NHS National Services Scotland

Patient and Resident Placement for Isolation and Cohorting Literature Review

V3.0

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Antimicrobial Resistance & Healthcare Associated Infection (ARHAI) Scotland
An NHS Scotland Assure Service

Version history

Version	Date	Summary of changes
1.0	September 2018	Patient placement SICPs and TBPs review were amalgamated and updated using a double reviewer methodology. Term ‘isolation room/suite’ changed to ‘enhanced single room’ to align with Scottish guidance. Additional recommendation on protective isolation and the placement of patients receiving haemodialysis added.
2.0	October 2021	Updated after review of current literature. New research question included on patient placement in an enhanced single room with a positive-pressure ventilation lobby room. Grading of recommendations updated to include new system based on HICPAC grading.
3.0	March 2026	Three-year update of the Literature Review. • Updated using a new methodology as outlined in the development process. • Databases were searched for evidence published between 2000 and 2023. • Search strategies added as Appendix 2 • The Question set was reviewed and consolidated into four questions. • Technical questions related to the design elements of patient areas, such as minimum standards for spacing and the provision of hygiene facilities, were removed as they fall under the purview of Health Facilities Scotland. One new research question was added. • How should patients or residents be assessed for infection risk prior to discontinuing isolation and cohorting?

Approvals

Version	Date Approved	Group/Individual
1.0	September 2018	National Policies, Guidance and Outbreaks Steering Group
2.0	October 2021	National Policies, Guidance and Outbreaks Steering Group
3.0	January 2026	National Policy Guidance and Evidence Working Group (NPGE)
		Care Home Infection Prevention and Control Working Group (CHIPC)

Key information

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Document information

Document information	Description
Description:	This literature review examines the available professional literature on patient and resident placement for isolation and cohorting in the health and care setting.
Purpose:	To inform the transmission-based precautions sections on patient placement in the National Infection Prevention and Control Manual and the Care Home Infection Prevention and Control Manual, to facilitate the prevention and control of healthcare-associated infections in NHS Scotland health and care settings.
Target Audience:	All NHS staff involved in the prevention and control of infection in NHS Scotland.
Update/review schedule:	Updated as new evidence emerges, with changes made to recommendations as required. Review will be formally updated every 3 years, with the next review in 2029.
Cross-reference:	National Infection Prevention and Control Manual Care Home Infection Prevention and Control Manual
Update level:	Practice – The implications for practice are formulated based on a review of the available professional scientific literature on the infection prevention and control (IPC) aspects/impacts of patient and resident placement for isolation and cohorting in health and care settings. Research – The implications for research are formulated based on a review of the available professional, scientific literature on the infection prevention and control (IPC) aspects/impacts of

Document information	Description
	patient and resident placement for isolation and cohorting in health and care settings.

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Abbreviation list

Acronym	Definition
ACH	Air Changes per Hour
AGREE	Appraisal of Guidelines for Research and Evaluation
AGP	Aerosol generating procedure
AIIR	Airborne Infection Isolation Room
CDC	US Centers for Disease Control and Prevention
CDI	*Clostridioides difficile* infection
CPE	Carbapenemase-producing enterobacteriales
ECDC	European Centre for Disease Prevention and Control
ED	Emergency Department
EPIR	Expedient Patient Isolation Room
GDH	Glutamate dehydrogenase
HAI	Healthcare-associated infection
HCWs	Healthcare Workers
HEPA	High Efficiency Particulate Arresting
ICU	Intensive care unit
iGAS	Invasive group A streptococcus
IPC	Infection Prevention and Control
IRR	Incidence Rate Ratio
MDRO	Multi-drug-resistant organism
MDR-TB	Multi-Drug-Resistant Tuberculosis
MERS CoV	Middle East Respiratory Syndrome Coronavirus
MRSA	Methicillin-Resistant *Staphylococcus aureus*
NAAT	Nucleic Acid Amplification Test
NI	Nosocomial infection
NICE	National Institute for Health and Care Excellence

Acronym	Definition
NPIR	Negative Pressure Isolation Room
PPIR	Positive Pressure Isolation Room
PPVL	Positive pressure ventilated lobby
RT-PCR	Reverse Transcriptase – Polymerase Chain Reaction
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus
SIGN50	Scottish Intercollegiate Guidelines Network (Publication No. 50)
TB	Tuberculosis
UKHSA	United Kingdom Health Security Agency
VHF	Viral haemorrhagic fever
VRE	Vancomycin-Resistant Enterococcus
VREfm	Vancomycin-Resistant *Enterococcus faecium*
WHO	World Health Organization

Contents

1 Objective

The aim is to review the extant scientific literature regarding patient placement for isolation and cohorting in health and care settings to inform evidence-based recommendations for practice. The specific research questions of the review are:

1. How should patients or residents be assessed for infection risk prior to placement within the health and care setting?
2. What different types of isolation areas are there, and when should patients or residents be placed in these areas?
3. What is a cohort area, and when should patients or residents be placed in these areas?
4. What is staff cohorting, and when should it be implemented?
5. How should patients or residents be assessed for infection risk prior to discontinuing isolation and cohorting?

2 Methodology

This targeted literature review was produced using a defined systematic methodology as described in the National Infection Prevention and Control Manual: Development Process.

In addition to the exclusion criteria outlined in the development process, the following exclusion criteria were used in this review.

- Studies or guidance were excluded if they compared types of diagnostic testing.

Initial database searches were done on August 20, 2024, with supplementary searches on October 17, 2024. The complete search strategy is provided in Appendix 1.

Grey literature searches were done between 20 August and 20 September 2024 and included documents published in or after 2021. For research question 5, however, the search was extended to guidelines or guidance published in or after 2000, as the question was new.

Definitions for grades of evidence are provided in Appendix 2.

A PRISMA flowchart is presented in Appendix 3 and was adapted from: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group.[1] Discussion

3 Implications for practice

3.1 How should patients or residents be assessed for infection risk prior to placement within the health and care setting?

Twenty-four pieces of evidence were included for this research question.[2-25] Three of these were carried over from the last version of this review.[22, 23, 25]

Two guidelines graded AGREE 'Recommend with modifications' were included.[19, 20]

Two documents published by the Scottish Government were graded 'mandatory'.[22, 25] Twenty guidance documents were graded SIGN 50 Level 4 expert opinion.[2-18, 21, 23, 24] This class of evidence presents a potential risk of bias due to its unclear methodology and the lack of supporting evidence for its recommendations.

Symptom-based triage

The evidence is consistent (16 out of 24) that some form of symptom-based assessment of infection risk is required to inform placement.[2, 4-12, 15, 16, 18-20, 23] This evidence includes two COVID-19-specific guidelines graded AGREE II 'Recommend with modifications'.[19, 20] There is a more recent edition of one of these documents available – a World Health Organization (WHO) guideline graded AGREE II 'Recommend with modifications'. The version of the guideline included is the one in which the recommendations relevant to this review were initially made (and details of the methodology included), and no updates to these recommendations have been made in the more recent edition.[20] Eleven documents discuss symptom-based triage as a prelude to diagnostic testing.[4-9, 11, 18-20, 23] Seven of these are specific to SARS-CoV-2,[4-8, 19, 20] with one each for *Clostridioides difficile* infections (CDI),[23] multidrug-resistant organisms (MDROs),[11] influenza,[9] and mpox.[18] The symptoms of interest differ according to the infectious agent involved. For example, the CDI guidance document, graded as SIGN 50 level 4 expert opinion, recommends prompt testing for *C. difficile* in stool samples for each case of nosocomial diarrhoea and for patients admitted to the hospital with diarrhoea acquired outside.[23]

Other criteria for triage

Other criteria to be considered in assessing infection risk before placement were also identified within the evidence. This includes the Scottish Government's mandatory policy for CPE admission screening based on previous CPE positivity, prior admission to a hospital outside Scotland, or exposure to a case.[22] These criteria were reinforced and labelled mandatory by a more recent Scottish Government document published in 2017.[25] Other criteria identified in the evidence base include:

- immunosuppression or immunocompromise [10, 12]
- international travel [4, 10, 11, 16, 24]
- contact with animals [4]
- treatment in an overseas hospital [3, 11, 21, 22]
- transfer from another health facility where there have been known cases [3, 13]
- vaccination status [8, 10, 15]
- exposure to case(s) [5, 10, 19, 22]
- membership of an under-vaccinated population group [24]
- previous positive test for an MDRO [10, 22]
- presence of a long-term indwelling catheter or in situ endotracheal tubes [11]
- wounds or breaks in the skin [10, 11]
- patient is a neonate [11]
- patient has an increased risk of complications [8]

Location for assessment

Five pieces of evidence contained provisions on where patient assessment should occur before placement.[4, 9, 15, 16, 20] Of these five, three are specific to acute respiratory infections - one for influenza[9] and two for SARS-CoV-2,[4, 20] and one each for avian flu[16] and measles.[15]

Virtual assessment

Three pieces of evidence, all graded SIGN 50 Level 4, recommend some form of virtual consultation to assess risk before placement. The documents are specific for

influenza,[9] measles,[15] and acute respiratory infections[4] in primary care and outpatient settings. They recommend that suspected patients be assessed by phone before visiting a primary care facility.[4, 9, 15] However, if this is not possible or the patient presents in the clinical setting before any suspicion of infection is raised, they should be isolated upon arrival and assessed accordingly.[4] The measles-specific document notes that ambulance services should pre-alert the receiving facility when a patient with suspected measles is brought in to ensure that the patient is admitted directly to a side room or segregated area.[15]

Assessment at first contact

Three documents, two guidance documents graded SIGN 50 level 4 expert opinion specific to influenza,[9] and measles[15] as well as a COVID-19-specific guideline[20] graded AGREE II 'Recommend with modifications', state that patients should be assessed on arrival at the entrance or reception. The COVID-19-specific guideline, developed by the WHO during the COVID-19 pandemic, states that all persons should be screened at the first point of contact in a healthcare facility, followed by immediate isolation if necessary.[20]

Continuous review

Two SIGN 50 level 4 expert opinion guidance, one specific to measles in healthcare settings[15] and the other to COVID-19 in adult social care,[10] recommend that this assessment be continuously reviewed throughout their stay in a healthcare facility or the period of use of the social care service.

