 1 Poland: 1 France: 4 Germany: 3, Spain: 2 Portugal: 1 Italy: 1 International: 3						2. Comparison of data from diabetic and non-diabetic patients showed that diabetic patients had a 4.75% greater colonization rate (based on 14 data sets) 3. The preva-lence of MRSA in 10,994 diabetic foot infection patients was 16.78% and among 2,147 non-

First author/year	Study period/ Search period	Countries	Setting	Population or subpopulation	Time of screening	Screening sites	Number of MRSA patients/residents colonized or infected	MRSA prevalence (%)
								foot skin and soft-tissue infections the MRSA prevalence rate was 18.03% (based on 41 data sets)
Zervou FN/ 2014 (32)	1999-2011/up to October 2013	18 studies, but 2 studies were over-lapping: USA: 10 Japan: 3 Korea: 1 UK: 2 Saudi Arabia: 1 Abu Dhabi: 1	Acute care for children: PICU: 6/17 NICU: 10/17 Both: 1/17	n = 19,722 Neonates admitted to 12 NICUs (12.284), children admitted to 6 PICUs (7.107), one study reported on 331 neonatal and pediatric patients (non-stratified data)	On admission: 14 studies <48 hours: one study ≤24 hours: one study ≤3 hours: one study	Nose alone: 9 studies Two or more swabbing sites: 8 studies	Not reported (only in %)	The pooled prevalence of MRSA colonization on admission to NICU/PICU: 1.9%. Among NICU patients alone: 1.5%. Among PICU patients alone: 3.0%. Outborn neonates had a prevalence of MRSA of 5.8%

First author/year	Study period/ Search period	Countries	Setting	Population or subpopulation	Time of screening	Screening sites	Number of MRSA patients/residents colonized or infected	MRSA prevalence (%)
								compared to inborn with 0.2%. The pooled acquisition rate of MRSA colonization was 4.1% during NICU/PICU stay and 6.1% during NICU stay.

Risk factors/associated factors for MRSA colonization and infection

Seven systematic review studies were included reporting on risk factors/associated factors for MRSA colonization and infection, for details see Table 4. These reviews were based on 286 primary studies from all over the world.

The settings were: Hospitals (ICU (adults), NICU, PICU, surgical and geriatric wards, ambulatories), LTCFs, nursing homes, community daycare centers, schools, primary care visits, farms (pigs, poultry, cattle, horses, sheep), and slaughterhouses. Populations included in the studies: Patients (hemodialysis), children (healthy, neonates, children with diseases: atopic dermatitis, cystic fibrosis, respiratory tract infections, and HIV), elderly people, farm personnel/livestock workers, veterinarians, slaughter workers, family members, community residents, and neighboring residents.

Screening sites were reported in five of seven review studies as shown in Table 4. One review reported on nasal screening alone in 40 primary studies (20) and in another review seven out of ten primary studies were only based on nasal screening (24). The remaining three reviews reported mainly on two or more screening sites (17,29,31).

The reported risk factors were:

- Previous admission to hospital (17,20,24,26,29)
- Previous antibiotic use (17,29)
- Previous colonization (29)
- Prolonged hospitalization (20)
- Exposure to health-care associated pathogens e.g. VRE, CDI (26)
- Patients transferred from nursing home/LTCF, exposure to nursing homes (17,26)
- Premature birth/low birth weight/critically ill neonates (20,31)
- Use of medical devices (29)
- Family member employed in health care facilities (20)
- Underlying diseases: Atopic dermatitis (20), diabetes (26, 29), dialysis (24), chronic lung disease (24, 26), immunosuppression/cancer (26,29), chronic wounds (29), dementia (29)
- Age/male sex (29)
- Livestock exposure, especially pigs (25).

Table 4. Summarizing the findings on risk factors/associated factors for MRSA colonization and infection

First author/year	Study period/ search period	Countries	Setting	Population (n)	Screening sites	Number (N) of MRSA patients colonized or infected	MRSA prevalence (%)	Statistics Control group	Risk factors
Forster AJ/ 2013 (17)	1994-2011/ 1950-2011	USA, Switzer-land, Spain, Turkey, Brazil, France, China, Germany, UK, Israel, Japan	Hospitals: All wards included: 10/27 ICU: 8/27 Geriatric: 5/27 Surgical: 2/27 Others: 2/27	n = 68,874 Patients	Nose/ nares: 10/27 Two or more sites: 17/27	n = 2,928	1.2-16.1%	Multi-variable analysis	• Previous admission to hospital • Previous antibiotic use • Patients transferred from nursing home/LTCF
Gesualdo F/ 2013 (20)	2000-2010/ Janu-ary 2000-August 2010	40 studies (all with cross-sectional design) used for the MRSA prevalence analysis: North America: 15 Asia: 12 South America: 2	Community Day care centers Schools Primary care visits Ambulatories Pediatric clinics NICU PICU	Healthy children Children with diseases: Atopic dermatitis Cystic fibrosis Respiratory tract infec-tions HIV etc.	Nose	Not reported	Healthy children: 2.3% Children with underlying medical conditions: 5.2% Prevalence by age: Children < 5 years of age: 2.8%	Multi-variate analysis (10 studies) Univariate analysis (5 studies)	• Premature birth (28 weeks) and low birth weight (1500 g) • Prolonged hospitalization • Family member employed in HCF • Atopic dermatitis • Hospitalization in previous 12 months

