NHS National Services Scotland

Safe Management of Linen Literature Review

Evidence Tables

Version 1.0

31 January 2025

ARHAI Scotland

Antimicrobial Resistance and Healthcare Associated Infection

Version history

Version	Date	Summary of changes
1.0	31 January 2025	New document

Contents

Introduction

All studies which are critically appraised as part of the literature review are assigned a grade of evidence based on the SIGN 50 methodology grading system (SIGN, 2019), which allows scientific studies to be assessed for quality using a number of reviewing forms (available from the SIGN website). Guidelines are appraised and graded using the AGREE II grading system (details available from the AGREE website).

Main conclusions from evidence sources (studies and guidance) are summarised along with a brief description of the methods and limitations within evidence table entries. Evidence sources with sufficient quality, which specifically answer a defined research question, are grouped together to enable the formation of an overall assessment regarding the evidence base.

Evidence grading

The following grades were given to the papers included in this evidence table:

SIGN50 Evidence levels

The SIGN50 methodology was used to appraise and grade primary studies and expert opinion guidance documents.

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

Grade	Description
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

The AGREE II tool was used to appraise guidelines which were based on a systematic review of evidence, and experts have formulated the recommendations and statements.

Grade	Description
AGREE 'Recommend'	This indicates that the guideline has a high overall quality and that it can be considered for use in practice without modifications.
AGREE 'Recommend with modifications'	This indicates that the guideline has a 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, in particular when no other guidelines on the same topic are available.
AGREE 'Do not Recommend'	This indicates that the guideline has a low overall quality and serious shortcomings. Therefore, it should not be recommended for use in practice.

Research questions for evidence tables

1. What is the definition of linen in health and care settings?
2. What are the legislative/mandatory requirements for the safe handling of linen?
3. How should linen be categorised?
4. What is the available evidence/guidance on products or methods for effective laundering of linen?
5. How should beds be stripped/made to minimise risk of infection transmission?
6. How should clean linen be safely handled?
7. How should clean linen be stored?
8. How should clean linen be transported?
9. How should used linen be safely handled?
10. How should used linen be sorted?
11. How should used linen be labelled?
12. How should used linen be stored?
13. How should used linen be transported?
14. Is there any specific evidence/guidance on the effective laundering of uniforms/scrubs?
15. Is there any evidence regarding washing used/infectious personal clothing at home?
16. What is the risk of infection transmission associated with linen in health and care settings?
17. How should infectious linen be safely handled?
18. How should infectious linen be sorted?
19. How should infectious linen be labelled?
20. How should infectious linen be stored?
21. How should infectious linen be transported?
22. What is the available evidence for the effectiveness of antimicrobial impregnated linen in reducing healthcare associated infection?

23. What is the available guidance/evidence on post-laundry disinfection for linen in healthcare?
24. When is linen deemed unfit for reuse?
25. How should linen deemed unfit for reuse be safely disposed?
26. How should curtains be put up and taken down to minimise transmission of infection?

Question 1: What is the definition of linen in health and care settings?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Healthcare Laundry Accreditation Council. HLAC Accreditation Standards: Accreditation Standards for Processing Reusable Textiles for Use in Healthcare Facilities. 2023 May [cited 2024 January 24];	Standards	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
These American standards were developed by the Healthcare Laundry Accreditation Council (HLAC) and “are intended to be used to obtain or maintain accreditation in the HLAC Accreditation Program. The standards represent the collective best judgment of HLAC leaders.”					

Assessment of evidence
The document uses the term ‘reusable surgical textile’ and defines it as “A drape, gown, towel, or sterilization wrapper that is intended to be used in surgery or assist in preparing the surgical team for surgery, that is made from a fabric (usually woven or knitted) or a fabric/film laminate, and that is intended to be used more than once, with appropriate cleaning, decontamination, and sterilization between uses.” **Limitations** • Method of producing guidance not stated. • May not be applicable to Scottish health and care settings. • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Sehulster LM, Chinn RYW, Arduino MJ, Carpenter J, Donlan R, Ashford D, Besser R, Fields B, McNeil MM, Whitney C, Wong S, Juranek D, Cleveland J. Guidelines for environmental infection control in health-care facilities: recommendations of	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). Chicago IL; American Society for Healthcare Engineering/American Hospital Association; 2004. [cited 2024 January 24]					

Assessment of evidence

This American guidance aims to “provide useful information for both health-care professionals and engineers in efforts to provide a safe environment in which quality health care may be provided to patients. The recommendations herein provide guidance to minimize the risk for and prevent transmission of pathogens in the indoor environment”.

Though not a recommendation, the document contains the following about linen:

“Laundry in a health-care facility may include bed sheets and blankets, towels, personal clothing, patient apparel, uniforms, scrub suits, gowns, and drapes for surgical procedures.”

“OSHA defines contaminated laundry as “laundry which has been soiled with blood or other potentially infectious materials or may contain sharps.”

Assessment of evidence
Limitations • Although a comprehensive review was done, it is unclear if it was systematic. • Update process or schedule not provided. • May not be applicable to Scottish health and care settings. • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Social Care. 2013 March [updated 2016 June 8; cited 2024 January 24];	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”. The document provides the following on the definition of linen: “For the purposes of this document, “linen” means all reusable textile items requiring cleaning/disinfection via laundry processing including: Bed linen: blankets, counterpanes, cot sheets and blankets, duvets, duvet covers, pillowcases and sheets (woven, knitted, half sheets, draw and slide sheets); bibs; blankets; canvases; curtains; hoist slings; patient clothing (gowns, nightdresses and shirts, pyjama tops and bottoms); staff clothing (coats, scrub suits, tabards, uniforms*); towels” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Social Care. Management and provision. 2013 March [updated 2016 June 8; cited 2024 January 24]					

Assessment of evidence

This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”.

The document provides the following on the definition of linen:

“For the purposes of this document, “linen” means all reusable textile items requiring cleaning/disinfection via laundry processing including: Bed linen: blankets, counterpanes, cot sheets and blankets, duvets, duvet covers, pillowcases and sheets (woven, knitted, half sheets, draw and slide sheets); bibs; blankets; canvases; curtains; hoist slings; patient clothing (gowns, nightdresses and shirts, pyjama tops and bottoms); staff clothing (coats, scrub suits, tabards, uniforms*); towels”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Question 2: What are the legislative/mandatory requirements or standards for the safe handling of linen?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Scottish Government. National uniform policy, dress code and laundering policy. DL (2018) 4 [cited 2024 January 24]	Regulation	Mandatory	N/A	N/A	N/A

Assessment of evidence

This Scottish Government document sets out the policy on uniform laundering for health and social care staff.

For laundry purposes, it categorised uniforms into two groups: used uniforms and contaminated uniforms. It also provides guidance on how to launder both categories.

“For laundering classification purposes, we have therefore identified 2 categories:

a. Used uniform, which has been worn in conjunction with appropriate PPE
b. Contaminated uniform, which following a PPE failure or other incident is visibly contaminated with blood or other body fluids, or uniform which Infection Control advise should be treated as contaminated following an outbreak.”

Assessment of evidence
Limitations • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
UK Government. The Control of Substances Hazardous to Health Regulations 2002. As amended in 2020 (31/12/2020) [cited 2024 January 24]	Legislation	**Mandatory**	N/A	N/A	N/A
Assessment of evidence					
COSHH regulations 2002 provide general regulations for the prevention and control of exposure to substances hazardous to health, including the provision of appropriate disinfection procedures and personal protective equipment. The document also provides, amongst other things, regulations for training/instructing employees, procedures for dealing with accidents and emergencies, and health surveillance for employees. This legislation is not specific to healthcare settings or linen management. The relevant provisions are provided below: General regulations for prevention and control of exposure to hazardous substances					

Assessment of evidence

"7.—

1) Every employer shall ensure that the exposure of his employees to substances hazardous to health is either prevented or, where this is not reasonably practicable, adequately controlled.

2) In complying with his duty of prevention under paragraph (1), substitution shall by preference be undertaken, whereby the employer shall avoid, so far as is reasonably practicable, the use of a substance hazardous to health at the workplace by replacing it with a substance or process which, under the conditions of its use, either eliminates or reduces the risk to the health of his employees.

3) Where it is not reasonably practicable to prevent exposure to a substance hazardous to health, the employer shall comply with his duty of control under paragraph (1) by applying protection measures appropriate to the activity and consistent with the risk assessment, including, in order of priority—

   (a) the design and use of appropriate work processes, systems and engineering controls and the provision and use of suitable work equipment and materials;

   (b) the control of exposure at source, including adequate ventilation systems and appropriate organisational measures; and

   (c) where adequate control of exposure cannot be achieved by other means, the provision of suitable personal protective equipment in addition to the measures required by sub-paragraphs (a) and (b).

4) The measures referred to in paragraph (3) shall include—

   (a) arrangements for the safe handling, storage and transport of substances hazardous to health, and of waste containing such substances, at the workplace;

   (b) the adoption of suitable maintenance procedures;

   (c) reducing, to the minimum required for the work concerned—

      i. the number of employees subject to exposure,

Assessment of evidence

ii. the level and duration of exposure, and

iii. the quantity of substances hazardous to health present at the workplace;

(d) the control of the working environment, including appropriate general ventilation; and

(e) appropriate hygiene measures including adequate washing facilities."

[–]

"(6) Without prejudice to the generality of paragraph (1), where it is not reasonably practicable to prevent exposure to a biological agent, the employer shall apply the following measures in addition to those required by paragraph (3)—

(a) displaying suitable and sufficient warning signs, including the biohazard sign shown in Part IV of Schedule 3;

(b) specifying appropriate decontamination and disinfection procedures;

(c) instituting means for the safe collection, storage and disposal of contaminated waste, including the use of secure and identifiable containers, after suitable treatment where appropriate;

(d) testing, where it is necessary and technically possible, for the presence, outside the primary physical confinement, of biological agents used at work;

(e) specifying procedures for working with, and transporting at the workplace, a biological agent or material that may contain such an agent;

(f) where appropriate, making available effective vaccines for those employees who are not already immune to the biological agent to which they are exposed or are liable to be exposed;

i. instituting hygiene measures compatible with the aim of preventing or reducing the accidental transfer or release of a biological agent from the workplace, including—

Assessment of evidence
ii. the provision of appropriate and adequate washing and toilet facilities, and iii. where appropriate, the prohibition of eating, drinking, smoking and the application of cosmetics in working areas where there is a risk of contamination by biological agents; and (g) where there are human patients or animals which are, or are suspected of being, infected with a Group 3 or 4 biological agent, the employer shall select the most suitable control and containment measures from those listed in Part II of Schedule 3 with a view to controlling adequately the risk of infection.”

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
UK Government. Personal Protective Equipment at Work Regulations 1992 (as amended) Amended in 2022. [cited 2024 January 24]	Legislation	**Mandatory**	N/A	N/A	N/A
Assessment of evidence					
This piece of legislation provides regulations for providing appropriate and suitable personal protective equipment to staff exposed to health or safety risks while at work. It also provides regulations on assessment, maintenance, storage, and training on the use of personal protective equipment.					

Assessment of evidence
This legislation is not specific to healthcare settings or linen management. Provision of personal protective equipment 4.— (1) [F1Subject to paragraph (1A),] every employer shall ensure that suitable personal protective equipment is provided to [F2their workers] who may be exposed to a risk to their health or safety while at work except where and to the extent that such risk has been adequately controlled by other means which are equally or more effective. (3) Without prejudice to the generality of paragraphs (1) and (2), personal protective equipment shall not be suitable unless—[F8 (a) it is appropriate for the risk or risks involved, the conditions at the place where exposure to the risk may occur, and the period for which it is worn; (b) it takes account of ergonomic requirements and the state of health of the person or persons who may wear it, and of the characteristics of the workstation of each such person;] (c) it is capable of fitting the wearer correctly, if necessary, after adjustments within the range for which it is designed; (d) so far as is practicable, it is effective to prevent or adequately control the risk or risks involved without increasing overall risk; Assessment of personal protective equipment 6.— (1) Before choosing any personal protective equipment which by virtue of regulation 4 [F1they are] required to ensure is provided, an employer or [F2relevant self-employed person] shall ensure that an assessment is made to determine whether the personal protective equipment [F3they intend] will be provided is suitable. (2) The assessment required by paragraph (1) shall include— (a) an assessment of any risk or risks to health or safety which have not been avoided by other means;

Assessment of evidence

(b) the definition of the characteristics which personal protective equipment must have in order to be effective against the risks referred to in sub-paragraph (a) of this paragraph, taking into account any risks which the equipment itself may create;

(c) comparison of the characteristics of the personal protective equipment available with the characteristics referred to in sub-paragraph (b) of this paragraph.

(d) [F4 an assessment as to whether the personal protective equipment is compatible with other personal protective equipment which is in use and which [F5a worker] would be required to wear simultaneously.]

Maintenance and replacement of personal protective equipment

7.—

(1) Every employer shall ensure that any personal protective equipment provided to [F1their workers] is maintained (including replaced or cleaned as appropriate) in an efficient state, in efficient working order and in good repair.

(2) Every [F2relevant self-employed person] shall ensure that any personal protective equipment provided to [F3them] is maintained (including replaced or cleaned as appropriate) in an efficient state, in efficient working order and in good repair.

Accommodation for personal protective equipment

8. Where an employer or [F1relevant self-employed person] is required, by virtue of regulation 4, to ensure personal protective equipment is provided, [F2they shall] also ensure that appropriate accommodation is provided for that personal protective equipment when it is not being used.

Information, instruction and training

9.—(1) Where an employer is required to ensure that personal protective equipment is provided to [F1a worker], the employer shall also ensure that [F2the worker] is provided with such information, instruction and training as is adequate and appropriate to enable [F2the worker] to know—

(a) the risk or risks which the personal protective equipment will avoid or limit;

(b) the purpose for which and the manner in which personal protective equipment is to be used; and

Assessment of evidence
(c) any action to be taken by [F2the worker] to ensure that the personal protective equipment remains in an efficient state, in efficient working order and in good repair as required by regulation 7(1) [F3and shall ensure that such information is kept available [F4to workers]].

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
UK Government. Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (known as the Carriage Regulations). [cited 2024 January 24]	Legislation	**Mandatory**	N/A	N/A	N/A
Assessment of evidence					
This piece of legislation provides regulations for the transportation of dangerous goods – which may include linen contaminated by use in patients with HCID.					

Assessment of evidence
“Most of the used linen that is transported to off-site laundries will not normally be assessed as dangerous for transport. Occasionally, infectious linen will need to be classified as dangerous for transport, such as when a consignment is thought to contain pathogens that pose a significant risk of spreading disease and the load is heavily soiled to the extent that the potential for exposure and infection is high”.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
British Standard BS EN 14065. Textiles. Laundry processed textiles. Biocontamination control system 2016	Standard	**Level 4**	N/A	N/A	N/A

Assessment of evidence
Objectives: “The purpose of this standard is to provide for a management system that can effectively and consistently ensure provision of processed textiles with a microbiological quality appropriate for the intended use.” Although this standard provides specifications for healthcare linen, it is not specific for healthcare linen. The standard provides the following on risk analysis and process management principles for linen. “The approach used in this standard is to apply recognized risk and process management principles, and to provide for a Risk Analysis and Biocontamination Control (RABC) system. The first core RABC element is a general Prerequisite Programme (PRP) which includes the conditions and good manufacturing practices necessary to achieve and maintain the hygiene of the work environment, process and textiles. The second element is an operational PRP which includes the control measures that are most essential for protecting washed, dried textiles from re-contamination and cross-contamination until they are securely packed. The final RABC element is the seven RABC

Assessment of evidence

principles, which are applied to the most capable and crucial process steps, called Critical Control Points (CCPs) wherein textiles are thoroughly decontaminated. This can only be demonstrated through effective process validation. Where RABC implementation is complete and current, laundries can then assure all product released is suitable for its intended use through ongoing monitoring and verification that enables identification and remedial action for product from non-conforming processes."

The standard also provides and discusses 7 principles for the implementation of RABC. That is items that the RABC team must establish and implement. They include:

i. "List of microbiological hazards and list of control measures
ii. Determination of critical control points (CCPs) and control points (CP)
iii. Establishment of target levels and tolerance limits for each CCP
iv. Establishment of a monitoring programme for each CCP
v. Establishment of corrective actions
vi. Establishment of RABC system checking procedures
vii. Establishment of a documentation system"

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
British Standards. BS EN ISO 20743:2021 Textiles — Determination of antibacterial activity of textile products	Standard	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2021					
Assessment of evidence					
Scope: “This document specifies quantitative test methods to determine the antibacterial activity of all antibacterial textile products including nonwovens. This document is applicable to all textile products, including cloth, wadding, thread and material for clothing, bedclothes, home furnishings and miscellaneous goods, regardless of the type of antibacterial agent used (organic, inorganic, natural or man-made) or the method of application (built-in, after-treatment or grafting).” This document provides standards on textiles with antimicrobial activity, including antimicrobial-impregnated linen.					