Conclusion

Extant guidance advises that assessment of patient infection risk should be guided by a risk assessment that considers: symptom presentation, patient status (immune status, age, wounds, breaks in skin, in-situ indwelling medical devices), travel history, past potential exposures (including prior overseas healthcare or treatment in a facility with known exposure risk, exposure to infectious persons or animals) vaccination status, and previous positive test results. Extant guidance also advises that patients suspected of being infected should be assessed virtually or by phone before presenting at a facility. If this is not possible, such patients should be isolated on arrival and evaluated accordingly.

3.2 What different types of isolation areas are there, and when should patients or residents be placed in these areas?

Forty-nine pieces of evidence were included for this research question.[2-7, 9, 10, 12, 13, 15-18, 20, 21, 23, 24, 26-56] Six of these were carried over from the last version of this review.[23, 46-50]

Five guidelines were included. One was graded AGREE 'Recommend',[26] and four were graded AGREE 'Recommend with modifications'.[20, 27, 28, 55] Some limitations of the latter category include unclear links to evidence[20] and the non-availability of high-quality evidence to support the recommendations concerning patient placement.[27, 55]

Four primary research studies were included. One retrospective cohort study, graded SIGN 50 level 2+, [47] and three studies graded SIGN 50 level 3: a before-and-after study,[48] and two interrupted time series.[46, 53]

All other documents (n = 40) were guidance documents graded SIGN 50 Level 4 expert opinion.[2-7, 9, 10, 12, 13, 15-18, 21, 23, 24, 29-45, 49-52, 54, 56]

Types of isolation areas

Within the evidence base, two broad isolation areas were identified: specialised ventilated isolation facilities[2, 4-6, 15, 16, 18, 26, 29, 30, 33, 34, 36, 41-43, 45, 49-52, 54-56] and single rooms[2-7, 9, 13, 15-18, 20, 23, 26-36, 38, 40-42, 44, 50, 51, 55] with several variations.

Specialised ventilated isolation facilities

Specialised ventilated isolation facilities were identified in one form or another in 23 pieces of evidence.[2, 4-6, 15, 16, 18, 26, 29, 30, 33, 34, 36, 41-43, 45, 49-52, 54-56] These forms include:

- Negative Pressure Isolation Rooms/Suites (NPIR) [2, 4-6, 15, 16, 18, 26, 29, 30, 33, 34, 36, 41-43, 49, 51, 52, 54-56]
- High-level isolation units (HLIU)[56]
- Expedient patient isolation rooms (EPIR).[45]
- enhanced single rooms with ensuite facilities and a ventilated lobby,[50]
- Positive pressure ventilated lobby isolation suites (PPVL),[52, 54]

- Positive Pressure isolation rooms (PPIR)[49, 52, 54]

Three pieces of evidence, all graded SIGN 50 level 4, define specialised ventilated isolation facilities. Two Health Building Notes (HBN) (from NHS England[52] and the Department of Health[51]), and an Irish Standard, use the term 'isolation rooms'.[50] They are generally defined as facilities designed with ventilation systems that control the direction of airflow to prevent the entry or escape of airborne pathogens or infectious aerosols. These systems aim to minimise the risk of airborne transmission by regulating air movement into and out of the isolation area.[50-52] The Irish Standard and HBN 00-09[50, 51] specify that such facilities must be ensuite, whilst the HBN 04-01 supplement 1 provides a broader scope, including isolation facilities without ensuite facilities, which it notes can be used when the patient is not ambulant.[52] HBN 00-09 also describes a special ventilated isolation suite as a room with a lobby.[51]

Within these systems, the volume of air delivered and/or removed dilutes the contaminated air, and maintains the desired pressure differential between the room and the surrounding areas.[52] HBN 04-01 Supplement 1 advises that, if properly designed and correctly operated, isolation against airborne pathogens will be maintained even when a door is opened, as long as the doors between the lobby and corridor, and bedroom and corridor are not open at the same time. However, no evidence was cited to support this.[52]

Negative Pressure Isolation Rooms (NPIRs)

Negative pressure isolation rooms are also referred to within the literature as Airborne Infection Isolation Rooms (AIIRs). The WHO defines them as "rooms with high ventilation rate and controlled direction of airflow that can be used to contain airborne infections and acute respiratory infections caused by a novel agent with the potential to pose a public health risk".[55] Three American guidance documents, all graded SIGN 50 level 4, describe them as single-patient rooms maintained at continuous negative pressure relative to the surrounding areas, with a minimum of 12 air changes per hour (ACH). An allowance of at least 6 ACH is permitted if the room was constructed or last renovated before 1997.[6, 43, 49] Two British documents also graded SIGN 50 level 4, provide a similar description but recommend 10 air changes per hour (ACH) compared to a minimum of 12 ACH required by the three American documents and by the WHO for facilities constructed or renovated after 1997.[52, 54 55]

Another area of inconsistency was the room's pressure relative to the surrounding areas. While guidance is generally consistent in advising that the NPIRs must be maintained at negative pressure relative to the surrounding areas, including the lobby (if it has one) and the corridor, differing pressure values are advised. The documents from the USA[2, 49] recommend a negative pressure of -2.5 pascals (Pa) relative to the corridor, while HBN 04-01 recommends -5 Pa relative to the corridor and -10 Pa relative to the lobby.[52]

Although extant guidance is consistent on what constitutes a negative pressure isolation room, it is referred to by various terminology. These include AIIRs,[2, 5, 6, 18, 29, 30, 33, 41-43, 49, 55] isolation rooms with an anteroom and negative pressure,[36] respiratory isolation rooms with negative pressure (with ensuite facilities),[4, 15, 16] airborne isolation room,[34] negative pressure room,[26] and negative pressure isolation suite.[52, 54] Documents from the USA,[2, 6, 18, 33, 43, 45, 49] Canada,[29, 30, 42] and New Zealand[5, 41] tend to favour 'AIIR'. In contrast, documents from the UK[15, 16, 26, 51, 52, 54] use the terms 'isolation room or suite' with added descriptors. Within this review, going forward, mentions of isolation rooms with negative pressure will be classified as negative pressure isolation rooms (NPIRs).

Three guidance documents[36, 49, 52] state that NPIRs should have a lobby or anteroom, but one of these – an American guidance – discusses it in terms that suggest they are preferred but not essential.[49] HBN 04-01 Supplement 1, recommends that NPIRs have a positive pressure lobby, into which clean air will be supplied and transferred into the bedroom via an above-door pressure stabiliser.[52] It also notes that air supply in a typical-sized lobby will result in an excess of 60 ACH, which will rapidly dilute and remove airborne contaminants shed during PPE doffing.[52] This dilution is also suggested by the American guidance, which recommends using industrial-grade HEPA filters in the patient's room to provide additional ACH if anterooms are not available.[49] The document, in its narrative, also notes that anterooms for NPIRs can have a positive or negative pressure differential with consequences for PPE use.[49] If the anteroom is negative relative to the patient's room and corridor, HCWs must mask before entering the anteroom; however, if the pressure is positive relative to the patient's room, masking is not necessary before entry provided that air is directly exhausted to the outside, and a minimum of 10 ACH is maintained.[49] Guidance from the ECDC on the investigation protocol for

exposures and cases of avian influenza, states that placement in an NPIR with an anteroom is preferred for cases who require hospitalisation.[36]

Three guidance documents recommend that air from NPIRs be exhausted directly outside, or, if recirculated, filtered through a high-efficiency particulate air (HEPA) filter.[2, 6, 49] A Scottish document graded SIGN 50 level 4, SHTM 03-01 notes that while extracted air from NPIRs do not normally need to be filtered, filtration is required if the air cannot be exhausted into a safe location i.e. the exhausted air could be drawn back into the building or there are people in the vicinity where the air is exhausted into.[54]

Guidance is consistent that room doors should be closed except for entry and exit, and that room pressure should be monitored and documented.[2, 6, 49] CDC guidance recommends installing self-closing devices in NPIR exit doors.[49] Three documents[49, 51, 54] recommend that windows in NPIRs should be appropriately sealed; one of them specifies that the windows should be unopenable.[51]

One document from the United States, graded SIGN 50 level 4, also provides recommendations regarding makeshift NPIRs that may be created during outbreaks involving a large number of patients.[2] It specifies that infectious patients be cohorted in a designated area of the facility, utilising temporary, portable solutions such as exhaust fans to create negative pressure. The contaminated air is discharged directly outside, away from people and air intakes, or directed through HEPA filters before being released into other areas.[2]

Indications for placement in an NPIR

Twenty SIGN 50 level 4 guidance documents[2, 4-6, 15, 16, 18, 29, 30, 33, 34, 36, 41-43, 45, 49-52] and two guidelines, one graded AGREE 'Recommend'[26] and the other graded AGREE 'Recommend with modifications'[55] provide evidence regarding the indications for placement in an NPIR. The two key indications are the containment of persons with known or suspected infections caused by infectious agents spread through the airborne route, and aerosol-generating procedures (AGPs).