First author/year	Study period/ search period	Countries	Setting	Population (n)	Screening sites	Number (N) of MRSA patients colonized or infected	MRSA prevalence (%)	Statistics Control group	Risk factors
		Middle East: 5 Africa: 2 Europe: 4 10 related articles were also included = a total of 50 studies					Children < 28 weeks of age: 6.7% Children in hospitals had a higher pooled colonization prevalence (5.4%) compared with children in the community (3.0%)		
Karanika S/ 2015 (24)	1998-2011/ up to March 2015	10 studies North America: 2 Asia: 6 Europe: 2	Hospital setting	n = 2364 Hemodialysis patients	Nose alone: 7 Two or more screening sites: 3	Not reported	Five of ten studies (n = 1,173 patients) had data on the prevalence of MRSA colonization. Patients with catheters	Pooled relative effects were reported as relative risks (RRs) or odds ratios (ORs)	Risk factors for MRSA colonization in dialysis patients: • Hospitalization within the previous 12 months (OR: 1.93)

First author/year	Study period/ search period	Countries	Setting	Population (n)	Screening sites	Number (N) of MRSA patients colonized or infected	MRSA prevalence (%)	Statistics Control group	Risk factors
							had a 66.2% higher probability of being colonized with MRSA than patients with permanent dialysis access		• Use of temporary dialysis access (RR: 1.66). MRSA carriage was associated with: • Lower serum albumin levels (OR: 0.8) compared to non-carriage • Chronic lung disease comorbidity.
Liu Y/ 2020 (25)	2006-2017/ Janu-ary 1990-June 2018	25 studies North America: 3 Asia: 2 Africa: 1 Europe: 19	Farms with pigs, poultry, cattle, horses, and sheep Slaughter houses	<u>Exposed group:</u> Farm personnel, veterinarians, slaughter workers, and community residents. <u>Non-exposed group:</u>	Not reported	n = 13,628	Livestock exposure versus non-exposure and risk of MRSA carriage on different continents:	Dose-response meta-analysis based on linear and non-linear regression model was used to explore the	Livestock exposure was significantly associated with an increased risk of MRSA carriage (OR= 7.03), and similar positive associations were observed for pig (OR= 11.41), poultry (OR= 6.20), and cattle (OR= 5.66) exposure.

First author/year	Study period/ search period	Countries	Setting	Population (n)	Screening sites	Number (N) of MRSA patients colonized or infected	MRSA prevalence (%)	Statistics Control group	Risk factors
				Family members, community residents, neighboring residents, and non-exposed livestock workers			North America (OR= 1.34), Asia (OR= 6.85), Africa (OR= 2.97), Europe (OR= 9.91)	frequency-risk relation-ship between livestock exposure and MRSA carriage	An increasing frequency-risk relationship between livestock exposure and MRSA carriage was also found.
McKinnell JA/ 2013 (26)	1991-2009/ 1966-2012	29 studies North America: 11 Asia: 4 Australia: 1 Europe: 13	Hospital setting ICU	n = 76.913	Not reported, but scree-ning samples were taken on admission to hospital or ICU	n = 3.512	2-24%	Mantel-Haenszel methods were used to calculate pooled odds ratios, 95% confidence intervals, and p-value associated with each	MRSA colonization at hospital admission was associated with: • Recent prior hospitalization (OR= 2.4) • Nursing home exposure (OR= 3.8) • Exposure to health-care-associated pathogens (MRSA carriage OR= 8.0;

First author/year	Study period/ search period	Countries	Setting	Population (n)	Screening sites	Number (N) of MRSA patients colonized or infected	MRSA prevalence (%)	Statistics Control group	Risk factors
								factor and MRSA coloniza-tion	CDI OR= 3.4; VRE carriage OR= 3.1) Select comorbidities, e.g. diabetes, lung disease, immunosuppression, were associated with MRSA colonization ($p < 0.01$). ICU admission was not associated with an increased risk of MRSA colonization
Rodriguez-Villodres A/ 2021 (29)	1987-2020/ not re-ported	Mainly Europe (n=70) North America (n=41) Asia (n=15) Oceania (n=7) South America (n=1)	Long-term care facilities (not all residents are older adults) and nursing homes	Elderly people	Screening sites not specified for MRSA alone	Not reported	• Europe (9.1%) • Asia (25.6%) • North America (22%) • South America (3.7%) • Oceania (10,0 %) • Overall preva-	Narrative review along with epidemio-logical data	• Age • Male sex • Chronic wounds • Use of medical devices • Previous antibiotic use • DM, cancer, dementia • Previous hospitalization • Previous colonization