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
British Standards BS EN 14885:2022 Chemical disinfectants and antiseptics — Application of European Standards for chemical disinfectants and antiseptics. 2022	Standard	**Level 4**	N/A	N/A	N/A

Assessment of evidence
Scope: “This document specifies the European Standards to which products have to conform in order to support the claims for microbicidal activity which are referred to in this document. This document also specifies terms and definitions which are used in European Standards. It is applicable to products for which activity is claimed against the following microorganisms: vegetative bacteria (including mycobacteria and Legionella), bacterial spores, yeasts, fungal spores and viruses (including bacteriophages). It is intended to: a) enable manufacturers of products to select the appropriate standards to be used in order to provide data which support their claims for a specific product; b) enable users of the product to assess the information provided by the manufacturer in relation to the use for which they intend to use the product; c) assist regulatory authorities in assessing claims made by the manufacturer or by the person responsible for placing the product on the market. It is applicable to products to be used in the area of human medicine, the veterinary area and in food, industrial, domestic and institutional areas.” Products covered in this standard include those for healthcare laundry.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
British Standards BS EN 14476:2013+A2:2019 Chemical disinfectants and antiseptics - Quantitative suspension test for the evaluation of virucidal activity in the medical area - Test method and	Standard	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
requirements (Phase 2/Step 1) 2019					
Assessment of evidence					
Scope: “This European Standard specifies a test method and the minimum requirements for virucidal activity of chemical disinfectant and antiseptic products that form a homogeneous physically stable preparation when diluted with hard water – or in the case of ready-to-use products, i. e, products that are not diluted when applied, – with water. Products can only be tested at a concentration of 80 % (97 %, with a modified method for special cases) as some dilution is always produced by adding the test organisms and interfering substance. This European Standard applies to products that are used in the medical area in the fields of hygienic handrub, hygienic handwash, instrument disinfection by immersion, surface disinfection by wiping, spraying, flooding or other means and textile disinfection.” “The document was revised to adapt it to the latest state of science, to correct errors and ambiguities, to harmonise the structure and wording with other existing tests of CEN/TC 216 or in preparation and to improve the readability of the standard and thereby make it more understandable. The following list is a list of significant technical changes since the last edition: • The scope was expanded for the following fields of application within the medical area, i.e. products for textile disinfection.”					

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
British Standard. BS EN 13624:2021 Chemical disinfectants and antiseptics — Quantitative	Standard	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
suspension test for the evaluation of fungicidal or yeasticidal activity in the medical area — Test method and requirements (phase 2, step 1) 2019					
Assessment of evidence					
Scope: “This document specifies a test method and the minimum requirements for fungicidal or yeasticidal activity of chemical disinfectant and antiseptic products that form a homogeneous, physically stable preparation when diluted with hard water, or – in the case of ready-to-use products – with water. Products can only be tested at a concentration of 80 % or less (97 % with a modified method for special cases) as some dilution is always produced by adding the test organisms and interfering substance. This document applies to products that are used in the medical area in the fields of hygienic handrub, hygienic handwash, surgical handrub, surgical handwash, instrument disinfection by immersion, and surface disinfection by wiping, spraying, flooding or other means,” “Fungicidal activity for textile disinfection products: The product shall be deemed to have passed the EN 13624 Standard if it demonstrates in a valid test for textile disinfection products at least a 4 lg reduction within the contact time according to the manufacturer's recommendation, at min. 20 °C and max. 50 °C for Candida albicans or max. 60 °C for Aspergillus brasiliensis, with the chosen interfering substance (dirty conditions) under the conditions defined by this document when the test organisms are Aspergillus brasiliensis and Candida albicans.” On yeasticidal activity for textile disinfection products, the document states “The product shall be deemed to have passed the EN 13624 Standard (yeasticidal activity) if it demonstrates in a valid test for textile disinfection products at least a 4 lg reduction within the contact					

Assessment of evidence
time according to the manufacturer's recommendation, at min. 20 °C and max. 50 °C, with the chosen interfering substance (dirty conditions) under the conditions defined by this document when the test organism is Candida albicans.”

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
British Standards. BS EN 14348:2005 Chemical disinfectants and antiseptics. Quantitative suspension test for the evaluation of mycobactericidal activity of chemical disinfectants in the medical area including instrument disinfectants. Test methods and requirements (phase 2, step 1) 2005	Standard	**Level 4**	N/A	N/A	N/A

Assessment of evidence
Scope: This document specifies a test method and the minimum requirements for mycobactericidal (or tuberculocidal) activity of chemical disinfectant products that form a homogeneous, physically stable preparation when diluted with hard water - or in the case of ready-to-use products - with water. Products can only be tested at a concentration of 80 % or less as some dilution is always produced by adding the test organisms and interfering substance. This document applies to products that are used in the medical area including those that are covered by the EEC/93/42 Directive on Medical Devices. This document applies to areas and situations where disinfection is medically indicated. Such indications occur in patient care, for example: in hospitals, in community medical facilities and in dental institutions; in clinics of schools, of kindergartens and of nursing homes; and may occur in the workplace and in the home. It may also include services such as laundries and kitchens supplying products directly for the patients.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
British Standards. BS EN 17126:2018 Chemical disinfectants and antiseptics. Quantitative suspension test for the evaluation of sporicidal activity of chemical disinfectants in the medical area. Test method and	Standards	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
requirements (phase 2, step 1) 2018					
Assessment of evidence					
“Scope: This document specifies a test method and the minimum requirements for sporicidal activity of chemical disinfectant that form a homogeneous, physically stable preparation when diluted with hard water, or - in the case of ready-to-use products - with water. Products can only be tested at a concentration of 80 % or less (97 % with a modified method for special cases) as some dilution is always produced by adding the test organisms and interfering substance. This European Standard applies to products that are used in the medical area in the fields of instrument disinfection by immersion, and surface disinfection by wiping, spraying, flooding or other means. This European Standard applies to areas and situations where disinfection is medically indicated. Such indications occur in patient care, for example: — in hospitals, in community medical facilities and in dental institutions; — in clinics of schools, of kindergartens and of nursing homes; and may occur in the workplace and in the home. It may also include services such as laundries and kitchens supplying products directly for the patients.” It provides the following on products for disinfection of textiles: “5.9.4 Sporicidal activity for textile disinfection products The product shall be deemed to have passed EN 17126 if it demonstrates in a valid test for textile disinfection products at least a 4 lg reduction within the contact time (max 60 min) and at the lowest temperature recommended by the manufacturer, min. 20 °C and max. 90 °C, with the chosen interfering substance (clean or dirty conditions) under the conditions defined by this standard when the test organisms					

Assessment of evidence
are Clostridium difficile spores for sporicidal activity against Clostridium difficile and Bacillus subtilis spores and Bacillus cereus spores for sporicidal activity.”

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
British Standards. BS EN 16616:2022 Chemical disinfectants and antiseptics. Chemical-thermal textile disinfection. Test method and requirements (phase 2, step 2) 2022	Standard	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
Scope: This document specifies a test method and the minimum requirements for the microbicidal activity of a specified disinfection process for the treatment of contaminated textile. This procedure is carried out by using a washing machine as specified in 5.3.2.18 and refers to the disinfection step without prewash. This procedure is not limited to certain types of textile. The suppliers' instructions are expected to be sufficient if they content the process parameters identified in the test (e.g. dosing disinfectant in whatever washing phase e.g. main wash, rinsing, disinfecting at 40 °C).					

Assessment of evidence
This document applies to areas and situations where disinfection is medically indicated. Such indications occur in patient care, for example: - in hospitals, in community medical facilities, and in dental institutions; - in clinics of schools, of kindergartens, and of nursing homes; and could occur in the workplace and in the home. It could also include services such as laundries and kitchens supplying products directly for the patients. 5.9.2.1 Processes at temperatures < 60 °C to 70 °C No test organisms are to be detected on the non-contaminated carriers. a) Bactericidal activity The product shall be deemed to have passed this document if it demonstrates in three valid runs for textile disinfection products < 60 °C under the conditions specified in this document when the test organisms Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa and *Enterococcus hirae* show at least a mean value of 7 lg reduction for the carriers. This reduction shall be shown at least on 8 of 10 contaminated carriers for each microorganism in each run. b) Yeasticidal activity The product shall be deemed to have passed this document if it demonstrates in three valid runs for textile disinfection products < 60 °C under the conditions specified in this document when the test organism *Candida albicans* shows at least a mean value of 6 lg reduction for the carriers. This reduction shall be shown at least on 8 of 10 contaminated carriers in each run. c) Fungicidal activity (additional) The product shall be deemed to have passed this document if it demonstrates in three valid runs for textile disinfection products < 60 °C under the conditions specified in this document when the test organism *Aspergillus brasiliensis* shows at least a mean value of 6 lg reduction for the carriers. This reduction shall be shown at least on 8 of 10 contaminated carriers in each run.

Assessment of evidence
d) Tuberculocidal activity (additional) The product shall be deemed to have passed this document if it demonstrates in three valid runs for textile disinfection products < 60 °C under the conditions specified in this document when the test organism *Mycobacterium terrae* shows at least a mean value of 7 lg reduction for the carriers. This reduction shall be shown at least on 8 of 10 contaminated carriers in each run. e) Mycobactericidal activity (additional) The product shall be deemed to have passed this document if it demonstrates in three valid runs for textile disinfection products < 60 °C under the conditions specified in this document when the test organisms *Mycobacterium terrae* and *Mycobacterium avium* shows at least a mean value of 7 lg reduction for the carriers. This reduction shall be shown at least on 8 of 10 contaminated carriers for each microorganisms in each run. 5.9.2.2 Processes at temperatures ≥ 60 °C No test organisms are to be detected on the non-contaminated carriers. The product shall be deemed to have passed this document if it demonstrates in three valid runs for textile disinfection products ≥ 60 °C under the conditions specified in this document when the test organism *Enterococcus faecium* shows at least a mean value of 7 lg reduction for the carriers, however additional microorganisms can be tested as well. This reduction shall be shown at least on 8 of 10 contaminated carriers in each run.

Question 3: How should linen be categorised?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health & Social Care. Infection prevention and control: resource for adult social care. [updated 2024 March 1; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This British document "contains general infection prevention and control (IPC) principles to be used in combination with advice and guidance on managing specific infections. It is for those responsible for setting and maintaining standards of IPC within adult social care in England."

The document provides the following on the categorisation of laundry:

"There are 3 categories of laundry:

- clean – laundry that has been washed and is ready for use

Assessment of evidence
• used – used laundry not contaminated by blood or body fluids • infectious – laundry used by a person known or suspected to be infectious and/or linen that is contaminated with blood or body fluids, for example faeces. **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Healthcare Laundry Accreditation Council. HLAC Accreditation Standards: Accreditation Standards for Processing Reusable Textiles for Use in Healthcare Facilities. 2023 May [cited 2024 January 24]	Standards	**Level 4**	N/A	N/A	N/A

Assessment of evidence
These American standards were developed by the Healthcare Laundry Accreditation Council (HLAC) and “are intended to be used to obtain or maintain accreditation in the HLAC Accreditation Program. The standards represent the collective best judgment of HLAC leaders.” It defines hygienically clean as “A clean state, free of pathogens in sufficient numbers to minimize risk of infection”. “All soiled textiles must be assumed to be contaminated.” **Limitations** • Method of producing guidance not stated. • May not be applicable to Scottish health and care settings. • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
World Health Organization. Practical guidelines for infection control in health care facilities. 2003. [cited 2024 January 25]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
These international “guidelines have been prepared specifically to assist infection control practitioners in the management and prevention of hospital-associated infections and to ensure that health care administrators understand the significance of infection control programmes”. It provides the following on linen categorization: “Two categories of used linen are recognized. Where there is visible contamination by blood, body fluids, secretions and excretions, this may be called ‘soiled’ or ‘contaminated’. Other used linen is termed ‘used’. These two categories should be segregated and treated separately.” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided. • May not apply to Scottish health and care settings. • Unclear how recommendations were reached. • The document is also quite old.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Aucamp, Marina. "Housekeeping and Linen Management (Chapter 23)." In IFIC Basic Concepts	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
of Infection Control, 3rd edition. International Federation of Infection Control 2016 [cited 2024 January 25]					

Assessment of evidence

This chapter is part of Basic Concepts of Infection Control, published by the International Federation of Infection Control. The document provides the following in a discussion on 'dirty linen':

"There are different types of dirty linen:

- Used linen is linen that has been used in patient care but is not visibly soiled.
- Soiled linen is visibly contaminated with blood, body fluids, secretions, or excretions, i.e., with a high bio-load of microorganisms.
- Infectious linen is linen that was used in the care of patients on transmission-based precautions (i.e. patients with communicable disease, colonised, or infected with multi-drug resistant microorganisms). The contamination may not be visible.
- Infested linen is linen used in the care of patients with parasites, such as lice, fleas, bedbugs, or scabies"

Limitations

- Method of producing document not stated.
- May not apply to Scottish health and care settings.
- Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Surveillance Centre (HPSC) Public Health & Infection Prevention & Control Guidelines on Prevention and Management of Cases and Outbreaks of COVID-19, Influenza & other Respiratory Infections in Residential Care Facilities V1.13 [Updated 2023 December 13; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This Irish document aims to provide guidance for the prevention and management of cases and outbreaks of COVID-19 in residential care facilities where residents are provided with overnight accommodation. It provides the following on infectious linen: “All towels, clothing or other laundry used in the direct care of residents with suspected and confirmed COVID-19 should be managed as ‘infectious’ linen;”					

Assessment of evidence
Limitations • Method of producing guidance not stated. • Update process or schedule not provided. • May not apply to Scottish health and care settings. • Unclear how recommendations were reached. • References not provided. • Specific to COVID-19

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
National Clinical Effectiveness Committee. Prevention and control methicillin-resistant Staphylococcus aureus (MRSA) national clinical guideline No. 2. 2013 [cited 2024 January 24]	Guidelines	**AGREE Recommend with modifications**	N/A	N/A	N/A

Assessment of evidence
This Irish guideline aims “to provide guidance and standards for improving the quality, safety and cost effectiveness of healthcare in Ireland. The implementation of National Clinical Guidelines will support the provision of evidence based and consistent care across Irish healthcare services.” The document provides the following recommendations on categorising soiled linen. “All linen soiled with bodily fluids should be treated as contaminated by placing in a water-soluble or alginate stitched bag prior to placing in a laundry bag which is designated for contaminated linen by label or colour.” **Limitations** • Unclear link between evidence and recommendations

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Social Care	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2013 March [updated 2016 June 8; cited 2024 January 24]					

Assessment of evidence

This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”.

It provides the following on linen categories in social care:

“In the simple on-site care-home setting, two categories should be used relating to the process, and these can be colour-coded as follows:

- Standard process – off white or white. Soiled and fouled items should be placed into a water-soluble bag(s) (and additionally within a white cotton sack if required) or alternatively placed directly in a white impermeable bag. Heavily soiled items should have any solids removed prior to being placed into the bag. In larger premises, patients’ clothing may sometimes be bagged separately to bed linen.
- Enhanced process – red. These items should be sealed in a red water-soluble bag immediately on removal from the bed. This primary container should then be placed in an impermeable or nylon/ polyester bag. The enhanced process is defined in Chapter 6, ‘Linen processing’. Additionally the outer bag must carry a bold legend stating “Infectious linen”.

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Scottish Government. National uniform policy, dress code and laundering policy DL (2018)4 [cited 2024 January 24]	DL	Mandatory	N/A	N/A	N/A
Assessment of evidence					
This Scottish Government document sets out the policy on uniform laundering for health and social care staff. On categorisation of uniforms, the document states the following: "For laundering classification purposes, we have therefore identified 2 categories: a. Used uniform, which has been worn in conjunction with appropriate PPE b. Contaminated uniform, which following a PPE failure or other incident is visibly contaminated with blood or other body fluids, or uniform which Infection Control advise should be treated as contaminated following an outbreak."					

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Linen for Health and Social Care. Management and provision. 2013 March [updated 2016 June 8; cited 2024 January 24]					

Assessment of evidence

This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”.

It provides the following on linen categories in healthcare settings:

“The following definitions apply specifically to the healthcare setting. Further guidance on applying definitions and classifications to the social care setting are discussed in HTM 01-04 ‘Social care’.