Extant guidance is consistent that NPIRs should be used as an airborne precaution for source isolation, that is, to contain persons with known or suspected airborne infectious diseases in hospital settings to protect other patients and hospital staff. [2, 41, 45, 49-52, 55] These documents generally do not specify the types of airborne

infections that require an NPIR. However, the specific examples provided show a predilection for high-impact infections, as shown in the paragraph below. This is explicitly stated by a WHO guideline, graded AGREE 'recommend with modifications', and an ECDC guidance on IPC practices for respiratory viral infections in healthcare settings, graded SIGN 50 level 4, which states that NPIRs should be used for respiratory infections with pandemic potential or high impact or which pose a public health risk.[4, 55] The ECDC document also lists MERS-CoV and avian influenza as examples of such infections.[4]

Eight guidance documents[2, 4, 5, 15, 16, 33, 36, 43] and two guidelines[26, 55] specify using an NPIR for patients suspected or confirmed to be infected with a specific infectious agent. This includes the following: Andes virus,[2] Nipah virus,[2] Avian influenza,[4, 16, 36] MERS-CoV,[4, 43] novel influenza A viruses,[33] measles (within hospital settings),[15, 55] SARS-CoV-2,[5] smallpox,[49] varicella zoster virus in mpox patients,[55] and multi-drug-resistant TB.[26] Four of these documents (covering MERS-CoV, measles, and avian influenza) note that prioritisation for isolation in single rooms is acceptable if NPIRs are unavailable.[4, 15, 16, 36]

A UK guideline published by NICE, graded AGREE 'Recommend', advises the placement of MDR-TB patients in an NPIR. This guideline advises that patients be transferred to another hospital with NPIRs if none are available locally.[26]

The other major indication for NPIRs is for patients with suspected or confirmed airborne infections that require aerosol-generating procedures (AGPs).[4-6, 18, 29, 30, 34, 42, 55] This represents the only indication for NPIR placement of mpox patients within the identified evidence.[18, 34, 42] A guidance document published by the Public Health Agency of Canada (PHAC), and graded SIGN 50 level 4, notes that the recommendation for placing mpox patients in NPIRs had been removed in the most recent update, except when AGPs are to be performed.[42] This is also echoed by a WHO guideline graded AGREE 'Recommend with modifications', which recommends that AGPs for mpox patients be performed in an NPIR.[55] And of the four[5, 6, 29, 30] SARS-CoV-2-specific guidance recommending NPIRs, three[6, 29, 30] recommend them only for AGPs.

A CDC expert opinion guidance, graded SIGN 50 Level 4, also recommends placing patients with viral haemorrhagic fevers (VHF) in NPIRs (preferably those with

anterooms). The document notes that although no evidence has been advanced for airborne transmission of VHF, it is prudent to isolate patients in NPIRs to reduce the risk of exposure to aerosolised infectious agents in blood, liquid stool, respiratory secretions and vomitus.[49] This is echoed in a British guidance documents graded SIGN 50 level 4.[56]

An Irish standards document, graded SIGN 50 level 4, notes that having arrangements in place to isolate patients with suspected or confirmed communicable disease, including HAI and colonisation with an MDRO, in an isolation room (or single room or cohort area), is one of the features that shows that a service is meeting the standard.[50]

The CDC guidance document also advises that immunocompromised patients with an airborne infection (such as TB or acute varicella-zoster virus) should be placed in NPIRs if bespoke isolation settings (see PPVL isolation suites below) are not available.[49] It is recommended that industrial-grade HEPA filters be used to enhance spore filtration in such situations.[49]

High-Level Isolation Units (HLIU)

A SIGN 50 level 4 guidance published in the UK discusses the use of HLIUs.[56]

The primary indication for placement in an HLIU is the containment of patients with confirmed infection with an ACDP hazard group 4 VHF.[56] The guidance provides two options for caring for patients with VHF. The first is the use of a negative-pressure patient isolator ('Trexler') within a negative-pressure isolation suite. The Trexler is a bed isolator that provides a physical barrier between the patient and the environment, utilising a flexible film and an air barrier to create a negative-pressure environment, which minimises contamination of the isolation suite as all body fluids are contained within the isolator. Exhaust air within the isolator, as is the air from the isolation suite, is HEPA filtered, providing double HEPA filtration. Access to the patient in the isolator is via in-built access portholes within the flexible film. The guidance notes that although everyday theatre scrubs and gloves should be used when necessary, additional PPE is not required if patients are cared for in an isolator.[56]

The second option is simply caring for the patient in a negative-pressure isolation suite (without an isolator). This option requires the use of a complete ensemble of

PPE/RPE for HCID and should only be used by staff who are trained and competent in the use of this type of PPE.[56]

The guidance also recommends that, in exceptional circumstances when it is inappropriate to transfer an unwell infectious VHF patient to an HLIU, they may be placed in an isolation room set at negative pressure, preferably with a ventilated lobby set at positive pressure to the corridor and the isolation room.[56]

Expedient Patient Isolation Room (EPIR)

The EPIR approach creates a high-ventilation-rate inner isolation zone, encompassing the space immediately surrounding the bed of an infected patient, within a larger ventilated zone. A HEPA filtration system is located between both zones.[45] The inner zone is created using a floor-to-ceiling retractable curtain surrounding the patient bed. The filtration system captures contaminated air from the inner zone, cleans it, and then discharges it into the outer zone — a situation designed to maintain a negative pressure in the inner zone relative to the outer one.[45] This was described in a CDC document graded SIGN 50 Level 4, which also states that with a HEPA system able to provide greater than 12 ACH to the overall patient room, the air cleaning is equivalent to an NPIR with an even higher air cleaning within the inner zone.[45]

The indications for placement in an EPIR are the same as those for NPIRs. The CDC recommend the use of EPIR set-ups as an emergency alternative in outbreaks or other situations where the need for NPIRs exceeds NPIR capacity.[45]

Positive Pressure Isolation Rooms (PPIR)

Two guidance documents, both graded SIGN 50 level 4 expert opinion, provide information on the design of, and indications for, positive pressure isolation rooms (PPIRs).[49, 52] The US CDC and NHS England HBN 04-01 describe a PPIR as a specialised patient care area, usually in hospital settings, with rooms at positive pressure relative to the surrounding areas.[49, 52] This positive pressure setting prevents the ingress of contaminated air from the surrounding environment.[52]

While both documents state that the room should be at positive pressure relative to the surrounding environment, the pressure values they provide are different. HBN 04-01 states that the bedroom should be at a pressure of +10 Pa relative to the corridor and +5 Pa relative to the lobby.[52] The CDC recommends a pressure of ≥2.5

Pa relative to the corridor.[49] The ACHs are the same as for NPIRs (10 ACH in HBN 04-01 and 12 ACH as per the CDC).

PPIRs are also called positive-pressure isolation suites[52] and protective environment rooms in CDC guidance.[49]

The primary indication for using PPIRs is to minimise the exposure of severely immunocompromised patients (including solid organ transplant patients, allogenic neutropenic patients, and gene therapy patients) to opportunistic airborne infectious agents.[49, 52]

UKHSA guidance on avian influenza advises that positive-pressure rooms must not be used for patients with suspected or confirmed avian influenza infections.[16]

Positive pressure ventilated lobby isolation suites (PPVL)

A HBN 04-01 supplement published by NHS England in 2024, graded SIGN 50 level 4 expert opinion, discusses PPVL isolation suites.[52] It describes PPVL isolation suites as single rooms with an entry lobby set at positive pressure relative to the room and the corridor, and ensuite facilities with extract ventilation.[52] The positive pressure lobby ensures that air from the corridor does not enter the isolation room, and that air from the isolation room does not escape into the corridor.[52] Filtered air is supplied into the lobby, which is set at positive pressure (10 Pa relative to the corridor).[52] This air outflow purges the lobby, diluting airborne pathogens introduced when staff enter. It also stops the movement of potentially contaminated air from the patient room to the corridors, ensuring that the patient is not a risk to others. The bedroom is set at neutral pressure (0 Pa) to the corridor, and the en-suite is set at negative pressure (-10 Pa) relative to the bedroom. Filtered air is supplied in the lobby and extracted at the ensuite in a setting that provides 10 ACH in the bedroom.[52]

According to HBN 04-01, PPVL isolation suites are indicated for both source and protective isolation (for example an ambulant patient who is immunocompromised and has chickenpox) and are especially useful for patients whose exact condition is unknown.[52] This is cited as an advantage, as there is no need to switch ventilation settings or require special staff training on how to manage the ventilation system.[52] It also specifies efficient particulate air (EPA) filtration for intake air (EPA filtration is

standard for immunosuppressed and neutropenic patient rooms as per SHTM 03-01 in Scotland).[52, 54]

A guidance document published by the US CDC advises that immunocompromised patients with an airborne infectious disease should be placed in isolation rooms that utilise an anteroom or lobby to maintain positive pressure in the bedroom.[49] The room description is unclear; however, it appears to provide for a design which allows for a positive pressure bedroom, which differs from the PPVL design specified in UK guidance.[49]

HBN 04-01 also recommends against using isolation rooms that are switchable between positive and negative pressure in new or upgraded facilities because of the risk to the isolated patient and/or the population outside the room if the settings are incorrect.[52]