First author/year	Study period/ search period	Countries	Setting	Population (n)	Screening sites	Number (N) of MRSA patients colonized or infected	MRSA prevalence (%)	Statistics Control group	Risk factors
							lence: 13.2%		
Washam M/ 2017 (31)	1995-2012/ up to Sep-tember 2015	USA (7) Italy (1) Taiwan (2) Japan (1)	Neonatal ICU	Neonates < 1,500 g and age < 32 weeks	• Nares/ naso-pha-rynx • Umbi-licus • Rec-tum/ peri-neum/f eces • Axilla • Post-auri-cular	n = 1,110	2.1% - 41%	Meta-analysis	• Preterm and very low birth weight • Critically ill neonates

Risk of secondary cases/secondary transmission of MRSA

Only few of the 23 systematic reviews had examined secondary transmission of MRSA. In the study by Zervou et al. (32) concerning neonates and children the pooled acquisition rate of MRSA colonization was 4.1% during NICU/PICU stay and 6.1% during NICU stay alone. The review by Gesualdo el al. (20) found that children recruited in hospitals had a higher MRSA-pooled prevalence estimate of 5.4% compared to children recruited in the community (3%) indicating that transmission of MRSA occurred among children in hospitals. Furthermore, the risk of MRSA colonization was high if a child had a family member or a household contact employed in the health care sector.

In the review of Nellums et al. (28) migrants were overrepresented among individuals with community-associated MRSA (62.7%). Evidence suggested that AMR in general are acquired during migration – in transit or in host countries, and the transmission was mainly seen in transit centers, refugee camps, and asylum centers. There was no evidence of onward transmission by migrants to host populations. Another review by Fulchini et al. (18) also showed high prevalences of MRSA in asylum seekers (21%) and in refugees at refugee centers (16%).

Main findings

Several of the included reviews found that antimicrobial resistance is increasing worldwide comprising MRSA.

In this literature review we found that the prevalence of MRSA colonization was high among refugees at asylum centers (no evidence of high rates of transmission from migrants to host populations however) (28), elderly people at nursing-homes and long-care facilities (22,29) and diabetic patients (higher than among non-diabetics) (30). MRSA colonization in hemodialysis patients was another risk factor (24). High prevalence was also seen among children – especially neonatal children with gestational age < 32 weeks and birth weight < 1,500 g (20). In addition, an increasing frequency-risk relationship between livestock exposure – especially pigs - and MRSA carriage was found (18,25). A single study (18) found an increasing prevalence of MRSA from 2008-2015 (6.6%-12%) in pig farmers. Targeted screening for MRSA in these groups was recommended.

Other risk factors as prolonged hospitalization, and hospitalization within the previous 12 months, dialysis access, comorbidities like cancer, diabetes and lung diseases, previous use of antibiotics, chronic wounds, male sex and use of medical devices (elderly people) are to be mentioned too.

Regarding screening sites, more than one screening site increased detection of MRSA (11,27). If screening was performed of nose alone studies found that 68.2% were detected, nose plus one more body site 89.6% and nose plus two more body sites 94.2% were detected (11). Extra-nasal MRSA screening at hospital or ICU admission in adults increased MRSA detection by one-third compared with nares screening alone (11). The yield was similar at ICU admission and hospital admission in high-prevalence and low-prevalence populations. Furthermore, no screening compared to screening of all hospitalized patients, decreases healthcare associated MRSA-infection (21). Some studies suggest fecal screening as intestinal carriage seems high (12,19).

The main part of screened persons were adult patients admitted to hospitals (mainly acute care, including ICU), newborns in NICU, health care workers (HCWs), residents at nursing homes or long-term care facilities, and asylum seekers/refugees. Time of screening was mainly on admission to hospital/ICU.

Conclusions

In this review, we did not find anything epochal new regarding risk populations, equivalent screening sites, time for screening or risk factors related to MRSA. Two risk factors, however, are worth noting, namely that diabetic patients are more likely to be colonized with MRSA regardless wounds or not (30) and dialysis treatment is associated with a significant high risk (relative risk: 1.66: 95% CI: 1.06-2.60) of MRSA colonization (24). In the Nordic countries, we do not screen diabetic patients nor patients who undergo dialysis treatment, as a matter of routine.

Some studies recommend fecal screening (12,19), but in the Nordic countries we screen from perineum and we assume that the outcome will be the same.