- Used (soiled and fouled) linen: This definition applies to all used linen, irrespective of state, but on occasions contaminated by body fluids or blood. It does not apply to: linen from infectious patients; those suspected of being infectious; and other linen covered by the following paragraph on “infectious linen”.
- Infectious linen: This definition applies to: linen from patients with diarrhoea; linen contaminated with blood or body fluids from patients with blood-borne viruses and other conditions as specified by local policy (for example, varicella zoster and measles).

Assessment of evidence
• Heat-labile items: This category includes fabrics damaged by the normal heat disinfection process and those likely to be damaged at thermal disinfection temperatures. These fabrics should be washed at the highest temperature possible for the item; disinfection may be achieved by chemical disinfection, if required. Service-users should agree local policies regarding purchase of heat-labile items in accordance with available methods of disinfection and linen processing." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland. National Guidance for Safe Management of Linen in NHSScotland.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2018 [cited 2024 February 02]					

Assessment of evidence

This Scottish document aimed to provide guidance to ensure safe and consistent linen management and reprocessing practice in health and care environments within NHSScotland.

The document provides for three categories of linen and lists heat-labile linen as an extra category.

- “Clean: Linen washed and ready to be reissued to the service.
- Used: All used linen in the ward setting not contaminated by blood or body fluids.
- Infectious: All linen used by a person known, or suspected to be infectious and linen that is contaminated with blood or other body fluids e.g. faeces.

Used or infectious linen may also be categorised as heat-labile.

- Heat-labile: Linen that may be damaged (shrinkage/stretching) by thermal disinfection.”

The document also provides colour codes for outer linen bags or fabric hampers in healthcare settings.

“Linen hampers in healthcare settings must be colour coded to denote the various categories of linen. It is suggested that the following colour coding is used:

- Clean – White
- Used – White
- Heat-labile – Blue
- Infectious – Red”

Assessment of evidence
Limitations • Method of producing guidance not stated. • Update process or schedule not provided. • Unclear how recommendations were reached.

Question 4: What is the available evidence/guidance on products or methods for effective laundering of linen?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
National Center for Emerging and Zoonotic Infectious Diseases. Basic Infection Control and Prevention Plan for Outpatient Oncology Settings.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
CDC, 2011 December [cited 2024 January 24]					

Assessment of evidence

This American document was “developed for outpatient oncology facilities to serve as a model for a basic infection control and prevention plan. It contains policies and procedures tailored to these settings to meet minimal expectations of patient protections as described in the CDC Guide to Infection Prevention in Outpatient Settings. The elements in this document are based on CDC’s evidence-based guidelines and guidelines from professional societies (e.g., Oncology Nursing Society)”.

The document provides the following guidance on laundering soiled linen:

- “In general, If hot-water laundry cycles are used, wash with detergent in water ≥160°F (≥71°C) for ≥25 minutes
- If low-temperature (<160°F [<70°C]) laundry cycles are used, wash with proper concentrations of laundry chemicals that are suitable for low temperature washing”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Management and provision. 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”. It is not clear within the document what is considered a recommendation or not. Even though it sometimes uses language that will be considered as such. On disinfection of linen, the document states					

Assessment of evidence
• "Traditionally, linen has been disinfected using heat. One of the advantages of this method is that time–temperature relationships can easily be set and monitored. However, disinfection by heat may not be suitable for some materials, either because they cannot tolerate high temperatures or because specialised coatings may be damaged by a thermal process. Whichever process is selected, effectiveness at decontaminating items contaminated with heat-resistant organisms such as Clostridium difficile or enterococci may need to be considered. • Temperatures other than those specifically recommended in the 'Disinfection by heat' section, when maintained for an appropriate time, are acceptable and will also be capable of producing a disinfected product. For a thermal disinfection process, a particular time at a particular temperature can be expected to have a predictable lethal effect against a standardised population of organisms. • Energy and environmental impact should also be considered when selecting an appropriate process. • Others processes use a combination of raised temperature (but less than 65ºC) and chemical disinfection. These processes, often termed "chemo-thermal" disinfection, are gaining popularity and are constantly being developed into more sophisticated processes. The term "chemical disinfection" is used throughout this HTM and includes such processes as well as any chemical processes operating at ambient temperature. • An additional pre-wash cycle may be necessary for heavily soiled/infectious linen processed in washer-extractors. The use of this additional stage should be recorded in the local policy." On disinfection by heat, the document states: • "The washing process should have a disinfection cycle in which the temperature of the load is either maintained at 65ºC for not less than ten minutes or 71ºC for not less than three minutes when thermal disinfection is used. Alternative time– temperature relationships may be used as long as the efficacy of the process chosen is equal to or exceeds that of the 65º or 71ºC processes. With all these options, mixing time should be added to ensure heat penetration and assure disinfection. For conventionally-

Assessment of evidence
designed machines and those with a low degree of loading (less than 0.056 kg/L), four minutes should be added to these times to allow for adequate mixing time. For a heavy degree of loading (that is, above 0.056 kg/L), it is necessary to add eight minutes. • The routine validation of achievement of the above parameters is important. The adoption of recommendations in the 'Engineering, equipment and validation' volume of this HTM could assist in demonstrating compliance." On chemical disinfection including chemo-thermal processes, the document states: • "This process is essential for some heat labile items. A variety of processes using a range of chemical agents are available, and the exact process should be chosen in discussion and agreement with the infection control team for a care provider and with the appointed Microbiologist (Decontamination). • It is important that the chemical does not damage fire-retardant or other specialist coatings. Hypochlorite should not be used on fabrics treated for fire retardance. • Chemical disinfection processes also need to be validated, but traditional time– temperature relationships are not applicable. The entire process (including washing, dilution and disinfection) should be capable of passing the microbiological tests specified within this HTM, including the ability to process a sterile swatch and leave it free of viable microorganisms (see 'Microbiological test for disinfection stage' in the 'Engineering, equipment and validation' volume). In addition, a method for proving a disinfecting efficacy equal to or exceeding that of the 65º or 71ºC thermal disinfection processes using semipermeable dose strips is specified in this HTM" On disinfection of linen contaminated with Clostridium difficile, the document states the following: • "The studies show that Clostridium difficile contamination occurs from colonised and/or infected patients at significant levels. This contamination is not necessarily linked to the presence of visible soil on the linen concerned.

Assessment of evidence
• A standard washer-extractor is highly effective in reducing the extent of contamination present at the end of the linen decontamination process provided that the quality requirements match those offered under EQR within this guidance (see paragraph 1.14, ‘Essential Quality Requirements (EQR) and Best Practice (BP)’. • Additional tests have shown that CTWs are more effective than standard washer extractors. However, low-level contamination of linen will persist if the initial level of Clostridium difficile spore contamination is high, irrespective of which type of machine/process is used. • DH concludes, subject to future review, that the guidance offered in this HTM when properly applied as part of a quality system does give adequate and reliable safeguard against the spread of this form of contamination/infection for the purpose of general hospital care. • In the case of highly immunosuppressed or compromised patients, the advice of a clinical microbiologist should be sought. It may be appropriate to consider the use of disposable single-use products." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Prevention and control of infection in care homes – an information resource 2013 February [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This British guidance aims to "assist staff in taking all reasonable steps to protect both residents and staff from acquiring infections and cross infection; and provide information and guidance on infection prevention and control that will assist managers undertaking risk assessments and in developing policies".

The document provides the following requirements for laundering bedding:

"Heat disinfection: 65°C for 10 minutes or 71°C for 3 minutes. For heat-sensitive fabrics use a low temperature wash at 40°C and tumble-dry at a minimum of 60°C. See section on laundering pages 59-61 Linen should be changed at frequent intervals and when soiled."

The document also recommends that each resident should have their own towels and that they should be laundered as for bed linen.

"Heavily soiled items should also have a pre-wash/sluice cycle selected. The washing process should have a disinfection cycle in which the temperature of the load is either maintained at 65ºC for not less than ten minutes or 71ºC for not less than three minutes when thermal disinfection is used. Alternative time–temperature relationships may be used as long as the efficacy of the process chosen is equal to or exceeds that of the 65º or 71ºC processes."

"Heat-labile items should be washed at the highest temperature possible for the item. All items should then enter a drying process (when the item is compatible). Once removed they should be stored in a clean area, above floor level and not be kept in the laundry area."

Assessment of evidence
Limitations • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Social care. 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”. On laundering in social care settings, the document provides the following: “The standard process • This is the normal process applied for most of the service-users most of the time. It is generally comparable to the soiled or fouled definition used in the ‘Management and provision’ volume. • Many microorganisms will be physically removed from the linen, by the detergent and water, during the washing cycle of a well-made “A”-rated (for washing performance) washing machine for household use. • To comply with EQR (see paragraph 3.2, ‘EQR’), the standard processes should be performed in a washing machine for household use achieving an EU Ecolabel wash performance rating of A (not to be confused with the energy performance rating) when measured in accordance with BS EN 60456 (or equivalent commercial model). The items should be washed in the highest suitable temperature in accordance with the garment care label. The enhanced process • The enhanced process should be used when triggers are identified relating to the possibility of infectious linen or clothing being generated. Example triggers include: • unexplained diarrhoea and vomiting; • confirmed infection; • unexplained rashes; • confirmed cases of scabies/lice; • unexplained fever. • The enhanced process should be performed in a machine as for the standard process, but using a cycle with a minimum temperature of 60ºC, or the highest temperature suitable for heat-sensitive items.

Assessment of evidence
• To achieve the BP requirements (see paragraph 3.3, 'BP'), all enhanced processes should use a washing cycle that has either: • a thermal disinfection cycle that reaches 71ºC for at least three minutes or 65ºC for at least ten minutes; or • a chemical disinfection process that satisfies the requirements in the section 'Disinfection of linen' (in the 'Management and provision' volume). • All linen/clothing should enter the laundry through the appropriate dirty entrance and should not be stored but processed as soon as possible. • The laundry staff should never open any inner water-soluble bags. Instead, the bags should be transferred to the washing machine for decontamination. • Washing machines should not be overloaded. • Heavily soiled items should also have a pre-wash/sluice cycle selected. • Heat-labile items should be washed at the highest temperature possible for the item. • All items should then enter a drying process (when the item is compatible). Once removed, they should be stored in a clean area above floor level and not be kept in the laundry area". **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
European Centre for Disease Prevention and Control. Public health considerations for mpox in EU/EEA countries. Stockholm: ECDC; 2023 April [cited 2023 November 28]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This European guidance aims "to provide advice and considerations, based on currently available evidence, to public health authorities in EU/EEA countries on how to prepare for and respond to mpox cases should an increase occur in the coming months."

The document provides the following considerations for laundering linen used in the care of Mpox patients:

"Laundry of bed linens and clothes of Mpox cases should be washed separately from other bed linens and clothes, without shaking items. No high temperature is required if detergent is used."

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Lemass H, McDonnell N, O'Connor N, Rochford S. Infection Prevention and Control for Primary Care in Ireland. A Guide for General Practice. 2013 [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Irish document "is in response to the Health Information and Quality Authority (HIQA) standards and aims to highlight the relevant issues for infection prevention and control in Irish general practice."

It provides the following on linen disinfection:

"The standard disinfection process for linen (used and infected) requires thermal disinfection at 65 degrees for 10 minutes or 71 degrees for 3 minutes."

Limitations

- Although the document stated that review of the scientific literature and consultations were done, no further detail was provided.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
National Clinical Effectiveness Committee. Surveillance, Diagnosis and Management of Clostridium difficile Infection in Ireland. National Clinical Guideline No. 3. 2014 [cited 2024 January 24]	Guideline	**AGREE Recommend with modifications.**	N/A	N/A	N/A

Assessment of evidence

This Irish "guideline is intended to be relevant to all healthcare staff involved in the care of patients/residents that may be at risk of or have CDI in acute hospitals, long-term care facilities, other institutions and in primary care nationally."

On laundering of linen used in the care of patients with CDI, the guidance states:

- "Linen should be heat-disinfected during the wash process by raising the temperature to either 65°C for not less than 10 minutes, or preferably 71°C for not less than three minutes.
- Disinfection of heat labile materials (according to manufacturer instructions) can be achieved at low temperatures, by introducing 150 ppm of available chlorine into the penultimate rinse.
- Sorting or manually rinsing soiled laundry is not recommended. A sluice cycle should be the first stage of the automated washing process".

Assessment of evidence
• "Used laundry should be machine-washed separately from other washing on the hottest wash cycle suitable for linen and clothing. • Laundry soiled with diarrhoea should first be machine washed using a cold pre-wash cycle and then washed using detergent powder/liquid at the hottest wash cycle tolerated for the clothing". **Limitations** • Full search strategy not provided. • The link between evidence and recommendation were not always clear. • No updates have been done on the document even though it was due to be reviewed in 2017.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
World Health Organization. Interim infection prevention and control guidance for care of patients with suspected or confirmed filovirus haemorrhagic fever in health-care settings, with focus on Ebola.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2014 [cited 2024 January 24]					

Assessment of evidence

This international “document provides a summary of infection prevention and control (IPC) measures for those providing direct and non-direct care to patients with suspected or confirmed cases of Filovirus haemorrhagic fever (HF), including Ebola or Marburg haemorrhagic fevers, in health-care facilities (HCFs). It also includes some instructions and directions for those managing the implementation of IPC activities”.

The document provides the following recommendations:

“For low-temperature laundering, wash linen with detergent and water, rinse and then soak in 0.05% chlorine solution (a solution containing 500 ppm available free chlorine) for approximately 15 minutes. Linen should then be dried according to routine standards and procedures.

Washing contaminated linen by hand should be discouraged. However, if washing machines are not available or power is not ensured, take the soiled linen out of the container and empty it into a large drum container of water and soap. Soak the linen in this drum and make sure it is totally covered with water. Use a stick to stir; then throw out the water and refill the drum with chlorine 0,05% (a solution containing 500 ppm available free chlorine) and soak for 15 minutes. Remove the linen and then rinse in clean water. Remove excess water and spread out to dry. Avoid splashing as much as possible.”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
World Health Organization. Practical guidelines for infection control in health care facilities. 2003. [cited 2024 January 25]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This international document has been prepared "specifically to assist infection control practitioners in the management and prevention of hospital-associated infections and to ensure that health care administrators understand the significance of infection control programmes".

It provides the following 'general instructions' on linen decontamination:

- "Disinfect by using hot water and/or bleach (use heavy-duty gloves, eye protection and masks to protect against splashes)."
- "Wash linen (sheets, cotton blankets) in hot water (70°C to 80°C) and detergent, rinse and dry preferably in a dryer or in the sun. (Heavy-duty washers/dryers are recommended for the hospital laundry.)
- Wash woollen blankets in warm water and dry in the sun, in dryers at cool temperatures or dry-clean.
- When laundering linen from an isolation room do not sort, shake, or handle excessively."

The document also provides the following standard procedures for disinfecting and cleaning reusable PPE.

Reusable gown: "If reusable: launder as per the health care facility guidelines for soiled linen For example: launder in hot water (70° - 80°C) if possible OR Soak in clean water with bleaching powder 0.5% for 30 minutes" and "wash again with detergent and water to remove the bleach."

Assessment of evidence
Reusable cap: “If reusable: launder as per the health care facility guidelines for soiled linen For example: launder in hot water (70° - 80°C) if possible OR Soak in clean water with bleaching powder 0.5% for 30 minutes Wash again with detergent and water to remove the bleach” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Prevention and control of infection in care homes – an information resource. 2013 February [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This English document aims to “assist staff in taking all reasonable steps to protect both” Care home “residents and staff from acquiring infections and cross infection; and provide information and guidance on infection prevention and control that will assist managers undertaking risk assessments and in developing policies.” The document provides the following on linen decontamination in social care:					

Assessment of evidence
“Heavily soiled items should also have a pre-wash/sluice cycle selected. The washing process should have a disinfection cycle in which the temperature of the load is either maintained at 65ºC for not less than ten minutes or 71ºC for not less than three minutes when thermal disinfection is used. Alternative time–temperature relationships may be used as long as the efficacy of the process chosen is equal to or exceeds that of the 65º or 71ºC processes. Heat-labile items should be washed at the highest temperature possible for the item. All items should then enter a drying process (when the item is compatible). Once removed they should be stored in a clean area, above floor level and not be kept in the laundry area.”

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Centers for Disease Control and Prevention. Guidelines for environmental infection control in health-care facilities: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC).	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
MMWR 2003; 52 (No. RR-10): 1–48. 2004. [cited 2024 January 24]					

Assessment of evidence

This American guideline aims “to provide useful information for both health-care professionals and engineers in efforts to provide a safe environment in which quality health care may be provided to patients.”