Single Rooms

Thirty-three sources provide evidence regarding the indications for placement in single rooms.[2-7, 9, 13, 15-18, 20, 23, 26-36, 38, 40-42, 44, 50, 51, 55] This includes one guideline graded AGREE Recommend,[26] four guidelines graded AGREE Recommend with modifications,[20, 27, 28, 55] one cohort study graded SIGN 50 level 2+,[47] three studies graded SIGN 50 level 3[46, 48, 53] and 27 guidance documents graded SIGN 50 Level 4.[2-7, 9, 13, 15-18, 23, 29-36, 38, 40-42, 44, 45, 50, 51]

Two guidance documents (graded SIGN 50 level 4), including an Irish standard[50] and English HBN 00-09[51] describe a single room as a bedroom accommodating a single patient. HBN 00-09 states in its definition that, as a minimum, single rooms should contain a bed, locker, clinical wash hand basin and a small cupboard with a worktop. Single bedrooms without ensuite facilities are not recommended.[51] Most extant guidance recommend that single rooms be en-suite[3, 15, 31, 34] or have access to a designated commode (or toilet) and sink where ensuite rooms are unavailable.[13, 18, 29, 31, 34, 36, 41, 42, 44]

The primary indication for isolation in a single room is to reduce the transmission of infectious agents spread by contact[2, 27, 32, 41, 50] or droplet routes.[2, 50] Single rooms are the primary placement of choice for patients with *Candidozyma auris*,[3, 40] COVID-19,[7, 20, 29, 30, 44] Carbapenemase-producing enterobactererales (CPE),[31] influenza,[9] *Clostridioides difficile*,[23] MDROs,[32] MRSA,[28] mpox,[18, 34, 42, 55] norovirus,[27]

laryngeal or pulmonary TB,[26] pertussis,[2] pneumonia in cystic fibrosis patients infected with *Burkholderia cepacia*,[2] and VRE.[13] It is also the choice of placement for patients who pose a transmission risk to others via environmental contamination.[17, 35]

Single rooms are also recommended as an alternative isolation placement when NPIRs are unavailable. Specifically for patients with avian influenza,[16, 36] measles,[15] and COVID-19.[5] Another indication for their use is for performing AGPs when NPIRs are unavailable, in which case they can be performed in a private single room with the door shut.[4, 26, 29, 30, 34]

A UK CPE-specific guidance graded SIGN 50 level 4 advises that for patients who have confirmed CPE, prioritisation for single-room isolation should be based on an assessment of additional risk factors that may increase transmission (including diarrhoea, faecal incontinence, wounds with uncontrolled drainage, respiratory tract colonisation, and cough) and other factors such as the level of patients' self-care, type of hospital stay and screening results.[31] The document also notes that in paediatric settings, placing mothers with their babies colonised by CPE in an ensuite room (or a room with a dedicated toilet) should be considered, as the mothers are also likely to be colonised by CPE.[31]

A UK MRSA-specific guideline graded AGREE 'Recommend with modifications', published jointly by the Healthcare Infection Society and the Infection Prevention Society, recommend that placing patients infected or colonised with MRSA in single rooms should be considered. It further notes that this should be based on a risk assessment that considers several factors, including the patient's condition, the extent of infection or colonisation, and the risk of transmission to other patients in the specific care setting, for example, burns units.[28] They advise that patients should be isolated for the shortest possible time to reduce negative feelings of stigma, loneliness, and poor mood.[28] The guideline notes the inconsistency of the evidence regarding the effectiveness of contact precautions on MRSA acquisition and infection. Only one of the three primary studies (all interrupted time series (ITS)) reviewed for the guideline reported effectiveness. Of the three studies, two were included in this review and are described below.[46, 53] The third, described as a 'very low-quality ITS', reported a non-statistically significant reduction in device-associated MRSA infection rates associated with discontinuing contact precautions for known MRSA-positive patients and was excluded from this review after critical appraisal.

Effectiveness of single room isolation

Four studies assessed the effectiveness of single-room isolation in reducing HAI transmission: a retrospective cohort study was graded SIGN 50 level 2+,[47] and three studies were graded SIGN 50 level 3-: two interrupted time series[46, 53] and a before-and-after study.[48] Overall, the evidence of effectiveness is uncertain, with two of the studies reporting significant reductions associated with single-room isolation,[48, 53] while the other two, including the cohort study, found no significant benefit.[46, 47]

One interrupted time series (ITS) compared rapid screening, contact precautions and isolation (intervention phase) to no isolation and standard precautions (control phase) and reported a 60% reduction in MRSA acquisition (hazard ratio: 0.39; 95% CI: 0.24-0.62) in the intervention phase compared to the control phase.[53] Another ITS found no difference in MRSA acquisition when MRSA-positive patients were isolated or cohorted compared to when they were left in the beds in which they were diagnosed. Across both phases, similar contact precautions were taken, whether in isolation or at the bed where they were diagnosed.[46] A significant limitation of both studies is that they present the data for patients isolated and cohorted together, thus making it impossible to make any statement on the effectiveness of either.[46] An American retrospective cohort study, graded SIGN 50 level 2+, found no difference in MRSA-related outcomes (time to MRSA colonisation, confirmed late-onset sepsis (CLOS), and combined CLOS or death) between neonates placed in single rooms and those placed in open bays in a neonatal ICU.[47] CLOS was defined as having a culture-positive bacterial infection of the blood or cerebrospinal fluid on or after 72 hours of life for which the neonate was treated with antibiotics for five or more days. The incidence of MRSA colonisation was similar in single rooms and open bays (2.1% vs. 3.3%; p = 0.11), as were the CLOS rates (3.9% vs. 4.1%; p = 0.89). In the patients with CLOS, coagulase-negative *Staphylococcus* spp was the most frequently recovered microorganism in both groups (43% of all positive cultures), followed by methicillin-susceptible *Staphylococcus aureus* (11%), *Escherichia coli* (10%), and *Streptococcus agalactiae* (8%). The CLOS or death parameter was evaluated to check that death did not mask differences in sepsis rates between the two groups. The rate was similar in single rooms and open bays (11.6% vs 10.8%; p=0.56). Bivariate analysis showed that, among patients in the single rooms, each additional patient in the average census

was associated with a 31% greater MRSA colonisation rate — a correlation not seen in patients in the open bays.[47] Lower rates of colonisation were however associated with a 1% increase in hand hygiene compliance on room entry (hazard ratio: 0.834; 95% CI: 0.731 – 0.951; p=0.0068) and exit (hazard ratio: 0.719; 95% CI: 0.611 – 0.846; p<0.0001 regardless of whether patients were in single rooms or shared bays.[47] A limitation of the study is that it does not indicate how the neonates were assigned to the beds.[47]

An Israeli before-and-after study, graded SIGN 50 level 3, found a significant reduction in mean nosocomial infection (NI) episodes after converting a paediatric intensive care unit (PICU) from an open bay unit to a 6-bed single-room unit (3.62±0.7 vs 1.87±0.2; p < 0.05).[48] A total of 78 and 115 children were included in the study during the pre- (open bay) and post-periods (single rooms), respectively; these were the patients admitted to the PICU for more than 48 hours. The authors noted no change in IPC protocols or barrier precautions over the two periods. The study also reported a statistically significant reduction in mean length of stay (11±2 vs 25±6 days; p<0.05), period prevalence of VAP (8% vs 22%; p<0.05) and UTI (3.2% vs 9%; p<0.05). There were reductions in the period prevalence of bacteraemia (7% vs 9%) and eye-related NIs (1.6% vs 3.0%), but the decreases were not statistically significant. There was also a statistically insignificant higher period prevalence of candidemia (1.7% vs. 1.2%) and gastrointestinal (GIT)-related NIs (13% vs. 12.8%) in the single-room period.[48] The study has several limitations: no formal evaluation of hand hygiene was reported, despite the authors noting that it was ‘essentially the same’ in both periods. It is also unclear whether the shorter stay during the single-room period affected the rate of NIs or whether it was a result of the lower rate. Another limitation is the age of the study, conducted between 1992 and 1995, as it is unclear how clinical practice may have changed since then and what effect this has on the applicability of the findings in today’s ICU.[48]

Prioritisation for single rooms

In six pieces of evidence, including five SIGN 50 level 4 guidance documents[4, 13, 28, 31, 35, 40] and one guideline graded AGREE II ‘Recommend with modifications’[28] it is recommended that patients with more pronounced symptoms or those who are likely to be most infectious (for example those with cough, diarrhoea, uncontrolled secretions, or draining wounds) should be prioritised for single rooms.[4, 13, 28, 31, 35, 40]

An UKHSA CPE-specific guidance graded SIGN 50 Level 4 advises that in a situation where there are not enough isolation rooms, patients should be prioritised based on characteristics that increase the risk of transmission (such as diarrhoea, incontinence, cough, wounds with uncontrolled drainage and cough in those colonised in their respiratory tract), the patient's ability to care for themselves, and the type of stay (pre-operative, day case, ICU etc).[31] This approach is closely mirrored in a VRE guidance published in New Zealand.[13] An ECDC guidance document graded SIGN 50 Level 4 advises that patients with viral respiratory tract infections requiring bedside procedures associated with an increased risk of transmission should also be prioritised for single rooms.[4]

Signage

Guidance from Canada[44] and New Zealand[3, 41] (graded SIGN 50 level 4 expert opinion) recommend providing clear signage on the doors of single rooms in use for patient isolation.