Based on this literature review there is no new evidence suggesting changes to the screening recommendations for MRSA in Denmark and Norway. However, it could be discussed, if diabetic patients should be screened as a matter of routine when admitted to hospital or nursing home/long-term care facility.

Strengths and limitations of this review

Several of the included review studies were of older date and performed in countries where MRSA was endemic. Eleven of the 23 reviews were from Europe but only few reviews included data from the Nordic countries, mainly Sweden, Finland, and Denmark.

Abbreviations

HCW: Health care worker

ICU: Intensive care unit

IPC: Infection prevention and control

LTCF: Long term care facility

MRSA: Methicillin-resistant *Staphylococcus aureus*

NICU: Neonatal intensive care unit

OR: Odds ratio

PICU: Pediatric intensive care unit

RR: Relative risk

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Appendix

Contact person: Mari Molvik

Search: Ragnhild Agathe Tornes

Peer review: Astrid Merete Nøstberg

Duplicate control in EndNote: Before duplicate control: 10,747 (2,953 systematic reviews, 7,794 primary studies)

After duplicate control: 6,539 (1,495 systematic reviews, 5,044 primary studies)

Database: Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions < 1,946 to December 01, 2023>

Date: December 4, 2023

Number of hits: 700 systematic reviews, 3,832 primary studies

1	Methicillin-Resistant Staphylococcus aureus/	20,096
2	(((((met?icillin or methillicin) adj resistan*) or met?icillinresistan* or methillicinresistan*) adj2 ((staphylococcus or S) adj aureus)) or staphylococcal infection? or MRSA).tw,kf.	46,458
3	1 or 2	49,387
4	limit 3 to "reviews (maximizes specificity)"	644
5	Meta-Analysis/ or Network Meta-Analysis/ or ((systematic* adj2 review*) or metaanal* or "meta anal*" or (review and ((structured or database* or systematic*) adj2 search*)) or "integrative review*" or (evidence adj2 review*)).tw,kf,bt.	53,7458
6	4 or (3 and 5)	790
7	exp "Scandinavian and Nordic Countries"/ or "Scandinavians and Nordic People"/ or Netherlands/	294,895
8	(Scandinavi* or nordic or Norway or norwegian? or Norge or Svalbard or Spitsbergen or Jan Mayen or Sweden or swedish or swede? or Sverige or Denmark or danish or Danmark or Finland or finnish or finns or Aland or Aaland or alandi* or aalandi* or Suomi or Iceland or icelandic* or icelander* or "Fa?roe Islands" or fa?roes* or Greenland or Kalaallit Nunaat or Netherland* or Holland or Dutch).tw,cp,in,lg,kf,pl.	398,7468
9	(sykehus* or sjukehus* or ((universitet* or University or univ) adj3 (haukeland or nordnorge or norge* or bergen or stavanger or tromso or tromsoe or trondheim or levanger or gjovik or gjoevik or harstad or lillehammer or narvik or nesna or stord or haugesund or volda or aalesund or alesund)) or ((universitet* or University or univ) adj1 nord) or sentralsjukehus* or sentralsykehus* or Finnmarkssykehuset or	60,408