The document provides the following recommendations:

- “Use and maintain laundry equipment according to manufacturers’ instructions. Category II
- Do not leave damp textiles or fabrics in machines overnight. Category II
- Disinfection of washing and drying machines in residential care is not needed as long as gross soil is removed before washing and proper washing and drying procedures are used. Category II”

The document provided the following recommendations for the laundry process.

A. “If hot-water laundry cycles are used, wash with detergent in water ≥160°F (≥71°C) for ≥25 minutes. Category IC (AIA: 7.31.E3)
B. No recommendation is offered regarding a hot-water temperature setting and cycle duration for items laundered in residence-style health-care facilities. Unresolved issue
C. Follow fabric-care instructions and special laundering requirements for items used in the facility. Category II
D. Choose chemicals suitable for low temperature washing at proper use concentration if low temperature (<160°F [<71°C]) laundry cycles are used. Category II
E. Package, transport, and store clean textiles and fabrics by methods that will ensure their cleanliness and protect them from dust and soil during interfacility loading, transport, and unloading. Category II”

Assessment of evidence
Limitations • No mention of plan or process for update – page also states “This page last reviewed 5/27/2003” • Unknown methods for producing guideline or consensus recommendations. • Some provisions may not be applicable to Scottish health and care settings

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Hooker EA, Ulrich D, Brooks D. Successful removal of *Clostridioides difficile* spores and pathogenic bacteria from a launderable barrier using a commercial laundry process. Infectious Diseases: Research and Treatment. 2020 May;13	Experimental	**Level 3**	Commercial laundering process of a polyurethane-coated fabric mattress barrier with detergent, sodium hypochlorite bleach and a souring agent.	N/A	Organism count (cfu/ml) Log_{10} reduction

Assessment of evidence
Objectives: This American study aimed to “determine the efficacy of a commercial laundry process in reducing bacterial and spore contamination” on a polyurethane-coated fabric mattress barrier. Setting: Experimental Washing machine type: Washer – Extractor Method: Three suspensions of microorganisms; the first one containing methicillin-resistant *Staphylococcus aureus* (ATCC 33592), *Pseudomonas aeruginosa* (ATCC 15442), *K pneumoniae* (ATCC 10031), and *Escherichia coli* (ATCC 11229); the second containing *Mycobacterium terrae* (ATCC 15755) and another containing *Clostridioides dificille* spores (ATCC 43598 Strain 1470 Serogroup F) were prepared for inoculation on the seams of three new polyurethane coated fabric mattress barrier. The seams are the most difficult-to-clean areas of the barrier. Representative body fluids and soils (a combination of Hucker’s and Miles soils) were used to simulate faecal matter and provide the protein and haemoglobin elements of blood to provide additional challenges to the load. The soil contained 10 g each of peanut butter, butter, flour, lard, dehydrated egg yolk, plus evaporated milk (15 mL), saline (3 mL), bovine serum (12 mL), dried milk powder (7.2 g), and rabbit blood mixed 1:1 with 0.85% saline (12 mL). Each test mattress barrier was laundered separately in a wash load with 11 ballast mattress barriers. Each mattress barrier in a wash load received 3g of soil, with three of the 11 ballast barriers receiving an additional 33.3g. The test barrier and five ballast barriers (including the three with an additional 33.3g of soil) received 100 ml of urine each. The test barrier and two ballast barriers (excluding the three with additional soil) also received 30ml of rabbit blood each. All were allowed to dry for at least 24 hours. Using a sterile spreader, The organisms were inoculated uniformly over a 4x4 inoculation area. The inoculum was allowed to dry for at least 2 hours and was visibly dry before testing. Each wash load (consisting of one test barrier and 11 ballast barriers) was laundered in a washer extractor consisting of eight steps running for a total of 34 minutes. The steps include a 2-minute flush with 1fl oz/100 lb detergent with a high water level at 60°C; a break process of 8 minutes with 4 fl oz/100 lb of alkali and 2 fl oz/100 lb of detergent with a low water level at 71.1°C; an eight (8) minutes bleach process with 6 fl oz/100 lb of 12.5% chlorine bleach with a low water level at 71.1°C; three 2-minutes rinse phases with high water levels at 60°C, 48.89°C and 37.78°C respectively; a 4-minute souring step with a souring agent at low water levels at 32.22°C and a final 6-minute low Spd extract process. All the barriers were dried at 71°C.

Assessment of evidence

The soiling, inoculation and laundering process was repeated for the three new and old test barriers (barriers that had undergone 200 laundry cycles, used to simulate linen at the end of life). There were two positive controls (one new and one with 200 cycles), the same with negative controls. The positive controls were soiled and inoculated in the same manner as the test but not laundered. They were used to verify the organism recovery efficiency and to establish the total viable cfus on the test barriers before laundering. The recovery target of at least 10^7 CFUs for each test organism was met.

The negative controls were not inoculated but laundered to determine if any relevant organisms were picked up in the laundering process. They were evaluated after the test barriers were laundered and again after organism recovery (the recovery target of less than 100 CFU/mL for each test organism was met).

Wash water was also sampled by aerobic plate count after the bleach portion of the wash cycle was completed (acceptance criteria of less than 10 CFU/100 mL were met).

Results: No pathogenic organism was found in any test barriers after laundering. The mean cfu count/ml was significantly reduced (none found) after laundering for all organisms in both new and old mattress barriers. The p-value was 0.037 for *E. coli, P. aeruginosa, S. aureus* and *K. pneumonia* in the end-of-life barriers and 0.034 for all other organisms in all other mattress barriers. All positive controls had >7.0 $\log_{10}$ cfu in the test areas, and all negative controls had no detectable growth after laundering.

Limitations

- Small sample size.
- The research was funded by the manufacturer of the launderable barrier.
- The lead author is also the manufacturer's staff (medical director).

Contributions to research question

This paper shows that the process it describes can sufficiently decontaminate polyurethane–coated fabrics using a washer–extractors type machine.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Owen L, Shivkumar M, Laird K. The stability of model human coronaviruses on textiles in the environment and during health care laundering. Msphere. 2021 Apr 28;6(2):10-128. Doi:10.1128/mSphere.00316-21	Experimental study	**Level 3**	Domestic laundering under different conditions	Industrial laundering	Viral recovery (Log_{10} $TCID_{50}$*/$25cm^2$)

Assessment of evidence

Objectives: This English study aimed to "to investigate the environmental stability of HCoV-OC43and HCoV-229E on different textile fiber types and their persistence on textiles during domestic and industrial laundering. The infectious viral titer of HCoV-OC43 and HCoV-229E was measured as a means to infer the potential risk of fomite transmission from textile surfaces, in contrast to the detection of viral RNA, which does not distinguish between infectious and inactive virus particles."

Methods: All experiments were done in triplicates on separate occasions (n=3). The exception was the laundering tests, which were conducted in duplicates in three independent washes (n=6).

Stability of infectious coronaviruses on textiles: Sterile 5x5cm swatches of 100% cotton, polycotton (65% cotton, 35% polyester), and 93% woven polyester were inoculated with 200µl of HCoV-OC43 or HCoV-299E (5 Log_{10} $TCID_{50}$*/$25cm^2$) suspended in Dulbecco's modified Eagle medium (DMEM) and incubated at room temperature (19.0±0.5°C, 34%±3% relative humidity) in a class 2 cabinet. The infectious virus was recovered from the textile by vigorous handshaking 30 times in Phosphate-buffered saline (PBS) at intervals of 0, 2, 6, 18, 24

Assessment of evidence
and 72 h post-inoculation. DMEM (without the virus) was also used to inoculate textile samples to serve as no-virus controls. Supernatants were titrated on BHK-21 (HCoV-OC43) or MRC-5 (HCoV-299E) cell monolayers seeded in a 96-well format. Plates were incubated at 33C, 5% CO2 for 4 days (HCoV-OC43) or 7 days (HCoV-299E) before scoring the wells for cytopathic effect (CPE). The 50% tissue culture infective dose was calculated using the Karber method. Leaching of viral inoculum from cotton and polycotton textile swatches into the petri dish housing the swatch was also evaluated. As polyester is not absorbent, it was not tested. As already described, sterile swatches of cotton and polycotton were inoculated with HCoV-OC43. After 0, 6, and 24 hours of incubation at room temperature, the swatch was removed, and the petri dish was swabbed thrice using a cotton swab. The swabs were vortexed for 30 seconds in 5ml of PBS, and the supernatant was titrated on BHK-21 cells as described earlier. Transfer of HCoV-OC43 to other surfaces from textiles: Sterile 5x5cm swatches of 100% cotton, polycotton (65% cotton, 35% polyester), and 93% woven polyester were inoculated with 200µl of HCoV-OC43 (5 Log_{10} $TCID_{50}$*/$25cm^2$) and incubated for 5 minutes to allow absorption of the inoculum or at room temperature for 2h, 18h, and 72h for polycotton, cotton and polyester respectively - the maximum time where HCoV-OC43 had been detected for each textile. The inoculated swatches were placed in contact with a sterile swatch of the same textile or a 5x5cm swatch of polyvinyl chloride (PVC) or polyurethane (PUR) safety flooring. For 10s under 100g pressure. The transfer of infectious viruses to textiles was determined by handshaking 30 times in PBS. Infectious virus was recovered from PVC/PUR by swabbing thrice with cotton swabs, vortexing for 30s in 5ml PBS, and filtering with a 0.45µm polyether sulfone (PES) syringe filter. Supernatants were titrated on BHK-21 cells, and viral titre was determined as already described. Effect of laundering. Sterile 5x5cm cotton swatches were inoculated with 200µl of HCoV-OC43 (8Log10 TCID50*/25cm2) suspended in either DMEM or artificial saliva as a soiling substance. The swatches were left at room temperature for 30 minutes to allow absorption before laundering. Some of the swatches were shaken by hand 30 times in 5ml PBS to determine the starting viral load present on them. Domestic laundering cycle: Inoculated swatches were processed using an Indesit IWSD61251 Eco machine (40°C main wash for 21 minutes and a cold rinse/spin for 44 minutes), alongside two sterile swatches (to evaluate cross-contamination) and 2kg polycotton makeweights (AATCC ballast type three). Temperature was monitored during the wash using an iButton Thermochron data logger.

Assessment of evidence
Washes were conducted at ambient temperature (23.44±0.06°C), with or without a detergent (standard ECE non-phosphate reference A detergent) and at 40C with a detergent. Domestic laundering in makeshift laundry bags: Domestic washes were also performed as already described but with the test swatches enclosed in a 50% polyester, 50% cotton blend pillowcase to simulate the practice of nurses who place their uniforms in pillowcases or reusable bags for laundering. Industrial laundering: Inoculated cotton swatches, sterile cotton swatches and 2kg makeweights prepared as earlier described were laundered in a commercial washing machine using the simulated industrial laundering process (35°C prewash for 3 minutes, 67°C main wash for 10 minutes, cold rinse and spin for 11 minutes) or On-Premises Laundering (OPL) cycle (40°C prewash for 4 minutes, 75°C main wash for 10 minutes, cold rinse and spin for 15 minutes).- Washes were conducted at ambient temperatures and without detergent (ambient water only) and with temperature and detergent. Ambient wash temperatures were 24.08±0.07°C for industrial cycles and 22.52±0.04°C for OPL cycles. 2.5ml/kg power extract and 3ml/kg Cool Care detergent were added during the prewash phase, and 16ml/kg Cool Asepsis disinfectant was added to the main wash phase for the industrial laundering process. For OPL cycles, however, 3ml/kg liquid detergent was added to the prewash phase and an extra 10ml/kg to the main wash phase. All detergents were from Christeyns, Ghent, Belgium. Statistics: Viral quantification for each sample was performed in technical quadruplicates. The significance of differences was tested using one-way ANOVA with Tukey's post hoc test where appropriate. Kruskal-Wallis tests with multiple comparisons or Mann-Whitney U tests were performed when assumptions of normality were not met. Results: Without simulated soiling with artificial saliva, no HCoV-OC43 was recovered from cotton swatches laundered using all three procedures with or without heat or detergent. However, in the presence of artificial saliva, 1.78±0.19 Log_{10} $TCID_{50}/25cm^2$ of HCoV-OC43 was recovered after domestic laundering without heat and detergent. No infectious virus (≤1.5 Log_{10} $TCID_{50}/25cm^2$) was recovered when cotton was washed in a domestic process at ambient temperature or at 40°C with detergent or in the industrial or OPL wash processes. There was no significant difference in infectious virus recovery from cotton enclosed in a pillowcase for laundering according to domestic processes at ambient temperature compared to cotton loose in the wash.

Assessment of evidence
No infectious virus (≤1.5 Log_{10} $TCID_{50}$/25cm^2) was recovered on sterile swatches placed alongside the wash for any of the laundering conditions investigated. This indicates that no detectable levels of cross-contamination occurred. No infectious virus was recovered from the no-virus controls. **Limitations** • Table showing laundering conditions unclear as the time for the different wash processes do not add up to the total time stated. • Some parts of the methodology were unclear. Contributions to question: This paper demonstrates that in the presence of soiling, coronavirus inoculated onto cotton swatches were only removed in their domestic wash process when detergent was used. It also showed that the coronavirus was removed when laundered according to the specific industrial or OPL process regardless of whether a detergent was used. *TCID – Tissue culture infective dose

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Tarrant J, Jenkins RO, Laird KT. From ward to washer: The survival of Clostridium difficile spores on hospital bed sheets through a commercial UK NHS healthcare laundry process.	Experimental study	**Level 3**	Laundering C. difficile contaminated linen according to HTM 01-04 laundry process.		Spore load (cfu/25cm^2)

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Infect Control Hosp Epidemiol. 2018;39(12):1406-1411.					

Assessment of evidence

Objective: This English study aimed to "To quantify the survival of Clostridium difficile spores on hospital bed sheets through the United Kingdom National Health System (UK NHS) healthcare laundry process (Health Technical Memorandum (HTM) 01-04) in vitro and on bed sheets from patients with C. difficile through the commercial laundry".

Methods: Sterile 5x5cm swatches of NHS sheets (100% cotton) were each inoculated with 0.1ml of C. difficile NCTC 11209 spore suspension containing 8 $\log_{10}$ CFU/ml spores. These were air dried overnight for 18 hours and then attached to a single NHS sheet using a sterile safety pin and placed in a washer extractor (Schulthess 6166, Wolfhausen, Switzerland). Each load weighed 6.5kg and contained 4 inoculated swatches, 4 sterile swatches and 10 additional sterile NHS (100% cotton) sheets. The temperature in the drum was monitored every 5 seconds by a data logger. The load was washed according to cycle parameters programmed by the detergent supplier according to industry standards. This cycle which took a total of approximately 90 minutes included a thermal disinfection process with 21.5L of water at 75°C for 10 minutes, sodium hypochlorite 15% (50ml) with 29.5L of water at 60°C for 5 minutes, rinse with 22L of cold water for 2 minutes, sour rinse with 50ml of peracetic acid with 26L of cold water for 2 minutes and spin for two minutes. Each of these processes was followed by draining except the spin process. The experiment was repeated with the clinical strain ribotype 001/072, and a control was also done without a detergent. On completion of the wash cycle, each swatch was vortexed five times for five seconds in 30ml of maximum recovery diluent (MRD) and then left in the MRD for five minutes. Surviving spore enumeration was done using vacuum filtering (black 0.45µm Whatman filter). For detergent cycles, the entire 30ml MRD was filtered. For the control cycles, however, duplicate 0.1ml samples were filtered, followed by duplicate 0.1ml samples from a 1 log10 serial dilution. The authors reported that method validations showed that filtration was successful at neutralizing the detergent, although the data was not shown. The filter membranes were then transferred to pre-reduced BHIS agar plates and incubated anaerobically at 37°C for 48 hours.