Ventilation

SHTM 03-01 recommends 6 ACH for single rooms.[54] Two other guidance documents suggest that single rooms should be well-ventilated, but they do not provide any specifications.[20, 34] A CDC document, graded SIGN 50 Level 4, notes that special air handling is not required for rooms housing suspected or confirmed mpox patients, except that the door should be kept closed if it is safe to do so.[18]

Care homes

Extant guidance also indicates that single-room isolation is an important infection control measure in care homes, with similar considerations for prioritisation.[6, 10, 12, 13, 32, 37, 40] This is noted by guidance documents on ARIs,[12] COVID-19,[6, 10] *Candidozyma auris*,[40] iGAS,[37] MDROs[32] and VRE.[13] Two documents specify that the rooms should have an ensuite – a SIGN 50 Level 4 guidance on VRE published in New Zealand,[13] and a similarly graded guidance on iGAS published in the UK.[37] The latter document also recommends that residents infected with iGAS be provided with dedicated equipment,[37] a provision echoed by a US MDRO-specific guidance graded SIGN50 Level 4.[32]

Conclusion

Two main types of isolation areas were identified: specialised ventilated isolation facilities and single rooms with varied designs. Specialised ventilated facilities include: NPIRs (and EPIRs) for containing individuals with known or suspected airborne infections and for performing AGPs, HLIUs for containing individuals with hazard group 4 pathogens including VHFs, PPIRs for protecting severely immunocompromised patients from opportunistic airborne pathogens, and PPVLs for both source and protective isolation. Single rooms are used to prevent the spread of infections transmitted via droplet or contact routes, or as an alternative when NPIRs were unavailable. The evidence also suggests that single-room isolation should be prioritised for patients most likely to be infectious or with more pronounced symptoms. The evidence for the effectiveness of single-room isolation in reducing the transmission of healthcare-associated infections (HAIs) is uncertain and does not allow for any firm conclusions.

3.3 What is a cohort area, and when should patients or residents be placed in these areas?

Twenty-five pieces of evidence were included for this research question.[4-7, 12-15, 19-21, 27-29, 31, 32, 35, 37, 40, 50, 57-59] Five of these were carried over from the previous version of this review.[23, 50, 57-59]

Five guidelines were graded AGREE 'Recommend with modifications'.[19, 20, 27, 28, 55] Some limitations to these guidelines include a lack of a direct link between recommendations of interest and the underlying evidence,[20] a lack of external review by independent experts before publication,[19] a narrow scope,[27] and the availability of only moderate to low-quality evidence.[27]

Three studies were graded SIGN 50 level 3;[57-59] two retrospective chart reviews,[57, 58] and an outbreak study.[59]

Seventeen guidance documents were graded SIGN 50 Level 4 expert opinion.[4-7, 12-15, 21, 23, 29, 31, 32, 35, 37, 40, 50] This class of evidence is potentially biased because of its unclear methodology and the lack of supporting evidence for its recommendations.

Definition of cohorting

Four sources (including a guideline graded AGREE II 'recommend with modifications' [20] and three SIGN 50 level 4 guidance) [5, 35, 51] provide some definition for cohorting. Within the included evidence, cohorting was defined as the co-location or grouping of patients with similar characteristics, including infection with the same infectious disease, in a multi-bedded room, part of a ward, or an entire ward, separate from patients who do not share these characteristics.[5, 20, 35, 51]

The cohort area

The evidence base identified for this question did not clearly define the cohort area. However, some documents provide a general description of the 'ideal' cohort area. with a lot of flexibility on what should constitute it, ranging from a shared (or multi-bed) room[27, 29, 40, 51] to parts of or whole dedicated wards or units[4, 6, 27, 31, 40] and even contiguous sections within a facility.[27] A CPE-specific guidance graded SIGN 50 level 4, notes that a cohort area should have dedicated bathroom facilities.[31]. One document from the United States, graded SIGN 50 level 4, also recommends cohorting infectious patients in makeshift NPIRs as an airborne precaution during outbreaks involving a large number of patients (this is already discussed under research question 2).[2]

Four documents highlight that cohort areas should be adequately ventilated.[4, 6, 20, 29] A SARS-CoV-2-specific document published in New Zealand and graded SIGN 50 Level 4 recommends considering portable air handling units to improve ventilation.[5]

Three pieces of evidence discuss bed distancing during cohorting and recommend that beds be separated by at least 1 metre.[2, 4, 20] The New Zealand COVID-19 guidance recommends alternative measures, such as leaving every second bed vacant to reduce patient density in cohort areas.[5] An ECDC guidance[4] specific to respiratory viral infections and a CDC guidance on isolation precautions,[2] both graded SIGN 50 Level 4, recommend considering physical barriers (such as privacy curtains) between patients. VRE guidance from New Zealand also specifies the use of disposable antimicrobial curtains.[13] Two guidance documents recommend using dedicated (one for each patient) or, when possible, disposable equipment during cohorting.[20, 31]

Indications for Cohorting

Fifteen pieces of evidence discuss the indications for patient cohorting.[4, 6, 7, 13, 15, 20, 21, 23, 27, 29, 31, 32, 37, 40, 55] The primary indication for patient cohorting is in situations where more than one patient or resident cannot be isolated individually due to a lack of single room provision or availability in inpatient or care home settings.[4, 6, 7, 13, 15, 20, 21, 23, 27, 29, 31, 32, 37, 40, 55] Cohorting is also indicated as a third choice when NPIRs and single rooms are unavailable for the isolation of multiple cases, as per a measles-specific SIGN 50 Level 4 guidance published in the UK.[15]

Cohorting in outpatient settings

Cohorting was generally not mentioned in connection with outpatient settings. Likely because appointments in these settings are typically scheduled in advance, often with designated time slots and opportunities for remote screening. As a result, the likelihood of multiple infectious patients arriving simultaneously is reduced. However, during large-scale community outbreaks, such as the COVID-19 pandemic, this risk increases. A WHO COVID-19 guideline published during the pandemic recommends that patients in emergency units, outpatient departments, or primary care clinics who meet the case definition for suspected COVID-19 should be cohorted with other suspected cases that share similar diagnoses or epidemiological risk factors, if there is not enough space for single-room isolation.[20] Another SARS-CoV-2 guidance document published by the CDC and graded SIGN 50 Level 4 recommends that COVID-19 patients who need to use dialysis facilities be cohorted according to shift (for example treated at the end of a session or during the last shift of the day) when separate rooms or hepatitis B isolation rooms are not available.[6]

Effectiveness of Cohorting

Three studies, all graded SIGN 50 level 3, provide mixed results about the effectiveness of cohorting.[57-59] Two retrospective chart reviews,[57, 58] reported a higher rate of CDI recurrence in cohort patients compared to those left in open bays; only one was statistically significant.[57] The third study reported the effective management of an outbreak of *Serratia marcescens*.[59]

The first retrospective chart review, an English study, reported that cohorted patients (n=138) had significantly higher odds of CDI recurrence within 30 days (OR: 3.77;

p=0.01) and severe disease (OR: 1.95; p=0.022) compared to non-cohorted patients (n=110).[57] Urinary tract infection was also associated with increased recurrence risk (OR: 5.15; p<0.001). The study, conducted over 33 months (2008–2011), reviewed cases diagnosed by ELISA testing. Cohorting followed hospital protocols, which allowed all confirmed CDI patients to be reviewed by the infectious diseases team and admitted to the cohort ward, where possible. Some patients, however, remained in their original wards due to clinical needs. All patients had a dedicated stethoscope, commode and disposable bed curtains. Gloves and aprons were used for all patients. Limitations included lack of demographic data, unclear consistency in infection control measures, no genetic typing of CDI strains, and the use of ELISA alone for diagnosis — now recognised as insufficiently specific.[57]

The second retrospective chart review was a brief report on a study conducted in Mexico. It compared CDI outcomes in patients cohorted in a common isolation unit (CIU), (n = 85) versus those who remained in their original beds (OB) (n = 91).[58] CDI recurrence was higher in the CIU group, although the difference was not statistically significant. However, the OB group had significantly higher 30-day mortality (34% vs. 18.8%, RR: 0.55; p = 0.027), longer treatment durations, and a more frequent history of surgery (all p = 0.001). Patients diagnosed with CDI during the study period (January 2014 – December 2016) were transferred to the CIU unless they were a.) in need of critical care, in which case they were transferred to the ICU, or b.) they were diagnosed in the surgical ward, or c.) the unit was full. CDI diagnosis was suspected based on clinical characteristics and confirmed using a two-step algorithm (a positive glutamate dehydrogenase/toxin assay or a PCR test). The study had several limitations, including a lack of methodological detail, such as how the data was retrieved or how hand hygiene compliance was measured. No genetic testing was performed to distinguish recurrence from reinfection.[58]

An American outbreak study described an outbreak of *Serratia marcescens* in a neonatal intensive care unit (NICU). The outbreak continued despite several interventions being implemented, including education about the organism, review and reinforcement of cleaning and disinfection procedures, and the installation of additional hand sanitiser dispensers. The outbreak only abated when patients and staff were cohorted, that is, cases were cohorted alongside healthcare workers (HCWs).[59]

Principles for safe cohorting

Three guidance documents, graded SIGN 50 level 4, note that suspected and confirmed cases should not be cohorted together.[5, 6, 15] CDC SARS-CoV-2 guidance recommends that only patients with the same respiratory pathogen be cohorted together and that MDRO colonisation status and the presence of other communicable diseases be considered in the cohorting process.[6] A UK CPE guidance graded SIGN 50 Level 4 also advises that patients or residents with varying mechanisms of antimicrobial resistance should not be cohorted together.[31]

VRE-specific guidance published in New Zealand proposes a traffic light (3-zone) system for cohorting: a red zone to accommodate VRE cases, an orange zone for contact patients with negative screening results, and a green zone for patients who were not contacts or have tested negative.[13]