	Helgelandssykehuset or Nordlandssykehuset or innlandet or "Olav? Hospital?" or revmatismesykehus or lungesykehus or "Hospitalet Betanien" or Kysthospitalet or Aleris or Feiringklinikken or Glittreklinikken or "Hjertesenteret i Oslo" or "Medi 3" or "Volvat Medisinske Senter" or "Helse Vest" or "Helse Stavanger" or "Helse fonna" or "helse bergen" or "helse forde" or "helse foerde" or sjukehusapotek* or sykehusapotek* or "helse midt norge" or "helse midtnorge" or "Ambulanse Midtnorge" or "Ambulanse Midt norge" or "helse nord" or "Helse Sorost" or "Helse Sor ost" or "Helse Soeroest" or "Helse Soer oest" or sunnaas or sunnas or sorlandet or soerlandet).cp,in,tw,kf,pl.	
10	(Akershus or Viken or Austagder or Agder or Buskerud or Finnmark or Hedmark or Hordaland or Romsdal or Nordland or Nordtrondelag or Trondelag or Nordtroendelag or Troendelag or Oppland or Oslo or Rogaland or Fjordane or Sortrondelag or Soertroendelag or Telemark or Troms or Vestagder or Vestfold or Ostfold or Oestfold or Longyearbyen or innlandet or vestland).cp,in,tw,kf,pl.	101,594
11	(sjukhus* or centralsjukhus* or laenssjukhus* or lanssjukhus* or lansdelssjukhus* or laensdelssjukhus* or barnsjukhus* or ungdomssjukhus* or lasarett* or Regionsjukhus* or Narsjukhus* or Naersjukhus* or Specialistsjukhus* or Beckombergasykehuset or "Danvikens hospital" or Konradsberg or "karolinska institute?" or (karolinska adj2 hosp*) or ("astrid lindgren" adj2 hosp*) or sahlgrenska or Radiumhemmet or Sophiahemmet or Sodersjukhuset or Soedersjukhuset or Blekingesjukhuset or Anestesiklinik* or Linneuniversitetet or Mittuniversitetet or "Royal Institute of Technology" or ((Universitet* or universit* or univ) adj2 (norrland* or skaane? or skane? or lindkoping or orebro or lindkoeping or oerebro or lund or lunds or uppsala or gothenborg? or gothenburg? or goteborg? or goteburg? or goethenborg? or goethenburg? or goeteborg? or goeteburg? or umeaa? or umea? or luleaa or lulea or karlstad? or vaxjo or vaexjo or vaxjoe or vaexjoe or kalmar or tekniska or Linnaeus or Chalmers or malmo or malmoe or Malardalen? or Maelardalen? or karolinska))).cp,in,tw,kf,pl.	326,993
12	(Blekinge or dalarna? or gotland or gavleborg? or gaevleborg? or halland or jamtland* or jaemtland* or jonkoping? or joenkoping? or kalmar? or kronoberg? or norbotten or skaane or skane or stockholm? or sodermanland? or soedermanland? or uppsala? or varmland? or vaermland? or vasterbotten? or vaesterbotten? or vasternorrland? or vaesternorrland? or vastmanland? or vaestmanland? or gotaland? or orebro? or "oster gotland?" or goetaland? or oerebro? or "oester gotland?").cp,in,tw,kf,pl.	240,359
13	(sygehus* or ((Universitet* or universit* or hospital* or hosp) adj3 (amager* or Augustenborg* or Bornholm* or farso* or give or herning* or hobro* or koge or koege or oringe* or randers or ringsted* or skagen* or "sct. hans*" or tarm or tonder* or toender* or thisted* or vejle* or viborg* or Aalborg* or aarhus* or Alborg* or arhus*)) or Specialhospital* or Universitetshospital* or Regionshospital* or "Psykiatrisk Cent*" or "Psykoterapeutisk Cent*" or Psykiatricenter* or Kommunehospital* or Centralsygeh* or "Hammel Neurocenter*" or "Vest Ribe*" or Aabenraa* or Abenra* or Aeroskobing* or Aroskobing* or Aeroeskobing* or	258,322

	Aroeskobing* or allerup* or Bispebjerg* or Bronderslev* or Broenderslev* or copenhagen* or Esbjerg* or Fakse or Fredericia* or Frederiksberg* or frederikshavn* or Gentofte* or Glostrup* or Grenaa* or Grena* or Grindsted* or Haderslev* or Herlev* or Hjorring* or Hjoerring* or holbaek* or Holbak* or Holstebro* or Horsens* or hovedstaden* or Hvidovre* or Kalundborg* or kobenhavn* or koebenhavn* or Kolding* or Korsor* or Korsoer* or Lemvig* or Middelfart* or Midtjylland* or Naestved* or Nakskov* or Nastved* or Nordjylland* or Nordsjaelland* or Nordsjalland* or Nykobing* or Nykoebing* or Odense* or Poppelhus* or Rigshospitalet* or Ringkobing* or Ringkoebing* or Risskov* or Roskilde* or Silkeborg* or Sjaelland* or Sjalland* or Skanderborg* or Skejby* or Slagelse* or Sonderborg* or Soenderborg* or Stolpegaard* or Svendborg* or Syddanmark* or sydvestjysk* or Syddansk* or "Tekniske Universitet*" or "IT Universitetet*" or ITUniversitetet* or "aarhus univ*" or "aalborg univ*" or "U of Aarhus*" or "U of aalborg*" or "Univ of Aarhus*" or "Univ of aalborg*" or "arhus univ*" or "alborg univ*" or "U of Arhus*" or "U of alborg*" or "Univ of Arhus*" or "Univ of alborg*").tw,cp,in,kf,pl.	
14	(tidsskrift for den norske laegeforening or lakartidningen or ugeskrift for laeger).jn.	110,377
15	or/7-14	4,020,873
16	3 and 15	5,156
17	16 not 6	5,076
18	limit 6 to yr="2009 -Current"	700
19	limit 17 to yr="2009 -Current"	3,832