Assessment of evidence
A set of experimental sheets were delivered to the C. diff isolation ward weekly. The sheets used on patient beds within this ward was changed daily or when soiling occurred. The used sheets were placed in alginate bags and sealed. The alginate bags were placed in standard red plastic nonpermeable bags labelled 'Infected linen' and stored in the ward's used linen room. The bags were collected every 24 hours and transferred to an external waste compound overnight. From here, the experimental sheets were collected the following morning for sampling. Areas of the sheets soiled with faecal matter were identified and from these, 25cm^2 swatches were cut out leaving adjacent 25cm^2 of the soiled area for sampling after washing. The sheet was put back into the alginate bag, resealed and then into the red labelled bags and transported to the laundry on the same day. The cut-out swatches were placed individually in 50ml Falcon tubes containing 30ml of MRD and vortexed five seconds five times on high speed to recover the viable spores. The swatches were then removed, and the suspensions were heat shocked at 80C for 10 minutes in a water bath. The suspensions were then vacuum filtered, and the filter membranes transferred into Agar plates which were then incubated anaerobically at 37°C for 48 hours. At the laundering facility, the sampled sheets were washed in a washer-extractor (30kg commercial washer extractor) cycle meeting the minimum requirements of HTM 01-04 and handled according to BS EN 14065:2002. The post wash samples were processed as already described. At the NHS-approved commercial healthcare laundry, the sealed alginate bags were loaded into a washer extractor for a wash cycle for 75C for ≥3 minutes with 8 minutes mixing time using the same industrial detergent system used in the simulated washes. The washed sheets were thereafter moved to the ironer bed, where they were pressed and dries at 175°C for 3 seconds with 4 bars of pressure (calendaring). All presumptive C. diff positive plates were confirmed by the gold-standard latex agglutination and long-wave UV fluorescence test. Ribotyping was done by PCR with capillary gel electrophoresis (CE-ribotyping) at a PHE laboratory. Each investigation repeated thrice on 2 separate occasions (n=6) unless otherwise stated. Results After the completion of the simulated laundry process for the control cycle (without detergent), significantly fewer spores (but still heavily contaminated) were recovered for both C. difficile NCTC 11209 (4.95 $\log_{10}$ CFU/25cm^2; P≤0.05) and ribotype 001/072 (5.27 $\log_{10}$ CFU/25cm^2; P≤0.05) compared to the original inoculum (7 $\log_{10}$ CFU/25cm^2). There was no difference between the spores recovered between the two strains. Cross contamination of the sterile swatch placed was recorded and was similar for both strains (2.72 and 2.89 $\log_{10}$ CFU/25cm^2 for NCTC 11209 and ribotype 001/072respectively). Standard sporicidal disinfection threshold not met.

Assessment of evidence
In wash cycles that included detergents, the number of spores recovered was significantly reduced for both strains (P≤0.05) to 0-4 and 0-9 CFU/25cm^2 for NCTC 11209 and ribotype 001/072 respectively. Cross contamination of sterile swatches was also recorded and ranged from 0-8 and 0-14 CFU/25cm^2 respectively. Swatches removed the contaminated experimental sheets obtained from the ward had an average spore load of 51 CFU/25cm^2 (1.7 $\log_{10}$ CFU/25cm^2) with a range of 2-158 CFU/25cm^2. The post-wash swatches (after laundering at ≥71C for 3 minutes plus 8 minutes mixing, dried and finished) still produced an average spore load of 33 CFU/25cm^2, a post wash reduction of 18 CFU/25cm2 (or 0.45 $\log_{10}$ CFU/25cm^2). Ribotyping of isolates recovered pre and post wash showed that they were indistinguishable and had only a single minor difference from ribotype 001.072, suggesting that the spores recovered post wash were present before the wash and were not a result of contamination during the wash cycle. **Limitations** • The first process included in the cycle parameters is given as “Spectrum EU industrial washing system” with 21.5L of water at 40°C for 2 minutes. This is not clearly understood. • The reporting of the methodology was sometimes unclear.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Aucamp, Marina. "Housekeeping and Linen Management (Chapter 23)." In IFIC Basic Concepts of Infection Control, 3rd edition.	Guidance	**Level 4**			

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
International Federation of Infection Control 2016 [cited 2024 January 25]					

Assessment of evidence

This document, a chapter in the IFIC basic concepts provides the following recommendations on how linen should be laundered.

“A typical laundry cycle consists of a pre-wash (to remove gross soil), main wash, and rinse. The settings of the laundry cycle are determined by the quality of the water, the size of the load, and the laundry chemicals used. Apart from washing with water and a laundry detergent, further decontamination of linen is achieved by the temperature of the wash water, the laundry additives, as well as the drying and ironing process. If warm water is available, the washing cycle temperature and duration must be at least 71°C (160°F) for a minimum of 25 minutes.14 These parameters must be used in conjunction with the manufacturer’s instructions for the washing machine. Heat-sensitive patient clothing and uniforms must be washed at a temperature of no more than 40°C. If warm water is not available, laundry can be washed with water at a temperature of 22°C–25°C (71°F–77°F), however it is recommended that a disinfecting agent such as chlorine (bleach, i.e., sodium hypochlorite) or hydrogen peroxide be added to the wash cycle. Laundry detergents and other chemicals added to the laundry cycle must be approved by the facility and they must be used according to the manufacturer’s instructions.”

Limitations

- It is unclear how the guidance was produced and how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health & Social Care. Infection prevention and control: resource for adult social care. [updated 2024 March 1; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

"This resource contains general infection prevention and control (IPC) principles to be used in combination with advice and guidance on managing specific infections. It is for those responsible for setting and maintaining standards of IPC within adult social care in England."

"Where workers are responsible for laundering the clothing of a person with an infectious illness, these should be laundered at the highest temperature possible recommended by the manufacturer. For delicate items of infectious laundry consider using a laundry bleach or alternative laundry disinfectant. Heavily soiled items should have a pre-wash cycle or sluice cycle selected where available."

Limitations

- The methods used to develop the guidance was not provided.

Evidence from previous updates

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland. National Guidance for Safe Management of Linen in NHSScotland. 2018 [cited 2024 February 02]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Scottish document aimed to provide guidance to ensure safe and consistent linen management and reprocessing practice in health and care environments within NHSScotland.

“The purpose of linen reprocessing is to remove or kill microbial contamination. The linen wash process consists of 3 stages: washing, disinfection and dilution. These stages are required regardless of whether linen is used or infectious. The wash stages should ensure that all linen is visibly clean by removing contamination from the fabric; a chemical or thermal disinfection stage should be performed on all linen to reduce the number of viable microorganisms by killing; finally, the number of viable microorganisms on the fabric is reduced by dilution, a minimum of two rinse cycles should be performed to reduce the microbial burden and remove detergents and disinfectants in the wash effluent. Washing processes for used/infectious linen should be carried out in a defined, functionally separate area from clean linen storage.”

Assessment of evidence

"Wash (used and infectious) – thermal disinfection

- The washing process for both used and infectious linen should include a disinfection cycle where the temperature should be maintained at:
  - ✓ 65°C for not less than 10 minutes or, preferably,
  - ✓ 71° C for not less than 3 minutes.
- To ensure adequate mixing and heat distribution:
  - ✓ Up to 4 minutes should be added to the above times when using machines with low (less than 0.056kg/L) degrees of loading.
  - ✓ Up to 8 minutes should be added to the above times when using machines with high (more than 0.056kg/L) degrees of loading."

"Heat labile linen will be damaged (shrinkage/stretching) by temperatures above 40°C and therefore cannot be subjected to thermal disinfection. The majority of heat labile linen will be personal items/clothing belonging to a patient; in this case patients should have been offered the opportunity to take these belongings home to wash. It is unlikely that these items will present at the laundry facility. Appendix 1 contains additional information for washing heat labile linen in care settings where the patient is a resident."

"All linen should be removed from machines at the end of the day and not left overnight."

Limitations

- The methods used to develop the guidance was not provided.
- No update has been done even though the document's review date was 2020

Question 5: How should beds be stripped/made to minimise risk of infection transmission?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Centers for Disease Control and Prevention (CDC). Implementation of Personal Protective Equipment (PPE) Use in Nursing Homes to Prevent Spread of Multidrug-resistant Organisms (MDROs). 2022 [cited 2023 June 07]	Guidance	**Level 4**			
Assessment of evidence					
This American Guidance “is intended to provide guidance for PPE use and room restriction in nursing homes for preventing transmission of MDROs, including as part of a public health response. For the purposes of this guidance, the MDROs for which the use of EBP applies are based on local epidemiology.” Lists ‘changing linens’ as part of high-contact resident care activities requiring gown and glove use for enhanced barrier precautions.					

Assessment of evidence
"This applies to all residents with any of the following: • Infection or colonization with an MDRO when Contact Precautions do not otherwise apply • Wounds and/or indwelling medical devices (e.g. central line, urinary catheter, feeding tube, tracheostomy/ventilator) regardless of MDRO colonization status." **Limitations** • The methods used to develop the guidance was not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Prevention and control of infection in care homes – an information resource. 2013 February [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This English document aims to "assist staff in taking all reasonable steps to protect both residents and staff from acquiring infections and cross infection; and provide information and guidance on infection prevention and control that will assist managers undertaking risk assessments and in developing policies." "A disposable plastic apron should be worn during direct care, bedmaking or when undertaking the decontamination of equipment."					

Assessment of evidence
"Linen should be removed from a resident's bed with care and placed in an appropriate container according to the segregation category." "After handling linen, hands should be properly washed." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
WHO Patient Safety and World Health Organization. WHO guidelines on hand hygiene in health care. World Health Organization; 2009 January [cited 2024 January 25]	Guideline	**AGREE Recommend with provisos**	N/A	N/A	N/A

Assessment of evidence
This international guideline "provide a comprehensive review of scientific data on hand hygiene rationale and practices in health care." The document recommends hand hygiene after touching patient surroundings as part of the 'five moments of hand hygiene'.

Assessment of evidence
Hand hygiene should be performed after touching patient surroundings including “Changing bed linen, perfusion speed adjustment, monitoring alarm, holding a bed rail, clearing the bedside table” **Limitations** • Full search strategy and time periods searched not provided. • Inclusion and exclusion criteria not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Surveillance Centre (HPSC) Public Health & Infection Prevention & Control Guidelines on Prevention and Management of Cases and Outbreaks of COVID-19, Influenza & other Respiratory Infections in Residential Care Facilities V1.13	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
[Updated 2023 December 13; cited 2024 January 24]					

Assessment of evidence

This Irish document provides guidance for the public health and infection prevention and control management of SARS-CoV-2 and other respiratory infections in residential care facilities.

"When handling linen, the HCW should not:

a. rinse, shake or sort linen on removal from beds/trolleys;

b. place used/infectious linen on the floor or any other surfaces (e.g., a bedside locker/table top)").

"When managing infectious linen, the HCW should:

a. Place linen directly into a water-soluble/alginate bag and secure”.

"Disposable gloves and an apron should be worn when handling linen"

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.
- May not be applicable to Scottish health and care settings.
- Unclear how recommendations were reached.
- References not provided.
- Specific to COVID-19

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Public Health Agency of Canada. Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Healthcare Settings. 2017 [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Canadian guidance aims to "identify and promote infection prevention and control (IPC) practices and precautions for preventing the transmission of microorganisms in healthcare settings, with the exception of bone marrow transplant settings."

"Linen

i. Patient bed linen should be changed regularly and when soiled, upon discontinuation of contact precautions and following patient discharge.

ii. Soiled linen from healthcare settings should be handled in the same way for all patients without regard to their infection status. Soiled linen should be placed in a no-touch receptacle at the point-of-use.

iii. Soiled linen should be handled with a minimum of agitation to avoid contamination of air, surfaces and persons.

iv. Soiled linen should be sorted and rinsed outside of patient care areas, except specialized items (e.g., antiembolic stockings) and personal clothing in specific healthcare settings.

Assessment of evidence
v. Heavily soiled linen should be rolled or folded to contain the heaviest soil in the centre of the bundle. Large amounts of solid soil (e.g., feces or blood clots) should not be removed by spraying with water. A gloved hand and toilet tissue should be used to place the solid soil into a bedpan or toilet for flushing. vi. vi. Hand hygiene should be performed after handling soiled linen." **Limitations** • Unclear methodology – although the document states that a 'thorough search' was performed from 1999 onwards, no further detail is provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Royal College of Physicians of Ireland. Guidelines for the Prevention and Control of Multi-drug resistant organisms (MDRO) excluding MRSA in the healthcare setting. 2012 [cited 2024 January 25]	Guidance	Level 4	N/A	N/A	N/A

Assessment of evidence
This Irish document “aims to provide information and guidance on how to control the spread of these bacteria inside and outside the hospital both on a local and on a national level.” It provides the following on bedmaking/stripping: “All linen from patients infected with or colonised with MDRO should be considered to be contaminated/ infected, including bedding and adjacent curtains. Linen should be removed from the bed with minimal agitation and should be further managed in accordance with local policy and national guidance, where provided.” **Limitations** • Although the document noted the ‘consideration of published literature’, it is not clear how these were used. • Update process or schedule not provided.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Management and provision. 2013 March [updated 2016 June 8; cited 2024 January 24]					
Assessment of evidence					
This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”. The document provides the following on bedmaking/stripping: "Infectious linen in this category should not be sorted but should be sealed in a water-soluble1 bag, which should then be placed in an impermeable bag immediately on removal from the bed or before leaving a clinical department." "Soiled and fouled linen should be placed in an impermeable bag immediately on removal from the bed or before leaving a clinical department. " **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.					

Question 6: How should clean linen be safely handled?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Management and provision. 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”.					

Assessment of evidence
The document provides the following on handling clean linen: “Clean linen should be transported around wards on a clean trolley and handled with clean hands.” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Healthcare Laundry Accreditation Council. HLAC Accreditation Standards: Accreditation Standards for Processing Reusable Textiles for Use in Healthcare Facilities. 2023 May [cited 2024 January 24]	Standards	**Level 4**			

Assessment of evidence
These American standards were developed by the Healthcare Laundry Accreditation Council (HLAC) and “are intended to be used to obtain or maintain accreditation in the HLAC Accreditation Program. The standards represents the collective best judgment of HLAC leaders.” The document provides the following point on clean linen handling: 7.4.3.1.2. Drivers must use gloves to minimize contact with soiled textiles and use appropriate hand hygiene after glove removal. Gloves used to handle soiled linen must never come in contact with clean linen. **Limitations** • Method of producing guidance not stated. • May not be applicable to Scottish health and care settings. • Unclear how recommendations were reached.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland. National Guidance for Safe Management of	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Linen in NHSScotland. 2018 [cited 2024 February 02]					
Assessment of evidence					
This Scottish document aimed to provide guidance to ensure safe and consistent linen management and reprocessing practice in health and care environments within NHSScotland. "Perform hand hygiene before handling clean linen." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.					

Question 7: How should clean linen be stored?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Australasian Health Infrastructure Alliance Australasian Health Facility Guidelines Part D - Infection Prevention and Control Revision 7.0 2016 [updated 2020 November; cited 2024 June 27]	Guidelines	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This guideline was developed by the Australasian Health Infrastructure Alliance – "representatives from government health infrastructure planning and delivery entities in all jurisdictions in Australia and New Zealand." The document is intended to "support the delivery of optimal patient care through provision of an appropriate physical environment" and to be "used to inform the planning and construction of new health facilities". Although, it is stated on the webpage of the guidelines that it is developed through a three-step review process, no detail is provided as to how this is done. On storage of clean linen, the document states the following.					

Assessment of evidence
"The following refers to linen handling in inpatient accommodation units and other patient care areas. Clean linen should be stored: • in a dedicated space/bay with a ABHR dispenser located nearby; • in a clean dry location that prevents contamination by aerosols, dust, moisture and/or vermin; • on clean shelves and, if necessary, wrapped in a protective dust cover; • separately from used/soiled linen; and • in a manner that allows stock rotation." **Limitations** • Some of the provisions may not apply to Scottish health and care settings.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
MacCannell, T., Umscheid, C., Agarwal, R., Lee, I., Kuntz, G., Stevenson, K. & Healthcare Infection Control Practices Advisory Committee (HICPAC) Guideline for the Prevention and Control of Norovirus	Guidance	**AGREE Recommend with modifications**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Gastroenteritis Outbreaks in Healthcare Settings. Infection Control & Hospital Epidemiology, 2011 32(10), 939-969. Doi:10.1086/662025					

Assessment of evidence

This American guideline provides “specific recommendations for implementation, performance measurement, and surveillance” for the prevention and control of norovirus gastroenteritis outbreaks in healthcare settings.

The document states the following on unused linen from patient rooms after norovirus patients on isolation are transferred or discharged.

“Consider discarding all disposable patient-care items and laundering unused linens from patient rooms after patients on isolation for norovirus gastroenteritis are discharged or transferred. Facilities can minimize waste by limiting the number of disposable items brought into rooms/areas on Contact Precautions”.

Limitations

- Limited details provided for the guideline development group.
- No statement regarding editorial independence from funding body is provided.
- Link provided for formulation of recommendations and finalisation of guidance seems out of date and did not work.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Clinical Excellence Commission. Infection prevention and control practice handbook. 2020 [cited 2024 June 27]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Australian document aims to "provide practical, day-to-day guidance to support the implementation of the NSW Health Infection Prevention and Control Policy, which establishes the infection prevention and control mandatory standards for NSW health organisations (HOs) including Affiliated Health Organisations".