Cohorting of contacts or suspected cases in inpatient settings

Four guidelines[19, 20, 27, 55] and four guidance documents[4, 5, 13, 15] discuss the cohorting of contacts or suspected cases. While there is agreement that suspected cases/contacts should not be cohorted with confirmed cases, there is inconsistency in extant guidelines and guidance documents as to whether suspected cases or contacts can be cohorted together. Three of the documents were specific to contacts, that is, individuals who had been exposed to a confirmed case.[13, 19, 27] Four were specific to ‘suspected cases’,[4, 15, 20, 55] while one seemed to likely include both as it clarified its usage of ‘suspected COVID-19 patients’ to be those awaiting test results or those on symptom watch following an exposure event.[5]

Contact cohorting

Three out of four pieces of evidence that discuss cohorting of contacts recommend it’s use.[13, 19, 27] They include two guidelines graded AGREE ‘recommend with modifications’: a COVID-19 guideline published by ESCMID during the pandemic,[19] and an American norovirus guideline.[27] The third is a New Zealand VRE guidance graded SIGN 50 level 4.[13] All three recommendations are specific to inpatient settings.[13, 19, 27] The COVID-19 guideline's recommendation applies to low-risk exposure contacts — individuals who had face-to-face or physical contact within 2 metres of a COVID-19 case for under 15 minutes, or those who had direct contact

with excretions from a COVID-19 case in a confined space, travelled with a COVID-19 case for less than 15 minutes, or cared for a COVID-19 case using appropriate PPE for healthcare workers for less than 15 minutes.[19] The norovirus guideline[27] and the VRE guidance[13] both recommend contact cohorting during outbreaks, although the latter permits it even in non-outbreak situations when no single rooms are available. The former categorises three possible patient cohorts: symptomatic, asymptomatic exposed (which aligns with contacts as described in this literature review), and asymptomatic unexposed.[27] The VRE guidance defines contacts as individuals who have shared a room or toilet facility with a confirmed case for 24 hours or longer, and provides a straightforward recommendation that they may be cohorted with other VRE contacts.[13]

In contrast, the fourth document, a COVID-19 guidance from New Zealand, advises against cohorting of contacts but provides no further details or alternatives for outbreak situations. It, however, curiously lists the ability to cohort contacts as part of the factors to consider in developing a plan to manage patients who develop COVID-19 during or after hospital admission.[5]

Cohorting of suspected cases

Three of the four documents that discuss the cohorting of suspected cases recommend it for outbreak situations.[15, 20, 55] One of these, a measles guidance published by NHS England, made this recommendation for outbreak situations in inpatient settings.[15] The recommendation in the others, WHO guidelines graded AGREE 'recommend with modifications' specific to mpox[55] and COVID-19,[20] apply to many settings, including inpatients. All three documents noted that a risk assessment should be carried out before cohorting, which should consider the similarity of clinical diagnoses and epidemiological risk factors.[15, 20, 55]

An ECDC guidance on respiratory viral infections differed in its provision on the subject.[4] It recommends avoiding the cohorting of patients with suspected respiratory viral infections in inpatient settings. It provides no alternative for situations where there is not enough single-room capacity for suspected cases.[4]

It is worth noting that cohorting contacts or suspected cases is very much a short-term measure, as patients can be reassigned to the appropriate location once test results are available.

Staff cohorting alongside

Three guidance documents, all graded SIGN 50 level 4, recommend staff cohorting as an adjunct to patient cohorting.[23, 29, 31] A VRE-specific document also advises that health and clinical teams group their activities to avoid multiple entries into the cohort area containing VRE patients.[13]

Conclusion

Cohort areas are typically defined as shared spaces, such as multi-bed rooms, dedicated wards, or adjacent sections within a facility, used to house patients with similar characteristics, such as those infected with the same infectious agent. Cohorting is primarily used when single rooms are unavailable or impractical in inpatient and care home settings. The application of cohorting in outpatient settings is limited. Extant expert opinion guidance advises that patients with suspected infection and those with confirmed infection be cohorted separately, and separate cohorting where patient isolates (of the same species) have different drug resistance patterns. There is some provision within extant guidance that contacts or suspected cases may be cohorted together in outbreak situations, however, there are also provisions that this be avoided. Evidence on the effectiveness of patient cohorting is limited and inconclusive.

3.4 What is staff cohorting, and when should it be implemented?

Twelve pieces of evidence were included for this research question.[12, 15, 20, 23, 27-29, 33, 35, 60-62] One of these was carried over from the previous version of this review.[23]

Three guidelines graded AGREE 'Recommend with modifications' were included.[20, 27, 28] Some limitations to these guidelines include a lack of a direct link between recommendations of interest and the underlying evidence,[20] a narrow scope,[27] and the availability of only moderate to low-quality evidence.[27]

A retrospective cohort study graded SIGN 50 Level 2+ was also included.[60]

Eight guidance documents were graded SIGN 50 Level 4 expert opinion.[12, 15, 23, 29, 33, 35, 61, 62] This class of evidence is potentially biased because of its unclear methodology and the lack of supporting evidence for its recommendations.

Definition

The identified evidence base did not clearly define staff cohorting. However, it was generally described as the designation of a team of healthcare workers to care solely for a patient or resident (or a group) based on a characteristic of the patient or resident (or group) that separates them from others for a period. A staff cohort provides care for one group of patients but is excluded from providing care to other patients who do not share the defining characteristics.[12, 20, 29, 33, 35, 61] The characteristics of the patient group may include a positive test result for, or a suspicion of, an infectious disease or immunocompromise.[12].

Indications

The primary indication for staff cohorting is as an outbreak control measure, as detailed in one guideline graded AGREE II 'recommend with modifications', a cohort study graded SIGN 50 level 2+ and three expert guidance documents graded SIGN 50 level 4.[12, 27, 60-62] Other indications include, as an adjunct to patient isolation (one guideline graded AGREE 'recommend with modifications' and three SIGN 50 level 4 guidance documents),[20, 23, 29, 33, 35] or as an alternative when isolation is not possible.[28]

Outbreak Control

Three pieces of evidence provide recommendations or advice on using staff cohorting as a tool for outbreak management.[12, 15, 61]

Two English guidance documents list restricting staff to wings or areas to avoid seeding the outbreak to other places as an outbreak control measure.[12, 61] One of the documents also notes that in an area with both cases and non-cases, staff should work only with one of the groups to reduce the risk of staff members cross-contaminating service users.[12] These guidance documents also list cohorting staff to care for symptomatic or positive and non-symptomatic or negative residents as examples of outbreak control measures.[12, 61] An English measles guidance recommends staff cohorts to care for patients in isolation or cohort areas as an additional measure in outbreak control.[15]

Adjunct to patient isolation or cohorting

Five sources recommend designating healthcare workers (HCWs) to care for patients or residents in isolation[15, 20, 29, 33, 35] or those who are being cohorted,[15, 20, 23, 29, 35] where possible. They note that this designation reduces the exposure of these HCWs to non-infected patients and other HCWs, thereby minimising the risk of transmission.[29, 33 23]

Alternative to isolation

A European guideline graded AGREE II 'recommend with modifications', includes a good practice point, suggesting nurse cohorting as an alternative strategy when isolation of an MRSA patient is not possible due to competing demands on single-room use.[28]

Considerations for safe cohorting

Staff characteristics such as pregnancy status,[12] immune status,[12] vaccination,[12, 15] and previous exposure to the pathogen of interest[27, 62] were described within the evidence to play a role in how staff are cohorted.

An American norovirus-specific guideline graded AGREE II 'Recommend with modifications' recommends that staff who have themselves recently recovered from norovirus infection may be best suited to care for symptomatic norovirus patients during an outbreak.[27] Another U.S. guidance specific to SARS-CoV-2 advises that during outbreaks where there are staff shortages, staff with confirmed SARS-CoV-2 may deliver direct care solely to other SARS-CoV-2 patients, ideally in a cohort environment.[62] The document notes that this group of staff should not be allowed to work with patients with moderate to severe immunocompromise.

Effectiveness of staff cohorting

A retrospective study graded SIGN 50 Level 2+ assessed a vancomycin-resistant *Enterococcus faecium* (VREfm) outbreak in a Japanese hospital. The incidence rate ratio of VREfm amongst patients housed in the same ward with confirmed VREfm patients and cared for by the same team was higher than for those housed in similar circumstances but with a different care team.[60] However, the difference was not statistically significant. The study observed 272 patients for 4038 patient-days and

detected 43 cases of Type A VRE, 14 of whom were found to be positive after discharge. Compared to patients on the same ward as VREfm-infected individuals but cared for by a different nursing team (reference group), those cared for by the same team had an incidence rate ratio (IRR) of 2.01 (95% CI: 0.62–10.28, p = 0.24) after one day of exposure, and an IRR of 1.48 (95% CI: 0.66–3.74, p = 0.33) after seven days of exposure.[60] The study has several key limitations: the lack of routine testing may have meant that some cases were missed. Additionally, nurses caring for infected patients may have also cared for non-infected patients during night shifts, which could have led to an underestimation of the impact of staff cohorting. Transmission via healthcare workers was not considered, and catheterisation, which is a risk factor for VRE infection, was not controlled for. No information was provided on this or the demographic characteristics of the cases.[60]

Conclusion

Staff cohorting involves assigning a dedicated team of healthcare workers to care exclusively for a specific patient or group of patients who share a common characteristic, typically infection status, for a defined period. It is primarily implemented as a measure to control outbreaks. When cohorting staff, individual factors such as pregnancy, immunity, and previous exposure should be considered. Only one study assessing the effectiveness of staff cohorting was included in this review, and it reported no significant difference compared to standard staffing practices.