Database: Embase <1974 to 2023 December 01>

Date: December 4, 2023

Number of hits: 1243 systematic reviews, 2322 primary studies

1	exp methicillin resistant Staphylococcus aureus/	57,586
2	(((((met?icillin or methillicin) adj resistan*) or met?icillinresistan* or methillicinresistan*) adj2 ((staphylococcus or S) adj aureus)) or staphylococcal infection? or MRSA).tw,kf.	58,372
3	1 or 2	76,569
4	limit 3 to (conference abstracts or embase or "preprints (unpublished, non-peer reviewed)")	68,597
5	limit 4 to "reviews (maximizes specificity)"	755
6	exp Meta-Analysis/ or "systematic review"/ or ((systematic* adj2 review*) or metaanal* or "meta anal*" or (review and ((structured or database* or	772,968

	systematic*) adj2 search*)) or "integrative review*" or (evidence adj2 review*)).tw,kf,bt.	
7	5 or (4 and 6)	1,436
8	exp scandinavia/ or exp north germanic people/ or Netherlands/	322,175
9	(Scandinavi* or nordic or Norway or norwegian? or Norge or Svalbard or Spitsbergen or Jan Mayen or Sweden or swedish or swede? or Sverige or Denmark or danish or Danmark or Finland or finnish or finns or Aland or Aaland or alandi* or aalandi* or Suomi or Iceland or icelandic* or icelander* or "Fa?roe Islands" or fa?roes* or Greenland or Kalaallit Nunaat or Netherland* or Holland or Dutch).in,ad,tw,lg,kf.	2601,846
10	(sykehus* or sjukehus* or ((universitet* or University or univ) adj3 (haukeland or nordnorge or norge* or bergen or stavanger or tromso or tromsoe or trondheim or levanger or gjovik or gjoevik or harstad or lillehammer or narvik or nesna or stord or haugesund or volda or aalesund or alesund)) or ((universitet* or University or univ) adj1 nord) or sentralsjukehus* or sentralsykehus* or Finnmarkssykehuset or Helgelandssykehuset or Nordlandssykehuset or innlandet or "Olav? Hospital?" or revmatismesykehus or lungesykehus or "Hospitalet Betanien" or Kysthospitalet or Aleris or Feiringklinikken or Glittreklinikken or "Hjertesenteret i Oslo" or "Medi 3" or "Volvat Medisinske Senter" or "Helse Vest" or "Helse Stavanger" or "Helse fonna" or "helse bergen" or "helse forde" or "helse foerde" or sjukehusapotek* or sykehusapotek* or "helse midt norge" or "helse midtnorge" or "Ambulanse Midtnorge" or "Ambulanse Midt norge" or "helse nord" or "Helse Sorost" or "Helse Sor ost" or "Helse Soeroest" or "Helse Soer oest" or sunnaas or sunnas or sorlandet or soerlandet).in,ad,ti,ab,kf.	90,083
11	(Akershus or Viken or Austagder or Agder or Buskerud or Finnmark or Hedmark or Hordaland or Romsdal or Nordland or Nordtrondelag or Trondelag or Nordtroendelag or Troendelag or Oppland or Oslo or Rogaland or Fjordane or Sortrondelag or Soertroendelag or Telemark or Troms or Vestagder or Vestfold or Ostfold or Oestfold or Longyearbyen or innlandet or vestland).in,ad,ti,ab,kf.	152,895
12	(oslonorway or bergennorway or sandnesnorway or stavangernorway or trondheimnorway or tromsonorway or tromsoenorway or Akershusnorway or Vikennorway or Austagdernorway or Agdernorway or Buskerudnorway or Finnmarknorway or Hedmarknorway or Hordalandnorway or Romsdalnorway or Nordlandnorway or Nordtrondelagnorway or Nordtroendelagnorway or Trondelagnorway or Troendelagnorway or Opplandnorway or Rogalandnorway or Fjordanenorway or Sortrondelagnorway or Sortroendelagnorway or Telemarknorway or Tromsnorway or Vestagdernorway or Vestfoldnorway or Ostfoldnorway or Oestfoldnorway or innlandetnorway or vestlandnorway).in,ad,ti,ab,kf.	702
13	(sjukhus* or centralsjukhus* or laenssjukhus* or lanssjukhus* or lansdelssjukhus* or laensdelssjukhus* or barnsjukhus* or ungdomssjukhus* or lasarett* or Regionsjukhus* or Narsjukhus* or Naersjukhus* or Specialistsjukhus* or	472,881