It provides the following points on storage of clean linen as per the 'AS/NZS (Australian/New Zealand Standard) 4146:2000 Laundry practice':

"Clean linen is to be stored:

- in a clean, dry place that prevents inadvertent handling, contamination by aerosols, dust, moisture or vermin and other soiled or contaminated items during sorting, packaging, transport and storage.
- on clean, washable shelves and, if necessary, wrapped in a protective covering;
- separately from used linen; and
- in a manner that will allow for stock rotation.

Clean linen should not be stored in patient bathrooms or places where there is a potential for moisture contamination.

Assessment of evidence
If clean linen is decanted from the linen trolley for bed making rounds, this linen should be discarded and not returned to the linen cupboard or clean linen trolley.” **Limitations** • Although systematic reviews were conducted for different topic areas, there was none for linen related subjects.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Social Care. 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”. On storage of clean linen in social care settings, the document states: “Processed linen should be stored in a clean area above floor level and should not be kept in the laundry area.” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health and Safety Executive. Managing infection risks when handling the deceased. 2018 July [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This British guidance "provides guidance on managing the risks of infection from work activities which involve handling the deceased". On Safe management of linen including uniforms, the document states "Store clean linen and clothing appropriately in a designated area and in sufficient supply for the scale of work. Dispose of any linen or work clothing that is unfit for reuse (e.g. badly torn)" **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Healthcare Laundry Accreditation Council. HLAC Accreditation Standards. 2023 May [cited 2024 January 24]	Standards	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This American "standards are intended to be used to obtain or maintain accreditation in the HLAC Accreditation Program. The standards represent the collective best judgment of HLAC leaders."					

Assessment of evidence
“Unwrapped clean textiles shall be stored in designated storage rooms, areas, or carts.” “Only clean textiles shall be stored in this area and signage posted as “Textile storage room”.” “Bundled and wrapped textiles shall be stored in open racks in the laundry, on the trucks, or at the customer’s facility provided the integrity of bundled and wrapped textiles is not compromised.” “. If unwrapped textiles are placed into carts or hampers and covered, the container shall remain covered at all times until delivered to the customer’s textiles storage room or other designated location in the healthcare facility.” “If the cart does not have a solid bottom (i.e., drain holes), the bottom must be lined with a hygienically clean barrier that prevents environmental contamination before placing clean textiles inside.” “If any textiles become soiled during storage, they must be rewashed and reprocessed in accordance with Part II Subpart 3 Section 3.1. of this HLAC Standard.” “Clean textiles shall be wrapped for delivery.” **Limitations** • Method of producing guidance not stated. • May not be applicable to Scottish health and care settings. • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
National Clinical Effectiveness Committee. Prevention and control methicillin-resistant Staphylococcus aureus (MRSA) national clinical guideline No. 2." 2013 [cited 2024 January 24]	Guidelines	**AGREE Recommend with modifications.**	N/A	N/A	N/A

Assessment of evidence

This Irish guideline aims “to provide guidance and standards for improving the quality, safety and cost effectiveness of healthcare in Ireland. The implementation of National Clinical Guidelines will support the provision of evidence based and consistent care across Irish healthcare services.”

The document provides the following recommendations when caring for residents colonised or infected with MRSA in residential care facilities.

“Clean linen should be stored in a clean dry area.”

Limitations

- The link between evidence and recommendations were not always clear. This is partly due to the format in which the guidance was written – as only the grade of the evidence (but not the references) was attached to each recommendation. The references are

Assessment of evidence
provided in a segment after each group of recommendations called ‘rationale’. However, while this segment seems to interrogate the evidence, it doesn’t always show how they translate into recommendations.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Balm MN, Jureen R, Teo C, et al. Hot and steamy: outbreak of Bacillus cereus in Singapore associated with construction work and laundry practices. J Hosp Infect. 2012;81(4):224-230. Doi: 10.1016/j.jhin.2012.04.022	Outbreak report	**Level 3**	N/A	N/A	N/A
Assessment of evidence					
Objectives: This Singaporean study describes the investigation and management of an outbreak of *Bacillus cereus* in a National University Hospital.					

Assessment of evidence
Setting: A 950-bed teaching hospital providing tertiary care for all patients. Clinical facilities include a mix of air-conditioned (AC) wards with single or two-person rooms and non-AC wards with shared rooms housing up to eight patients. The hospital has no burns unit. Organism: *Bacillus cereus* **Background:** Following a sudden increase in invasive infections caused by B. cereus group organisms in March 2010, when rates went above two standard deviations above the average of the last two years, an extensive report was launched. Prior to the noted increase, building work had been underway beside the hospital in 2008 which was expected to run until 2014. The project involved the construction of an underground railways station and three multi-storey buildings. The work began in 2008, with deep drilling phases in the early parts of 2009, 2010 and mid 2010 at three different sites around the hospital. A case was defined as an inpatient with B. cereus group-type organism isolated from clinical cultures after 1 March 2010. Data was collected on patient location and movements, IV devices and therapeutic interventions by clinicians. Patients were grouped into outbreak phase (March to August 2010), intervention phase (September 2010 to February 2011) and monitoring phase (March to August 2011). Terminal cleaning, at the time of the outbreak, was performed using a phenolic compound after the discharge of a patient with bacterial colonisation or infection requiring contact precautions. 1.0% solution of sodium hypochlorite (10,000 ppm, household beach) was used following discharge of patients with tuberculosis or viral illness requiring contact or droplet precaution. Routine cleaning was generally performed twice daily for acute wards using a quaternary ammonium-based disinfectant regimen. Equipment cleaning was done daily by nursing staff using alcohol wipes. Linen in the hospital was laundered by a commercial laundry located at the national prison. Most of the linen is laundered in continuous tunnel watchers at 70°C with 198 ppm hydrogen peroxide for 12 minutes of each cycle. A 50kg batch of linen enters the tunnel washers every 3 minutes, spending 3 minutes in each of the 14 wash compartments. Baby linen and infectious linen were washed separately in 300kg capacity drum washers. Linen is dried using industrial tumble driers at 110°C for 12 minutes and gowns and sheets are pressed at ~135°C for 10 seconds after which they are packaged in plastic bags for storage until use. Blankets and towels are not pressed. From August 2010, linen processing was contracted to another commercial laundry due to reasons unconnected to the outbreak. This laundry used 500kg capacity drum washers using >200ppm sodium hypochlorite with a peak temperature of 65°C for all type of linen.

Assessment of evidence
Investigations: Settle plates were placed in patient rooms, nursing stations, linen trolleys, and preparation areas on the most affected wards. Plates were read and B. cereus group species were identified using matric-assisted laser desorption/ionisation-time of flight-mass spectrometry (MALDI-TOF-MS). Settle plates were placed at two, four and eight months according to a predetermined protocol during a series of interventions. Ventilation systems were reviewed by hospital engineers and an external contractor and air sampling was done using an SAS 100 portable microbiological air sampler. Plates were examined to determine the proportion of B. cereus group colonies present. Air exchanges were measured, a smoke test was performed in two rooms, one with positive pressure ventilation and the other with standard air-conditioning. Following heavy contamination on settle plates from linen trolleys, laundry practices were examined closely. Semiquantitative assessment of linen was done using an immersion method, repeated at intervals to assess the effect of washing linen with >200 ppm sodium hypochlorite. Strips of 4x4cm fabric squares were cut from separate pieces of linen each was sonicated in 10ml of nutrient broth for two minutes and removed. The broth was centrifuged at 3000 rpm for five minutes after which the supernatant was removed and 25µl of the pellet was inoculated as a lawn on to a blood agar plate and incubated aerobically at 36°C. Batches of 20 – 30 pieces of similar type of linen were processed at the same time. Freshly laundered linen at the hospital were usually stored in airtight plastic bags until use. Given the high ambient temperature and humidity in Singapore, it was postulated that storage in those conditions might encourage the propagation of B. cereus spores. To test this, linen from the same washing batch was stored for 24h in either plastic bags or porous canvas bags. Both laundries were visited on separate days in August. Settle plates were placed throughout both laundries and swab samples from inside the drum washers at both laundries were collected. Water samples from the CTWs at the primary laundry were also taken. In addition, pieces of autoclaved linen were washed in a batch of dirty linen to evaluate whether transfer of spores was occurring during the wash process. Cultures were also obtained from gloves used for accessing IV devices, infusion flush fluids and infusion tubing sets. Hospital environmental cleaning procedures were reviewed. Statistical analysis was performed using STATA using tests of two proportions to calculate Z-scored with $p<0.05$ considered significant. **Findings:** Routine surveillance showed a 10-fold increase in B. cereus group organisms in clinical samples during a 5-month period in 2010. Although B. cereus predominated, other species of the B. cereus group were represented. Blood cultures with B. cereus group increased a mean monthly rate (±SD) or 24 ± 14 (range 0-50) to 122 ± 48 (range: 60-200) per 10,000 blood cultures performed. Increased isolation was also noted in wound, fluid, and sterile sites but not in respiratory or urine cultures. Cases were reported in 33 of 37 wards. Among these, 52/171 (30.4%) cases occurred in haematology or oncology patients, some of whom had evidence of sepsis without any alternative explanation. The mean number of patients with B. cereus group organisms recovered from clinical cultures which was seven

Assessment of evidence
per month (±3.58, range 1-11) in 2008-2009 rose steadily to 51 in August 2010, the peak of the outbreak. During the outbreak period, 201 positive cultures for B. cereus group organisms were recovered from 171 patients (0.71% of admitted patients). Median age of patients was 51 years (range 0-97) and 65.5% were male. 34.9% (51/146) of patient bacteraemia episodes occurred in immunocompromised patients, 39% (57) in patients that had intravascular devices and 26.7% (39) in patients who were both immunocompromised and had intravascular devices. Deep tissue involvement was evident in 20 patients and 29 patients required therapeutic interventions including IV vancomycin, removal of 18 central lines or portacaths and two external ventricular drains. Multiple Bacillus spp were identified as B. cereus group organisms from air samples after settle plates were exposed for a 1h period. An index of B. cereus group air contamination derived from the index of microbial air contamination (IMA) was calculated and showed highest contamination from inner surfaces of linen trolleys and within patient rooms in all wards. Active air sampling showed extremely high bacillus counts in outside air (~600 cfu/m^3) but low counts within empty rooms without linen (0-5 cfu/m^3). Particle counts and air exchanges per hour complied with hospital guidelines. Bacillus spp, mostly B. cereus – were isolated from all types of linen sampled at the beginning of the investigation in August 2010. The density of contamination increased with more absorbent materials. Towels had an average contamination density of 7403 ± 1054 cfu/cm^2, cotton blankets 840 ± 386 cm^2, patient gowns 585 ± 356 cfu/cm^2, fitted sheets 370 ± 191 cfu/cm^2, and flat cotton sheets 80 ± 36 cfu/cm^2. Settled plates in areas where linen was handled in both laundry sites showed semiconfluent growth of bacillus. Water sampling showed high bacillus counts in partially recycled pre-wash water (7.2 x10^2 cfu/ml), 2.4 x 10^2 cfu/ml and 4.1 x 10^4 cfu/ml in the compress water post-final extraction from each tunnel washer. Water recycled to the washers showed 3.9 x 10^2 cfu/ml, demonstrating that bacillus remained viable after water treatment. Internal surfaces of washing machines were however not contaminated with Bacillus spp and co-washing with sterile linen showed minimal transfer of viable spores during the wash process. Only one colony of B. cereus was found in one of the four samples tested. No growth was observed in samples from glove, infusion fluid or infusion tubing samples. The investigators also found that storage of freshly laundered linen in plastic bags encouraged the propagation of spores compared to storage in porous canvas bags. After a 24-hour storage period, there was a significantly higher contamination in the towels stored in the plastic bags (10 per bag) (4437 cfu/cm^2; CI: 3125-5750) compared to those stored in the canvas bags (166 cfu/cm^2; CI: 76-256; P<0.001). **Interventions:** Non-Laundry: Initial interventions targeted the haematology-oncology units at the beginning of the outbreak as patients there were most likely to have bacillus isolated from clinical specimens associated with clinical symptomatic infection. Disinfectant used for terminal cleaning was changed to 0.5% acidified bleach (5000ppm, one part 5% sodium hypochlorite, eight parts water and one part vinegar)

Assessment of evidence
throughout the hospital. Oncology wards were cleaned thoroughly with bleach and cleaned terminally after each patient discharge. Aseptic technique for IV device access was reviewed and reinforced by directly observed assessment. Removal of IV devices was advised if there was a bacteraemia recurrence despite vancomycin treatment, if the B. cereus group was isolated from paired peripheral and line cultures, or if the patient was septic with no organism implicated. Additional filters were also placed in the ventilation system and all re-usable filters were cleaned monthly. Laundry: Autoclaved towels were used in the four haematology–oncology wards from 28 August, when linen contamination was suspected. At both commercial laundries, switching to a bleach-based protocol for white linen by September 2010 led to a reduction in contamination of towels from 7403 ± 1054 to 4437 ± 1128 cfu/cm^2 (P<0.001) after eight weeks. Laundered linen was thereafter stored in canvas bags from December 2010, leading to a sustained reduction in bacillus contamination of the towels. During a retest in February 2011, the contamination level was (107 cfu/cm^2; CI:58-157). **Outcomes:** Case numbers rapidly declined following interventions and returned to pre-outbreak levels (≤7 cases/month) by November 2010. “During the intervention period (September 2010 to February 2011), 63 positive cultures were obtained from 51 patients (0.23% of admitted patients, P < 0.01). Positive blood or line cultures comprised 38 patient episodes (74.5%), of which 24 (63.1%) occurred in immunocompromised patients or those with intravascular devices.” Reduction in contamination of the clinical environment was evidenced by reduced cfus in both settle plate and linen cultures during the intervention period. Interventions were thereafter relaxed at the end of February 2011. Autoclaving of towels for the haematology-oncology wards and terminal cleaning following patient discharge was discontinued. Case numbers rose from five per month to 11-17 almost immediately and were sustained at this level for six months following. In April, towel cultures showed that there had been another significant contamination of linen (2160 cfu/cm2; CI: 1128 – 3292). Investigation showed that the external laundry was still using an incorrect concentration of sodium hypochlorite and that only towels had been stored in the canvas bags due to cost constraints (other linen were still being stored in plastic). The external laundry was advised on the need to achieve 200ppm sodium hypochlorite in the rinse phase and to clean the environment thoroughly with 5000ppm sodium hypochlorite. The laundry made no changes despite these recommendations, and case numbers stayed up. In July 2011, towel cultures showed ongoing

Assessment of evidence
dense contamination with B. cereus (4093 cfu/cm2; CI: 2755-5340; compared to 107 cfu/cm2; CI: 58-157 in February 2011; P<0.001). At the time of the report, the outbreak team was still working with the external laundry to address the problems while monitoring the Bacillus spp contamination within the hospital as the construction work continued. Genetic relatedness: None performed. **Limitations:** • Genetic relatedness not done. • Outbreak was still ongoing at the time of the report. **Contribution to question:** This study shows that storing linen in plastic bags can encourage the growth of bacillus spores and that this can be mitigated by storage in porous canvas bags.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Ling ML, Apisarnthanarak A, Thu le TA, Villanueva V, Pandjaitan C, Yusof MY. APSIC Guidelines for environmental cleaning and decontamination.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Antimicrob Resist Infect Control. 2015;4:58. Published 2015 Dec 29. Doi:10.1186/s13756-015-0099-7					

Assessment of evidence

This document aims “to highlight practical recommendations in a concise format designed to assist healthcare facilities in the Asia Pacific region in implementing an environmental hygiene program.”

The document provides the following recommendations for storing clean linen.

- “There must be clear separation between clean and dirty laundry. [AII]
- There must be policies and procedures to ensure that clean laundry is packaged, transported and stored in a manner that will ensure that cleanliness is maintained. [BII]
- There must be designated areas for storing clean linen. [BII]”

Limitations

- Method of producing guidance unclear.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Association of Surgical Technologists. AST Guidelines for Best Practices for Laundering Scrub Attire. 2017 [cited 2024 June 26]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This American guidance aims to “provide information OR supervisors, risk management, and surgical team members can use in the development and implementation of policies and procedures for laundering scrub attire in the surgery department.”

The document provides the following recommendations on how clean, freshly laundered scrub attire should be stored:

“The scrub attire can be stored on shelves in the locker-room/changing room. 1) The shelves must be two inches from the wall; the top of any item on the top shelf must be eighteen inches below the ceiling; and the bottom shelf must be of solid, nonporous construction situated eight inches from the floor. There must be a written schedule in place for cleaning the shelves and floors in the storage area. 2) Clean textiles are required to be stored at a temperature of 68° F (20° C) to 78° F (25.6° C) in an area that is kept clean.”