3.5 How should patients or residents be assessed for infection risk prior to discontinuing isolation and cohorting?

A total of 22 pieces of evidence were included for this research question.[4-6, 8, 10, 12, 13, 18, 19, 21, 23, 26, 27, 29, 36, 43, 44, 63-67] This includes one study carried over from the previous version of this review.[23]

Three guidelines were included: two[19, 27] were graded AGREE II ‘Recommend with modifications’ and one[26] graded ‘AGREE II Recommend’.

Nineteen guidance documents were graded SIGN 50 Level 4 expert opinion.[4-6, 8, 10, 12, 13, 18, 21, 23, 29, 36, 43, 44, 63-67]

Eleven documents describe pathogen-specific criteria for ending patient isolation, including a negative diagnostic test,[6, 12, 21, 26, 36] time after symptom resolution,[12, 23, 27, 29, 65-67] time after symptom onset,[12, 29, 36, 43] time after a positive test,[36] time since treatment initiation,[26] symptom resolution,[65] and presence of other pathogens.[43]

Long-term shedding

A guideline graded AGREE 'recommend with modifications' specific to norovirus,[27] and four SIGN 50 Level 4 expert opinion guidance specific to SARS-Cov-2 (or other respiratory viruses)[4, 10, 12, 64] and Avian influenza[36] advise that in ending isolation, it should be considered that the elderly,[12] children (under two years),[27] and the immunocompromised [4, 5, 10, 12, 27, 36, 64] may shed infectious agents for a longer period of time, hence remaining infectious for longer, a phenomenon described as 'long-term shedding'. While not mentioning the term 'long-term shedding,' other documents also note that whether a patient is immunocompromised should be considered in the assessment to determine when to discontinue precautions.[6, 8] Other documents state that time spent in isolation should be determined on a case-by-case basis and may be higher among immunocompromised patients or residents than among immunocompetent ones without any direct reference to long-term shedding, although this can be implied.[5, 29, 44, 65]

A norovirus guideline published in 2021 by the CDC and graded AGREE 'Recommend with modifications' recommends considering more extended isolation or cohorting periods for complex medical patients (patients with cardiovascular, autoimmune, immunosuppressive or renal disorders), infants and young children even after symptoms have resolved, because of the potential for prolonged shedding.[27] The document provides no recommendations on the correlation between prolonged norovirus shedding and the risk of infection to susceptible patients, citing that further research is needed.[27]

ECDC avian influenza guidance graded SIGN 50 Level 4 expert opinion recommends that in cases where long-term shedding is a concern, discontinuing isolation should be based on an assessment of the patient's clinical and immune status.[36] The document notes that such a scenario presents the highest risk for the virus to adapt to human systems and urges that particular care be taken when such cases are removed from isolation while the RT-PCR remains positive.[36]

Consideration of other vulnerable patients

A NICE tuberculosis guideline graded AGREE 'Recommend' notes that isolation can be discontinued after two weeks of treatment, after a consideration of risks and benefits, if (amongst other factors, including cough resolution and clinical improvement of other symptoms) there are no immunocompromised individuals in the same ward, care home or accommodation to which they would be transferred or discharged.[26]

Conclusion

Assessments for ending isolation vary depending on the infectious agent. They may involve a negative diagnostic test, symptom resolution, or consideration of time after a test, symptom onset or resolution, or treatment initiation. Another consideration is the presence of immunocompromised patients in the accommodation where the patient is to be placed following deisolation. Isolation may be terminated early if specific criteria are met for certain infectious agents and may be extended if concerns arise about long-term shedding.

3.6 Implications for research

This review has demonstrated that further high-quality research is needed to explore several key themes.

A significant issue was the lack of evidence. Generally, only very few primary studies that explored the effectiveness of isolation and/or cohorting were identified in the search period. Most of these were conducted during the pandemic, a period marked by significant changes in healthcare practices and behaviours.[68] Transmission was not demonstrated in some studies comparing the effectiveness of isolation and cohorting or single-room isolation and NPIR.[69, 70] These factors made it difficult to attribute outcomes to patients' placements reliably

Another notable theme is long-term shedding and its potential impact on transmission risk in isolated patients. This will vary depending on the infectious agent and patient cohort. This was, however, not the focus of this literature review. The search strategy was not explicitly set to find this kind of evidence. An outbreak study that reported this was excluded because no tests were done to evaluate the genetic

relatedness of the isolates from the index case and those from the other case patients.[71]

Further research is needed to better understand the effectiveness of different isolation and cohorting strategies in healthcare settings. Ethical and practical constraints limit the feasibility of randomised trials. Observational and quasi-experimental studies – some of which are included in this review – can offer valuable insights; however, outcomes for isolation and cohorting must be reported separately to allow for a separate assessment of each.

Outbreak studies can also provide real-world evidence of the effectiveness and risks of cohorting. To strengthen this evidence, a stepwise implementation of interventions (where possible), evaluation of genetic relatedness to evidence transmission, and transparent reporting of outbreak management and outcomes will be helpful.

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Appendix 1: Search Strategy

Ovid MEDLINE® ALL 1946 to August 20, 2024

1. Cross Infection/
2. exp Disease Transmission, Infectious/
3. exp Infection Control/
4. exp Infections/
5. (infect$ adj3 (prevent$ or control$)).ti,ab,kf.
6. cross infect$.ti,ab,kf.
7. 1 or 2 or 3 or 4 or 5 or 6
8. Patient Isolation/
9. Hospitals, Isolation/
10. isolat$.ti,ab,kf.
11. cohorting.ti,ab,kf.
12. 8 or 9 or 10 or 11
13. Patients' Rooms/
14. patient$ room?.ti,ab,kf.
15. resident$ room?.ti,ab,kf.
16. (single adj3 room?).ti,ab,kf.
17. (private adj3 room?).ti,ab,kf.
18. (single-bed adj3 room?).ti,ab,kf.
19. (two-bed adj3 room?).ti,ab,kf.
20. (multiple-bed adj3 room?).ti,ab,kf.
21. (multi-bed adj3 room?).ti,ab,kf.
22. (isolat$ adj3 room?).ti,ab,kf.
23. (isolat$ adj3 suite?).ti,ab,kf.
24. (enhanc$ adj3 room?).ti,ab,kf.
25. (side adj3 room?).ti,ab,kf.
26. ward?.ti,ab,kf.
27. bay?.ti,ab,kf.
28. exp Residential Facilities/

29. assisted living.ti,ab,kf.
30. care home?.ti,ab,kf.
31. care facilit$.ti,ab,kf.
32. nursing home?.ti,ab,kf.
33. residential facilit$.ti,ab,kf.
34. retirement home?.ti,ab,kf.
35. 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34
36. 7 and 12 and 35
37. limit 36 to (english language and yr="2021-Current")

Embase 1974 to 2024 August 20

1. cross infection/
2. exp disease transmission/
3. exp infection/
4. exp infection control/
5. (infect$ adj3 (prevent$ or control$)).ti,ab,kf.
6. cross infect$.ti,ab,kf.
7. 1 or 2 or 3 or 4 or 5
8. patient isolation/
9. isolation hospital/
10. isolat$.ti,ab,kf.
11. cohorting.ti,ab,kf.
12. 8 or 9 or 10 or 11
13. patient$ room?.ti,ab,kf.
14. resident$ room?.ti,ab,kf.
15. (single adj3 room?).ti,ab,kf.
16. (private adj3 room?).ti,ab,kf.
17. (single-bed adj3 room?).ti,ab,kf.
18. (two-bed adj3 room?).ti,ab,kf.
19. (multiple-bed adj3 room?).ti,ab,kf.

20. (multi-bed adj3 room?).ti,ab,kf.
21. (isolat$ adj3 room?).ti,ab,kf.
22. (isolat$ adj3 suite?).ti,ab,kf.
23. (enhanc$ adj3 room?).ti,ab,kf.
24. (side adj3 room?).ti,ab,kf.
25. ward?.ti,ab,kf.
26. bay?.ti,ab,kf.
27. residential home/
28. nursing home/
29. assisted living facility/
30. assisted living.ti,ab,kf.
31. care home?.ti,ab,kf.
32. care facilit$.ti,ab,kf.
33. nursing home?.ti,ab,kf.
34. residential facility$.ti,ab,kf.
35. retirement home.ti,ab,kf.
36. 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35
37. 7 and 12 and 36
38. 37 not conference$.so,pt.
39. limit 38 to (english language and yr="2021-Current"t")

CINAHL (20 August 2024)

S35 S7 AND S11 AND S33 Limiters - Publication Date: 20210101-; English Language

S34 S7 AND S11 AND S33

S33 S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32

S32 TI retirement home* OR AB retirement home* OR SU retirement home*

S31 TI residential facilit* OR AB residential facilit* OR SU residential facilit*