	Beckombergasykehuset or "Danvikens hospital" or Konradsberg or "karolinska institute?" or (karolinska adj2 hosp*) or ("astrid lindgren" adj2 hosp*) or sahlgrenska or Radiumhemmet or Sophiahemmet or Sodersjukhuset or Soedersjukhuset or Blekingesjukhuset or Anestesiklinik* or Linneuniversitetet or Mittuniversitetet or "Royal Institute of Technology" or ((Universitet* or universit* or univ) adj2 (norrland* or skaane? or skane? or lindkoping or orebro or lindkoeping or oerebro or lund or lunds or uppsala or gothenborg? or gothenburg? or goteborg? or goteburg? or goethenborg? or goethenburg? or goeteborg? or goeteburg? or umeaa? or umea? or luleaa or lulea or karlstad? or vaxjo or vaexjo or vaxjoe or vaexjoe or kalmar or tekniska or Linnaeus or Chalmers or malmo or malmoe or Malardalen? or Maelardalen? or karolinska))).in,ad,ti,ab,kf.	
14	(Blekinge or dalarna? or gotland or gavleborg? or gaevleborg? or halland or jamtland* or jaemtland* or jonkoping? or joenkoping? or kalmar? or kronoberg? or norbotten or skaane or skane or stockholm? or sodermanland? or soedermanland? or uppsala? or varmland? or vaermland? or vasterbotten? or vaesterbotten? or vasternorrland? or vaesternorrland? or vastmanland? or vaestmanland? or gotaland? or orebro? or "oster gotland?" or goetaland? or oerebro? or "oester gotland?").in,ad,ti,ab,kf.	359,954
15	(norrlandsweden or skaanesweden or skanesweden or lindkopingsweden or lindkoepingsweden or orebrosweden or oerebrosweden or lundsweden or uppsalasweden or gothenborgsweden or gothenburgsweden or goteborgsweden or goteburgsweden or goethenborgsweden or goethenburgsweden or goeteborgsweden or goeteburgsweden or umeaasweden or umeasweden or luleaasweden or luleasweden or karlstadsweden or vaxjosweden or vaexjosweden or vaxjoesweden or vaexjoesweden or kalmarsweden or malmosweden or malmoesweden or Malardalensweden or Maelardalensweden or Blekingesweden or dalarnasweden or gotlandsweden or gavleborgsweden or gaevleborgsweden or hallandsweden or jamtlandsweden or jaemtlandsweden or jonkopingsweden or joenkopingsweden or kalmarsweden or kronobergsweden or norbottensweden or stockholmsweden or sodermanlandsweden or soedermanlandsweden or uppsalasweden or varmlandsweden or vaermlandsweden or vasterbottensweden or vaesterbottensweden or vasternorrlandsweden or vaesternorrlandsweden or vastmanlandsweden or vaestmanlandsweden or gotalandsweden or goetalandsweden or orebrosweden or oerebrosweden or gotlandsweden or Vasteraassweden or Vaesterassweden or helsingborgsweden or norrkopingsweden or norrkoepingsweden).in,ad,ti,ab,kf.	2,033
16	(sygehus* or ((Universitet* or universit* or hospital* or hosp) adj3 (amager* or Augustenborg* or Bornholm* or farso* or give or herning* or hobro* or koge or koege or oringe* or randers or ringsted* or skagen* or "sct. hans*" or tarm or tonder* or toender* or thisted* or vejle* or viborg* or Aalborg* or aarhus* or Alborg* or arhus*)) or Specialhospital* or Universitetshospital* or Regionshospital* or "Psykiatrisk Cent*" or "Psykoterapeutisk Cent*" or Psykiatricenter* or Kommunehospital* or Centralsygeh* or "Hammel Neurocenter*" or "Vest Ribe*" or Aabenraa* or Abenra* or Aeroskobing* or	387,478

	Aroskobing* or Aeroeskobing* or Aroeskobing* or allerup* or Bispebjerg* or Bronderslev* or Broenderslev* or copenhagen* or Esbjerg* or Fakse or Fredericia* or Frederiksberg* or frederikshavn* or Gentofte* or Glostrup* or Grenaa* or Grena* or Grindsted* or Haderslev* or Herlev* or Hjorring* or Hjoerring* or holbaek* or Holbak* or Holstebro* or Horsens* or hovedstaden* or Hvidovre* or Kalundborg* or kobenhavn* or koebenhavn* or Kolding* or Korsor* or Korsoer* or Lemvig* or Middelfart* or Midtjylland* or Naestved* or Nakskov* or Nastved* or Nordjylland* or Nordsjaelland* or Nordsjalland* or Nykobing* or Nykoebing* or Odense* or Poppelhus* or Rigshospitalet* or Ringkobing* or Ringkoebing* or Risskov* or Roskilde* or Silkeborg* or Sjaelland* or Sjalland* or Skanderborg* or Skejby* or Slagelse* or Sonderborg* or Soenderborg* or Stolpegaard* or Svendborg* or Syddanmark* or sydvestjysk* or Syddansk* or "Tekniske Universitet*" or "IT Universitetet*" or ITUniversitetet* or "aarhus univ*" or "aalborg univ*" or "U of Aarhus*" or "U of aalborg*" or "Univ of Aarhus*" or "Univ of aalborg*" or "arhus univ*" or "alborg univ*" or "U of Arhus*" or "U of alborg*" or "Univ of Arhus*" or "Univ of alborg*").in,ad,ti,ab,kf.	
17	(amagerdenmark or Augustenborgdenmark or Bornholmdenmark or farsodenmark or farsoedenmark or givedenmark or herningdenmark or hobrodenmark or kogedenmark or koegedenmark or oringedenmark or randersdanmark or ringsteddenmark or tarmdenmark or thisteddenmark or tonderdenmark or toenderdenmark or Vejledanmark or viborgdenmark or Aalborgdenmark or aarhusdenmark or Alborgdenmark or arhusdenmark).in,ad,ti,ab,kf.	323
18	(tidsskrift for den norske laegeforening or tidsskrift for den norske laegeforening tidsskrift for praktisk or tidsskrift for den norske laegeforening tidsskrift for praktisk medicin ny raekke or Norsk Epidemiologi or lakartidningen or ugeskrift for laeger).jn.	94,352
19	or/8-18	2,648,995
20	4 and 19	3,279
21	20 not 7	3,185
22	limit 7 to yr="2009 -Current"	1,243
23	limit 21 to yr="2009 -Current"	2,322