Limitations

- Method of producing guidance unclear.
- Update process or schedule not provided.
- May not be fully applicable to Scottish health and care settings.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Aucamp, Marina. "Housekeeping and Linen Management (Chapter 23)." In IFIC Basic Concepts of Infection Control, 3rd edition. International Federation of Infection Control 2016 [cited 2024 January 25]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This document, a chapter in the IFIC basic concepts, provides the following recommendations on how clean linen should be stored.

“Clean linen must be transported from the laundry to the clinical area in a clean and closed linen cart or linen bags. In the clinical area linen must be stored on shelves in a clean linen room or in a cupboard with a door that can close. This way the linen can be kept clean until it is used. Trolleys with linen must not be parked for long periods outside in corridors or inside clinical areas. They can be placed outside rooms only for periods of bed-making.”

Limitations

- Method of producing guidance unclear.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health & Social Care. Infection prevention and control: resource for adult social care. [updated 2024 March 1; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

"This resource contains general infection prevention and control (IPC) principles to be used in combination with advice and guidance on managing specific infections. It is for those responsible for setting and maintaining standards of IPC within adult social care in England."

It provides the following on linen storage:

"Clean: Store clean linen in a clean, designated area, preferably an enclosed cupboard.

Used: All dirty linen should be handled with care, and attention paid to the potential spread of infection. Within a care home, place used laundry in an impermeable bag immediately on removal from the bed, or before leaving the person's room. Place the laundry receptacle as close as possible to the point of use, for immediate laundry deposit.

Handle used laundry safely by wearing a single use or washable apron to protect your clothing if necessary. Avoid:

- shaking or sorting laundry on removal from beds
- placing used laundry on the floor or any other surfaces

Assessment of evidence
• re-handling used laundry once bagged • overfilling laundry receptacles (not more than two-thirds full) • placing inappropriate items in the laundry receptacle **Infectious:** Infectious laundry includes laundry that has been used by someone who is known or suspected to be infectious and/or linen that is contaminated with body fluids. • Seal infectious laundry in a water-soluble bag (appropriate for the washing machine used) immediately on removal from the bed, and then place this within an impermeable bag. • Place water-soluble bags containing infectious laundry directly into the washing machine without opening the bags. • Use separate containers for transporting clean laundry, and used or infectious laundry, and wash infectious laundry separately. • Clean hands between handling different categories of laundry." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Sehulster LM, Chinn RYW, Arduino MJ, Carpenter J, Donlan R, Ashford D, Besser	Guidance	**4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
R, Fields B, McNeil MM, Whitney C, Wong S, Juranek D, Cleveland J. Guidelines for environmental infection control in health-care facilities: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). MMWR 2003; 52 (No. RR-10): 1–48. [cited 2024 January 24]					

Assessment of evidence
This American guideline aims “to provide useful information for both health-care professionals and engineers in efforts to provide a safe environment in which quality health care may be provided to patients.” The document recommends a minimum of two (2) air changes per hour for clean linen storage rooms.

Assessment of evidence
Limitations • No mention of plan or process for update – page also states, “This page last reviewed 5/27/2003” • Unknown methods for producing guidelines or consensus recommendations. • Some provisions may not apply to Scottish health and care settings

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Prevention and control of infection in care homes – an information resource. 2013 February [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This English document aims to “assist staff in taking all reasonable steps to protect both residents and staff from acquiring infections and cross infection; and provide information and guidance on infection prevention and control that will assist managers undertaking risk assessments and in developing policies.” The document provides the following on clean linen storage: “Laundered items should be stored in a clean area, above floor level and not be kept in the laundry area.”					

Assessment of evidence
Limitations • Method of producing guidance not stated. • Update process or schedule not provided.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland. National Guidance for Safe Management of Linen in NHSScotland. 2018 [cited 2024 February 02]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This Scottish document aimed to provide guidance on ensuring safe and consistent linen management and reprocessing practices in health and care environments within NHS Scotland.					

Assessment of evidence
It provides the following on linen storage: "All linen arriving at the laundry must be identified by the hospital, care area/ward/department, and dated. Portering, transport and laundry staff should not accept delivery or collect linen that is not appropriately bagged and labelled. • Upon arrival, linen should be held in a designated storage area until a viable complete load has been gathered. • The designated storage area for used/infectious linen should be secure and inaccessible to the public." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Management and provision.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2013 March [updated 2016 June 8; cited 2024 January 24]					

Assessment of evidence

This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”.

It provides the following on linen storage:

- “Storage areas should be dedicated for the purpose and not used for other activities. The storage area should be appropriately designed to prevent damage to linen and to allow for the rotation of stocks.
- Laundry rooms, central linen rooms, linen rooms, linen cupboards and mobile storage units should be equipped with shelving that can be easily cleaned and allow the free movement of air around the stored linen. Linen should be stored above floor level away from direct sunlight and water in a secure, dry and cool environment.
- Cleaning frequencies should be agreed locally but should be at least quarterly.
- Linen stocks should be removed temporarily to facilitate thorough cleaning of the storage area and shelving.
- Clean linen should be transported around wards on a clean trolley and handled with clean hands.”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Question 8: How should clean linen be transported?

Evidence added to the current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Clinical Excellence Commission Infection prevention and control practice handbook. 2020 [cited 2024 June 27]	Guidelines	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This Australian document aims to "provide practical, day-to-day guidance to support the implementation of the NSW Health Infection Prevention and Control Policy, which establishes the infection prevention and control mandatory standards for NSW health organisations (HOs) including Affiliated Health Organisations". It provides the following points on transporting clean linen: "Waste should not be transported in the same lift at the same time as clients/patients/residents or clean/sterile instruments /supplies/linen" "During transport externally to the hospital clean linen should be protected from the elements or potential environmental contamination (e.g. covered trolleys). Clean linen and used linen are not to be transported together unless separated by a suitable barrier					

Assessment of evidence
Limitations • Although systematic reviews were conducted for different topic areas, there were none for linen-related subjects.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Management and provision. 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”. It provides the following on clean linen transport. “Processed linen should be transported and stored in such a way as to avoid microbiological recontamination as far as is reasonably practicable.”					

Assessment of evidence
“If used to transport clean linen after transporting used or infectious linen, all reusable transport containers, cages and the inside hold area of transport vehicles should be decontaminated daily and between uses in order to ensure that the condition and decontaminated status of the linen is not compromised. This should be undertaken according to a documented procedure and the process validated. The use of easy-to-clean impervious smooth surfaces will aid this process.” “There should be a physical barrier between clean and used or infectious linen when carried on a vehicle at the same time. Linen bags that are not securely fastened should not be placed in a vehicle.” “Trolleys for clean linen in transit should be covered with a washable or disposable cover. If fully enclosed and sealed containers with lockable doors are used, these covers are not required.” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Healthcare Laundry Accreditation Council. HLAC Accreditation Standards. 2023 May [cited 2024 January 24]	Standards	**Level 4**	N/A	N/A	N/A

Assessment of evidence
These American “standards are intended to be used to obtain or maintain accreditation in the HLAC Accreditation Program. The standards represent the collective best judgment of HLAC leaders.” On transport Carts, the document states the following: “Clean textiles shall be wrapped for delivery.” “Carts shall be maintained in good working order with wheels free from strings or other debris that impairs functioning or collects dirt.” The document also says the following on cart cleanliness: • “Carts must be cleaned and disinfected in accordance with Part II Subpart 1 Section 1.4 of this HLAC Standard. • Carts, containers, reusable cart covers, and liners used for clean textiles shall be properly cleaned and disinfected after the cart is emptied and upon return to the facility. • Reusable textile cover materials (e.g., liners) must be washed before the next use. • If a cart used to transport clean textiles appears soiled, it must be cleaned and disinfected before it is subsequently used.” On vehicular transportation of linen, the document states: • “The best practice is to transport clean and soiled linen separately, however if clean and soiled textiles are transported in the same vehicle, proper and effective functional separation must be maintained at all times. • Separation must be accomplished by the use of physical barriers and/or space separation sufficient to protect clean textiles from contact with soiled textiles. • The interior of the vehicle’s cargo area used to transport healthcare textiles shall be cleaned on a regular basis per provider’s policies and procedures and whenever visibly soiled. • Should the interior surfaces of the cargo area become contaminated with blood or OPIM, these surfaces must be decontaminated, cleaned with a detergent and water, and disinfected with a hospital grade disinfectant labelled as tuberculocidal and used according to label instructions.”

Assessment of evidence
It also provides for hand hygiene for drivers of vehicles used for linen transport. • "Vehicles used to transport healthcare textiles must have alcohol-based hand sanitizer (ABHS) that contains at least 60 percent alcohol available on board for the purpose of hand hygiene." • "Drivers must use gloves to minimize contact with soiled textiles and use appropriate hand hygiene after glove removal. Gloves used to handle soiled linen must never come in contact with clean linen." • "Vehicles used to transport healthcare textiles shall have PPE and Spill Kits on board for the purpose of self-protection while cleaning and disinfecting the spill according to the provider's policies and procedures." For surgical textiles, the document recommends the following: "Carts that are utilized for clean surgical textiles must be cleaned and disinfected in accordance with Part II, Subpart 7, Section 7.3. of this HLAC Standard." **Limitations** • Method of producing guidance not stated. • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Siegel JD, Rhinehart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. [Last updated July 2023; cited 2024 January 24]					

Assessment of evidence

This American guideline aims to provide infection control recommendations for all components of healthcare, reaffirm the importance of transmission-based precautions as a foundation for preventing transmission during patient care, and provide recommendations for improving infection control.

It provides the following on linen transport in its review of the evidence on ‘textiles and laundry’.

“When laundering occurs outside of a healthcare facility, the clean items must be packaged or completely covered and placed in an enclosed space during transport to prevent contamination with outside air or construction dust that could contain infectious fungal spores that are a risk for immunocompromised patients.”

Limitations

- Lack of detail provided to determine if a systematic literature review was carried out to obtain evidence.
- May not be fully applicable to Scottish health and care settings.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Association of Surgical Technologists. AST Guidelines for Best Practices for Laundering Scrub Attire. 2017 [cited 2024 June 26]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This American guidance aims to “provide information OR supervisors, risk management, and surgical team members can use in the development and implementation of policies and procedures for laundering scrub attire in the surgery department.”

The document provides the following recommendations on transporting clean freshly laundered scrub attire:

“Clean, freshly laundered scrub attire should be protected from contamination when transported from the HDO laundry or commercial laundry facility to the storage area.

HLAC standards for transporting scrub attire should be followed.

The laundry facility is responsible for either using fluid-resistant material to wrap the scrub attire in bundles or place bundled, but unwrapped scrub attire into fluid resistant covered carts for transportation to the designated location, usually locker-rooms, where surgery personnel change into scrub attire. If the textiles are transported unwrapped, it must be lined with a hygienically clean barrier prior to placing the clean textiles inside.

1) During packaging the clean textiles should be handled as little as possible to prevent soiling or contamination. 2) Clean and soiled textiles must not be stored in the same container. 3) If a cart is soiled, it must be cleaned by either steam cleaning,

Assessment of evidence
cleaning with a detergent or water, or use of an Environmental Protection Agency (EPA) registered disinfectant. The EPA-registered disinfectant must be used according to the instructions on the label. The reusable cover must also be washed and dried. 4) If a cart is used to transport soiled textiles, it must be cleaned before next use, no matter if it is used to transport clean or soiled textiles. Reusable textile covers and liners must also be washed and dried before using again. 5) If clean and soiled textiles are transported by vehicle, the clean and soiled textiles must always be kept separate by either a physical barrier or sufficient space. The interior of the storage space of the vehicle must be cleaned on a regular basis per facility policy or when visibly soiled. 6) The vehicle must have a waterless antibacterial hand cleaner available for hand hygiene for the workers. The vehicle must also have PPE and spill kits for cleaning and disinfecting spills per employer's policies and procedures. The workers must wear gloves when handling visibly soiled textiles and upon removal of the gloves, perform a hand wash as soon as possible." **Limitations** • Method of producing guidance unclear. • Update process or schedule not provided. • May not be fully applicable to Scottish health and care settings.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Aucamp, Marina. "Housekeeping and Linen Management (Chapter 23)." In IFIC Basic Concepts of Infection Control, 3rd edition.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
International Federation of Infection Control 2016 [cited 2024 January 25]					

Assessment of evidence

This document, a chapter in the IFIC basic concepts provides the following recommendations on how clean linen should be transported.

“Clean linen must be transported from the laundry to the clinical area in a clean and closed linen cart or linen bags. In the clinical area linen must be stored on shelves in a clean linen room or in a cupboard with a door that can close. This way the linen can be kept clean until it is used. Trolleys with linen must not be parked for long periods outside in corridors or inside clinical areas. They can be placed outside rooms only for periods of bed-making.”

Limitations

- Method of producing document not stated.
- May not be applicable to Scottish health and care settings.
- Unclear how recommendations were reached.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
and NHS National Services Scotland. National Guidance for Safe Management of Linen in NHSScotland. 2018 [cited 2024 February 02]					

Assessment of evidence

This Scottish document aimed to provide guidance to ensure safe and consistent linen management and reprocessing practice in health and care environments within NHS Scotland.

The document provides the following on linen transport:

“Water soluble bags (also referred to as alginate bags) are used for the storage and transport of infectious linen. The entire inner bag is made from either a soluble material or the bag is impermeable but has soluble seams so that linen is released on contact with water. These bags are intended to be placed directly into the washing machine to minimise operator contact with infectious linen. The capabilities of the equipment and composition of the load should be determined in advance of linen reprocessing. Alginate bags must be placed in a clear polythene bag before being secured in a linen bag (hamper).”

“All linen bags (hampers) must be labelled with the hospital, care area/ward/department, and dated. Portering, transport and laundry staff will not accept delivery or collect linen that is not appropriately bagged and labelled.”

The document also provides the following recommendations for transporting linen in vehicles:

Assessment of evidence

- “Clean and used/infectious linen should not be transported in the same vehicle unless they can be physically separated, i.e. in a separate, covered cage or trolley.
- Drivers should have access to hand washing facilities at pickup and delivery points and carry a personal alcohol-based hand rub.
- Spill kits for managing body fluids spillages should be available in all linen transfer vehicles.
- All vehicles must have a documented cleaning schedule in place for both internal and external cleaning.”

The document also provides the following recommendations for internal transport and storage:

- “Trolleys used for transporting linen must be impervious and have a documented cleaning schedule in place following use (responsibility to be assigned by linen services manager).
- All reusable transport containers and cages should be decontaminated daily (responsibility to be assigned by linen services manager).
- Clean linen must be protected from environmental contamination, e.g. with an impervious protective covering. Clean linen should be stored separately (or physically separated, i.e. a separate compartment) from all other linen.”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.
- Unclear how recommendations were reached.

Question 9: How should ‘used’ linen be safely handled?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Clinical Excellence Commission Infection prevention and control practice handbook. 2020 [cited 2024 June 27]	Guidelines	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Australian document aims to “provide practical, day-to-day guidance to support the implementation of the NSW Health Infection Prevention and Control Policy, which establishes the infection prevention and control mandatory standards for NSW health organisations (HOs) including Affiliated Health Organisations”.

It provides the following points on the handling of used linen:

“All used linen should be handled with care to avoid dispersal of microorganisms into the environment and to avoid contact with HW clothing. Each HO is to have a written policy and/or procedures on the collection, transport, and storage of linen. Furthermore, a HO that processes or launders linen in-house will also have documented policies and/or procedures consistent with AS/NZS 4146:2000 Laundry Practice.

The following principles apply when handling linen used for all patients: i.e. whether or not transmission based precautions are required.

Assessment of evidence

- Handle soiled laundry with minimum agitation to avoid contamination of the air, surfaces and persons (e.g., roll up).
- Used, soiled or wet linen should be placed into appropriate laundry receptacle at the point of generation; water-soluble bags and double bagging are not necessary and are not recommended.
- Clear leak-proof bags are to be used to contain linen that is heavily soiled with blood, other body substances or other fluids (including wet with water).
- Linen bags should be tied securely and not be filled completely as this will increase the risk of rupture in transit and injury to bag handlers.
- Reusable linen bags must be laundered before re-use.
- Hand hygiene must be performed following the handling of used linen. Used or soiled linen are not to be rinsed or sorted in patient care areas or washed in domestic washing machines."

"Special handling of linen for clients/patients/residents on Additional Precautions is not routinely required.

Routine practices for handling and laundering are sufficient, regardless of the source of the linen.

Linen bags should be held away from the body to avoid potential risks of contamination and injuries due to possible sharps."

Limitations

- Although systematic reviews were conducted for different topic areas, there was none for linen related subjects.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Management and provision. 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”.