S30	TI care facilit* OR AB care facilit* OR SU care facilit*
S29	TI care home* OR AB care home* OR SU care home*
S28	TI assisted living OR AB assisted living OR SU assisted living
S27	(MH "Residential Facilities+")
S26	TI bay* OR AB bay* OR SU bay*
S25	TI ward* OR AB ward* OR SU ward*
S24	TI side N2 room* OR AB side N2 room* OR SU side N2 room*
S23	TI enhanc* N2 room* OR AB enhanc* N2 room* OR SU enhanc* N2 room*
S22	TI isolat* N2 suite* OR AB isolat* N2 suite* OR SU isolat* N2 suite*
S21	TI isolat* N2 room* OR AB isolat* N2 room* OR SU isolat* N2 room*
S20	TI multi-bed N2 room* OR AB multi-bed N2 room* OR SU multi-bed N2 room*
S19	TI multiple-bed N2 room* OR AB multiple-bed N2 room* OR SU multiple-bed N2 room*
S18	TI two-bed N2 room* OR AB two-bed N2 room* OR SU two-bed N2 room*
S17	TI single-bed N2 room* OR AB single-bed N2 room* OR SU single-bed N2 room*
S16	TI private N2 room* OR AB private N2 room* OR SU private N2 room*
S15	TI single N2 room* OR AB single N2 room* OR SU single N2 room*
S14	TI resident* N2 room* OR AB resident* N2 room* OR SU resident* N2 room*
S13	TI patient* N2 room* OR AB patient* N2 room* OR SU patient* N2 room*
S12	(MH "Patients' Rooms")
S11	S8 OR S9 OR S10
S10	TI cohorting OR AB cohorting OR SU cohorting
S9	TI isolat* OR AB isolat* OR SU isolat*
S8	(MH "Patient Isolation+")
S7	S1 OR S2 OR S3 OR S4 OR S5 OR S6
S6	TI cross infect* OR AB cross infect* OR SU cross infect*
S5	TI ((infect* N2 (prevent* or control))) OR AB ((infect N2 (prevent* or control))) OR SU ((infect N2 (prevent* or control*)))
S4	(MH "Infection+")
S3	(MH "Infection Control+")
S2	(MH "Disease Transmission+")

S1 (MH "Cross Infection")

Supplementary Search Strategy

Ovid MEDLINE® ALL 1946 to October 17, 2024

1. Cross Infection/
2. exp Disease Transmission, Infectious/
3. exp Infection Control/
4. exp Infections/
5. (infect$ adj3 (prevent$ or control$)).ti,ab,kf.
6. cross infect$.ti,ab,kf.
7. 1 or 2 or 3 or 4 or 5 or 6
8. Patient Isolation/
9. Hospitals, Isolation/
10. isolat$.ti,ab,kf.
11. cohorting.ti,ab,kf.
12. 8 or 9 or 10 or 11
13. exp Emergency Service, Hospital/
14. Waiting Rooms/
15. 13 or 14
16. 7 and 12 and 15
17. limit 16 to (english language and yr="2021 -Current")

Embase 1974 to 2024 October 17

1. cross infection/
2. exp disease transmission/
3. exp infection/
4. exp infection control/
5. (infect$ adj3 (prevent$ or control$)).ti,ab,kf.
6. cross infect$.ti,ab,kf.

7. 1 or 2 or 3 or 4 or 5
8. patient isolation/
9. isolation hospital/
10. isolat$.ti,ab,kf.
11. cohorting.ti,ab,kf.
12. 8 or 9 or 10 or 11
13. emergency ward/
14. waiting room/
15. 13 or 14
16. 7 and 12 and 15
17. limit 16 to (english language and yr=”2021 – Current”)

CINAHL (18 October 2024)

S1. (MH “Cross Infection”)

S2. (MH "Disease Transmission+")

S3. (MH "Infection Control+")

S4. (MH "Infection+")

S5. (TI ((infect* N2 (prevent* or control*))) OR AB ((infect* N2 (prevent* or control*))) OR SU ((infect* N2 (prevent* or control*)))

S6. TI cross infect* OR AB cross infect* OR SU cross infect*

S7. S1 OR S2 OR S3 OR S4 OR S5 OR S6

S8. (MH "Patient Isolation+")

S9. TI isolat* OR AB isolat* OR SU isolat*

S10. TI cohorting OR AB cohorting OR SU cohorting

S11. S8 OR S9 OR S10

S12. (MH "Emergency Service+")

S13. (MH "Waiting Rooms")

S14. S12 OR S13

S15. S7 AND S11 AND S14

S16. S7 AND S11 AND S14 (Limiters - Publication Date: 20210101-20241231; Narrow by Language: - English Language)

Appendix 2: Evidence Levels

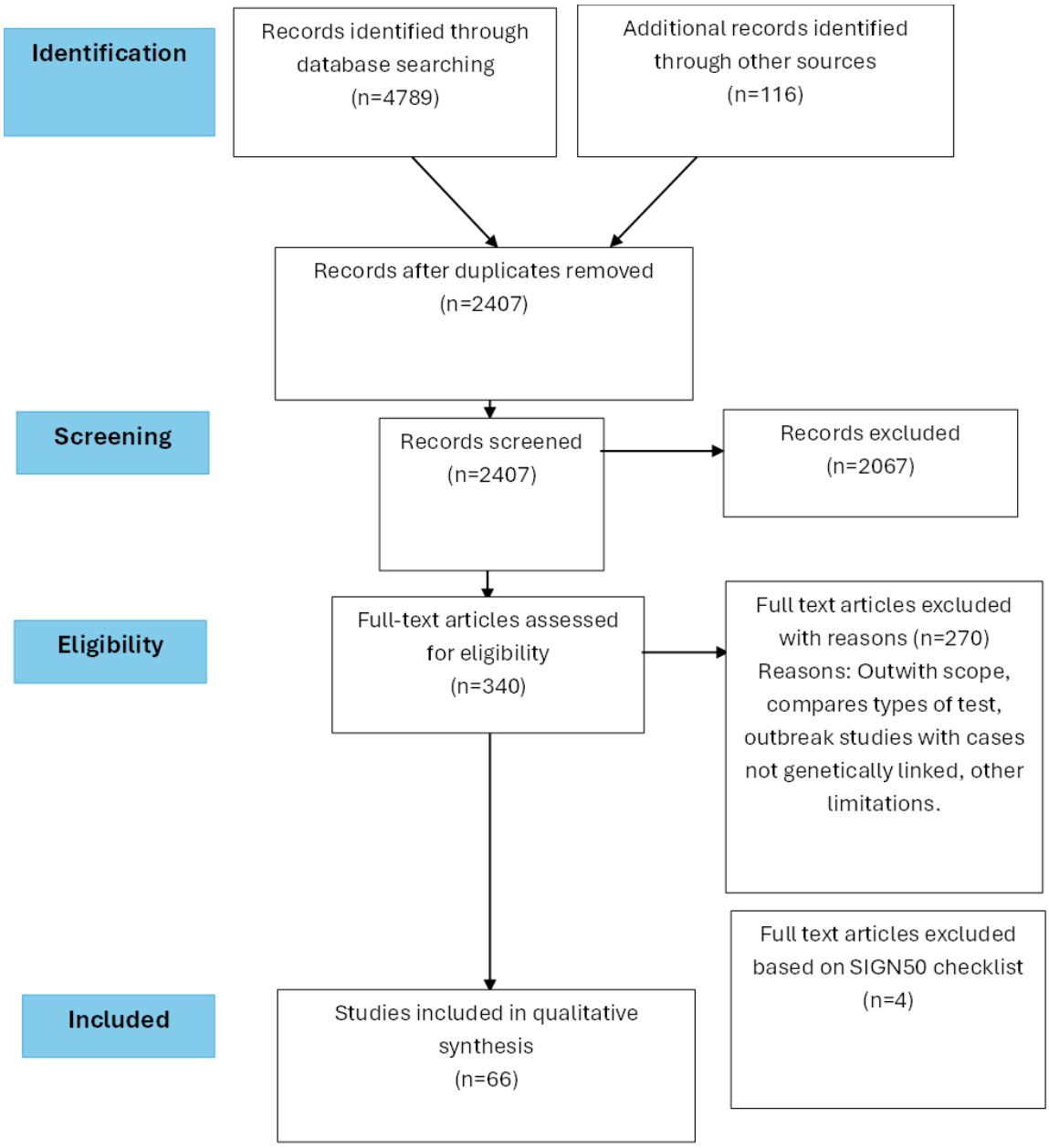
SIGN 50 Evidence Levels

Grade	Description
1++	High-quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+	Well conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias
1-	Meta-analyses, systematic reviews of RCTs, or RCTs with a high risk of bias
2++	High-quality systematic reviews of case-control or cohort studies. High-quality case-control or cohort studies with a very low risk of confounding, bias, or chance and a high probability that the relationship is causal
2+	Well-conducted case-control or cohort studies with a low risk of confounding, bias, or chance and a moderate probability that the relationship is causal
2-	Case control or cohort studies with a high risk of confounding, bias, or chance and a significant risk that the relationship is not causal
3	Non-analytic studies, for example, case reports, case series
4	Expert opinion

AGREE II Evidence Levels

Grade	Description
AGREE 'Recommend'	This indicates that the guideline is of high overall quality and can be considered for use in practice without modifications.
AGREE 'Recommend with modifications'	This indicates that the guideline is of moderate overall quality. This could be due to insufficient or lacking information in the guideline for some items. If modifications are made, the guideline could still be considered for use in practice when no other guidelines on the same topic are available.
AGREE 'Do not Recommend'	This indicates that the guideline is of low overall quality and has serious shortcomings. Therefore, it should not be recommended for use in practice.

Appendix 3: PRISMA flow diagram



Appendix 4: Studies excluded following critical appraisal

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3. Kim CS, Kim UJ, Lee Y, et al. Nosocomial Outbreak of COVID-19 from a Kidney Transplant Patient: Necessity of a Longer Isolation Period in Immunocompromised Patients. Infection and Chemotherapy 2022; 54: e77.
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