Database: **Cochrane Database of Systematic Reviews**

Issue 11 of 12, November 2023

Cochrane Central Register of Controlled Trials

Issue 11 of 12, November 2023

Date: December 4, 2023

Number of hits: 16 systematic reviews, 12 primary studies

#1	[mh ^"Methicillin-Resistant Staphylococcus aureus"]	299
#2	((("methicillin resistant" or "meticillin resistant" or "methicillin resistance" or "meticillin resistance" or "methillicin resistant" or "methillicin resistance" or meticillinresistan* or methicillinresistan* or methillicinresistan*) NEAR/2 ("staphylococcus aureus" or "S aureus")) or (staphylococcal NEXT infection?) or MRSA):ti,ab	1,493
#3	#1 or #2	1,524
#4	[mh "Scandinavian and Nordic Countries"] or [mh ^"Scandinavians and Nordic People"] or [mh Netherlands]	12,717
#5	(Scandinavi* or nordic or Norway or norwegian? or Norge or Svalbard or Spitsbergen or "Jan Mayen" or Sweden or swedish or swede? or Sverige or Denmark or danish or Danmark or Finland or finnish or finns or Aland or Aaland or alandi* or aalandi* or Suomi or Iceland or icelandic* or icelander* or "Faroe Islands" or "Faeroe Islands" or fa?roes* or Greenland or "Kalaallit Nunaat" or Netherland* or Holland or Dutch):ti,ab	32,485
#6	#4 or #5	42,259
#7	#3 and #6	17
#8	#3 with Cochrane Library publication date Between Jan 2009 and Dec 2023, in Cochrane Reviews	16
#9	#3 and #6 with Publication Year from 2009 to 2023, in Trials	12

Database: **Web of Science Core Collection**

- WOS.SCI: 1987 to 2023

- WOS.AHCI: 1987 to 2023

- WOS.ESCI: 2018 to 2023

- WOS.SSCI: 1987 to 2023

Date: December 5, 2023

Number of hits: 570 systematic reviews, 1486 primary studies

1	TS=(((((met$icillin or methillicin) NEAR/0 resistan*) or met$icillinresistan* or methillicinresistan*) NEAR/1 ((staphylococcus or S) NEAR/0 aureus)) or "staphjylococcal infection$" or MRSA)	Exact search	4,1703
2	TS=(("systematic*" NEAR/1 "review*") or ("review" and (("structured" or "database*" or "systematic*") NEAR/1 "search*")) or "integrative review*" or ("evidence" NEAR/1 "review*")) OR	Exact search	598,031

	TI=("metaanal*" or "meta anal*") OR AB=("metaanal*" or "meta anal*")		
3	#1 AND #2	Exact search	612
4	#1 AND (CU==("NORWAY" OR "SWEDEN" OR "DENMARK" OR "FINLAND" OR "ICELAND" OR "NETHERLANDS"))	Exact search	1,992
5	#4 not #3	Exact search	1,959
6	#3 Timespan: 2009-01-01 to 2023-12-31	Exact search	570
7	#5 Timespan: 2009-01-01 to 2023-12-31	Exact search	1,486

Database: **Epistemonikos**

Date: December 5, 2023

Number of hits: 424 systematic reviews, 142 primary studies

Title/abstract: ("methicillin resistant staphylococcus aureus" or "meticillin resistant Staphylococcus aureus" or "Staphylococcus aureus methicillin resistant" or "Staphylococcus aureus methicillin−resistant" or "methillicin resistant Staphylococcus aureus" or "staphylococcal infection" or "staphylococcal infections" or MRSA)

Publication type: Systematic Review

Publication year: Custom year range from: 2009 to: 2023

424 hits

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