The document provides for the following with regards to safe handling of used linen:

“Immediately on removal from the bed or before leaving a clinical department, linen should be either:

- sealed in a water-soluble bag, which should then be placed in an impermeable bag; or
- sealed in an impermeable reusable bag having the infectious-linen colour code in accordance with the ‘Colour coding of linen bags’ section, and labelled, if considered necessary locally.”

“If a water-soluble bag is used, the inner bag should be transferred to the designated washer without opening.”

On colour coding of linen bags, the document states as follows:

Assessment of evidence
"Soiled and fouled linen: Linen not identified as infectious should be placed in a white impermeable bag for despatch to the laundry. A risk assessment should be taken at local level to be assured the containment of soiled and fouled linen is not compromised. All staff at local level should be trained in the correct coding and bagging procedures to ensure that sharps, clinical waste and non-clinical waste do not return to the laundry. … Heat-labile linen: All heat-labile linen should be placed inside an impermeable bag, the colour of which should be agreed with the laundry." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Prevention and control of infection in care homes – an information resource 2013 February [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This British guidance aims to “assist staff in taking all reasonable steps to protect both residents and staff from acquiring infections and cross infection; and provide information and guidance on infection prevention and control that will assist managers undertaking risk assessments and in developing policies”.

The document provides the following requirements for handling dirty linen:

“All dirty linen should be handled with care and attention paid to the potential spread of infection. Personal protective equipment (PPE) such as plastic aprons and suitable gloves should be worn for handling dirty or contaminated clothing and linen. Linen should be removed from a resident’s bed with care and placed in an appropriate container according to the segregation category. Personal clothing should also be removed with care and placed in the bag, not placed upon the floor. Linen and other dirty laundry should not be held close to the chest to prevent contamination of the uniform (a plastic apron should be worn). Any segregation required prior to washing should be carried out before transport to the laundry area, avoiding the need for additional handling within the laundry. Staff should never empty bags of linen onto the floor to sort the linen into categories – this presents an unnecessary risk of infection. Many care homes currently use water-soluble bags within cotton sacks in a wheeled trolley to facilitate this separation, keeping linen off the floor before taking the bags to the laundry. After handling linen, hands should be properly washed.”

“Within a care home, place used laundry in an impermeable bag immediately on removal from the bed, or before leaving the person’s room. Place the laundry receptacle as close as possible to the point of use, for immediate laundry deposit.”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Social Care. 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”. The document provides the following in respect to handling used linen: On handling dirty linen in social care settings, the document states in addition to the provisions in the Management and Provision document (see above): “If linen is sent to an off-site laundry, the laundry should be made aware of its nature, and written guidelines should be agreed and followed regarding its transportation and handling.”					

Assessment of evidence

- “All dirty linen should be handled with care and attention paid to the potential spread of infection.
- Personal protective equipment (PPE) such as plastic aprons and suitable gloves should be worn for handling dirty or contaminated clothing and linen.
- Linen should be removed from a service-user’s bed with care and placed in an appropriate container according to the segregation category (see Chapter 5, ‘Categorisation and segregation of linen’). Personal clothing should also be removed with care and placed in the bag, not placed upon the floor.
- Souled or fouled linen should not be held close to the chest to prevent contamination of the uniform (an apron should be worn). [this bullet may be more relev to RQ17 handling infectious linen?]
- Any segregation required prior to washing should be carried out before transport to the laundry area, negating the need for additional handling within the laundry. Staff should never empty bags of linen onto the floor to sort the linen into categories – this presents an unnecessary risk of infection. Many care homes currently use water-soluble bags within cotton sacks in a wheeled trolley to facilitate this separation, keeping linen off the floor before taking the bags to the laundry.
- After handling linen, hands should be washed properly.”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health and Safety Executive. Managing infection risks when handling the deceased. 2018 July [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This British guidance "provides guidance on managing the risks of infection from work activities which involve handling the deceased".

On Safe management of linen including uniforms, the document states:

"Categorise any linen (e.g sheets or blankets) used for transfer of the deceased at the point of use. For all used linen, provide a laundry container as close as possible to the point of use for immediate deposit. The used linen should not be:

- rinsed, shaken or sorted when removed from trolleys;
- placed on the floor or other surfaces (e.g locker or table top);
- rehandled once bagged.

Do not overfill laundry containers and do not put inappropriate items in them (e.g needles or used equipment).

Assessment of evidence
Store all used and contaminated linen in a designated safe area while awaiting collection or laundering. The storage should be lockable if it is in a publicly accessible area. A suitable frequency for collection or laundering should be in place to avoid a build-up of linen receptacles." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Healthcare Laundry Accreditation Council. HLAC Accreditation Standards: Accreditation Standards for Processing Reusable Textiles for Use in Healthcare Facilities. 2023 May [cited 2024 January 24]	Standards	**Level 4**	N/A	N/A	N/A

Assessment of evidence
These American standards were developed by the Healthcare Laundry Accreditation Council (HLAC) and “are intended to be used to obtain or maintain accreditation in the HLAC Accreditation Program. The standards represent the collective best judgment of HLAC leaders.” The document provides the following recommendations on occupational safety for drivers picking up and delivering laundry. “7.4.3.1.1. Vehicles used to transport healthcare textiles must have alcohol-based hand sanitizer (ABHS) that contains at least 60 percent alcohol available on board for the purpose of hand hygiene. 7.4.3.1.2. Drivers must use gloves to minimize contact with soiled textiles and use appropriate hand hygiene after glove removal. Gloves used to handle soiled linen must never come in contact with clean linen. 7.4.3.2. Vehicles used to transport healthcare textiles shall have PPE and Spill Kits on board for the purpose of self-protection while cleaning and disinfecting the spill according to the provider’s policies and procedures.” The document also provides PPE regulations for handling clean textiles: “6.4.2. Personnel attire in the surgical pack assembly room must protect personnel and the integrity of the textile product. (ANSI/AAMI ST65:2018, Std. 4.5.1)” “6.4.2.1. All head and facial hair (excluding eyebrows and eyelashes) must be completely covered. Hair and beard covers must be worn in areas where clean textiles are processed. If religious head coverings such as hijabs, veils, turbans or bonnets are worn, they should be clean, unadorned, constructed of tightly woven and low-linting material, and should fit securely, with loose ends tucked in the scrub top. Coverings such as kippahs and yarmulkes that cover only a portion of the hair and scalp may be worn under another head covering. (ANSI/AAMI ST65:2018; Std. 4.5.1; AORN 2019)” “6.4.2.2. Dedicated surgical pack assembly room attire laundered by the facility must be covered or changed upon leaving or entering the surgical pack assembly room in accordance with provider’s policy.” “6.4.2.2.1. When leaving the surgical pack assembly room, dedicated pack room personnel first must don the appropriate protective cover (e.g., cover gowns, shoe covers, hair covering, etc.) over their surgical pack assembly room attire and then must remove the appropriate

Assessment of evidence
protective cover (e.g., cover gowns, shoe covers, hair covering, etc.) that was over their surgical pack assembly room attire before re-entering the surgical pack assembly room in accordance with written facility policy. (AORN 2020)" "6.4.2.3. Dedicated shoes and/or disposable shoe covers must be worn in the surgical pack assembly room." "Standard/Universal Precautions must apply to all personnel who handle soiled textiles during moving, containing, loading, unloading, and sorting said textiles." "All healthcare textiles must be handled and collected in accordance with federal regulations or the Authority having Jurisdiction (AHJ), thereby minimizing potential exposure of laundry personnel to bloodborne pathogens or other infectious agents." "Soiled, contaminated textiles and fabrics must be handled and collected with minimal agitation at all times to prevent contamination of air, surfaces, clean textiles, and persons." **Limitations** • Method of producing guidance not stated. • May not be applicable to Scottish health and care settings. • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Lemass H, McDonnell N, O'Connor N, Rochford S. Infection Prevention and Control for	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Primary Care in Ireland. A Guide for General Practice. 2013 [cited 2024 January 24]					
Assessment of evidence					
This Irish document "is in response to the HIQA standards and aims to highlight the relevant issues for infection prevention and control in Irish general practice." The document provides the following with respect to handling used linen: "Staff handling soiled linen should wear gloves and a disposable plastic apron. Foul/infected linen must be placed carefully into a soluble alginate bag in line with the national linen segregation policy." **Limitations** • Although the document stated that review of the scientific literature and consultations were done, no further detail was provided. • Update process or schedule not provided.					

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
NHS National Patient Safety Agency The NHS Cleaning Manual.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2009 June [cited 2024 January 24]					

Assessment of evidence

The NHS Cleaning manual is intended as "as a resource for the Trust Board member or senior manager with responsibility for cleanliness and for all managers and staff with responsibilities for cleaning. The Manual is applicable to all healthcare settings including hospitals, ambulances, and primary care." It is aimed at providing "guidance on cleaning techniques and best practice advice on defining responsibilities, scheduling work, measuring outcomes, reporting and driving improvements.". The document provides the following with respect to handling used linen:

On terminal cleans of vacated rooms – using a hypochlorite disinfectant cleaning product:

- "Wash hands, put on single-use gloves and other protective wear required (see Health and Safety notes) and enter room.
- Display the warning signs.
- Take down curtains (refer to curtain changing method statement), place in separate clearly marked infected linen laundry bag.
- Strip bed and place linen in separate clearly marked infected linen laundry bag."

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Public Health Agency of Canada. Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Healthcare Settings. 2017 [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Canadian guidance aims "to identify and promote infection prevention and control (IPC) practices and precautions for preventing the transmission of microorganisms in healthcare settings, with the exception of bone marrow transplant settings."

In the glossary, under the entry for 'terminal cleaning', the document states that bed linens should be removed before terminal cleaning.

Limitations

- Unclear methodology – although the document states that a 'thorough search' was performed from 1999 onwards, no further detail is provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Aucamp, Marina. "Housekeeping and Linen Management (Chapter 23)." In IFIC Basic Concepts of Infection Control, 3rd edition. International Federation of Infection Control 2016 [cited 2024 January 25]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This document, a chapter in the IFIC basic concepts provides the following recommendations on how used linen should be stored. The document provides the following in handling used linen.

“All healthcare textiles must be handled and collected in accordance with federal regulations or the Authority having Jurisdiction (AHJ), thereby minimizing potential exposure of laundry personnel to bloodborne pathogens or other infectious agents.”

“Soiled, contaminated textiles and fabrics must be handled and collected with minimal agitation at all times to prevent contamination of air, surfaces, clean textiles, and persons.”

“Dirty linen must not be shaken unnecessarily to prevent aerosolisation of skin scales or other particles that may contain pathogens. When removing linen from a bed, fold it towards the centre of the bed. When linen is removed from the patient’s bed or examination trolley, the dirty linen hamper/bag must be taken to the bedside and the linen placed directly from the bed into the linen hamper to ensure minimum handling of linen and also to ensure that the healthcare worker does not contaminate his/her clothing.14,45 Soiled (wet), infectious, and

Assessment of evidence
infested linen must be placed into leak-proof plastic bags and the bags must be closed on the spot. No linen must be sluiced in the ward areas – sluicing creates aerosols; staff often do not wear the appropriate PPE when they sluice linen." **Limitation:** • May not be applicable to Scottish health and care settings. • Unable to access full book to ascertain method of development. • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
WHO Patient Safety and World Health Organization. WHO guidelines on hand hygiene in health care. World Health Organization; 2009 January [cited 2024 January 25]	Guideline	**AGREE 'Recommend with modifications'**	N/A	N/A	N/A

Assessment of evidence
This international guideline “provide a comprehensive review of scientific data on hand hygiene rationale and practices in health care.” The document recommends hand hygiene after touching patient surroundings as part of the ‘five moments of hand hygiene’. Hand hygiene should be performed after touching patient surroundings including “Changing bed linen, perfusion speed adjustment, monitoring alarm, holding a bed rail, clearing the bedside table” **Limitations** • Full search strategy and time periods searched not provided. • Inclusion and exclusion criteria not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health & Social Care. Infection prevention and control: resource for adult social care. [updated 2024 March 1; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
“This resource contains general infection prevention and control (IPC) principles to be used in combination with advice and guidance on managing specific infections. It is for those responsible for setting and maintaining standards of IPC within adult social care in England.” The documents provide the following on safe handling of used linen: **“Used**: All dirty linen should be handled with care, and attention paid to the potential spread of infection. Within a care home, place used laundry in an impermeable bag immediately on removal from the bed, or before leaving the person’s room. Place the laundry receptacle as close as possible to the point of use, for immediate laundry deposit. Handle used laundry safely by wearing a single use or washable apron to protect your clothing if necessary. Avoid: • shaking or sorting laundry on removal from beds • placing used laundry on the floor or any other surfaces • re-handling used laundry once bagged • overfilling laundry receptacles (not more than two-thirds full) • placing inappropriate items in the laundry receptacle” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland. National Guidance for Safe Management of Linen in NHSScotland 2018 [cited 2024 February 02]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Scottish document aimed to provide guidance to ensure safe and consistent linen management and reprocessing practice in health and care environments within NHS Scotland.

The document provides the following on linen handling:

“To protect against infection and cross-contamination, staff should be provided with uniforms and personal protective equipment (PPE). All staff should be trained and competent in the use of PPE, including the safe removal and disposal of PPE.

- Staff changing facilities should be provided.
- Hand washing facilities should be provided at entry/exit points of all washing/reprocessing areas.
- Staff handling linen should ensure that any abrasions or cuts on the hands are covered with a waterproof dressing.

Assessment of evidence

- Staff should wear PPE at all times when handling linen, such as:
  - ✓ disposable gloves (*puncture resistant if necessary);
  - ✓ disposable plastic aprons.

PPE should be safely removed and disposed of when moving between dirty and clean areas. http://www.nipcm.hps.scot.nhs.uk/ *Puncture resistant gloves used to prevent sharps injuries when decanting and sorting used linen are not required to be single-use disposable as there is no crossover with clean, processed linen. However, these gloves should be cleaned between use with soap and water and stored to dry. These gloves should be disposed of when visibly worn/damaged and immediately if contaminated with blood or body fluids."

"Perform hand hygiene after handling used/infectious linen."

Decanting linen/machine loading

- "Linen hampers should be opened as close to the machine as possible and never emptied onto the floor.
- All clear polythene bags should be disposed of as healthcare waste.
- If a water-soluble bag is present (as for infectious linen) this should not be opened but instead placed directly into the machine.
- After decanting the linen, place any reusable hampers directly into the machine.
- Follow the manufacturer's instructions for maximum and minimum load weights."

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.
- Unclear how recommendations were reached.

Question 10: How should ‘used’ linen be sorted?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Healthcare Laundry Accreditation Council. HLAC Accreditation Standards 2023 May [cited 2024 January 24]	Standards	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
These American “standards are intended to be used to obtain or maintain accreditation in the HLACA Accreditation Program. The standards represent the collective best judgment of HLAC leaders.” The document provides the following recommendations on sorting linen: “The surfaces in the soil sort room must be cleaned and disinfected in accordance with Part I Subpart 2 Section 2.2 of this HLAC Standard.” “All personnel who handle soiled healthcare textiles must follow Standard/Universal Precautions and use appropriate PPE for this task.” “Soiled textiles shall be sorted and loaded appropriately in order to provide hygienically clean linen.”					

Assessment of evidence
"Laundry bags and textiles contaminated with hazardous substances must be prewashed, and then the textiles added to other laundry for a second wash." "Foreign objects shall be removed during the sorting process to be disposed of or returned to the customer in accordance with provider/customer contract. • Reusable surgical instruments shall be retrieved from the textiles prior to laundering, placed into designated containers, and returned to the customer. • Disposable devices shall be retrieved from the textiles prior to laundering, discarded into designated containers, and/or returned to the customer." **Limitations** • Method of producing guidance not stated. • May not be applicable to Scottish health and care settings. • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Prevention and control of infection in	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
care homes – an information resource 2013 February [cited 2024 January 24]					

Assessment of evidence

This British guidance aims to "assist staff in taking all reasonable steps to protect both residents and staff from acquiring infections and cross infection; and provide information and guidance on infection prevention and control that will assist managers undertaking risk assessments and in developing policies".

The document provides the following information on categorisation and segregation of linen:

In an on-site care home setting, two categories should be used relating to the process and these can be colour coded as follows:

- Standard Process – Off White or White. Soiled and fouled items should be placed into a water-soluble bag(s) (and additionally within a white cotton sack if required) or alternatively placed directly in a white impermeable bag. Heavily soiled items should have any solids removed prior to being placed into the bag. In larger premises, patients' clothing may sometimes be bagged separately to bed linen.
- Enhanced Process – Red. These items should be sealed in a red water-soluble bag immediately on removal from the bed. This primary container should then be placed in an impermeable or nylon/polyester bag. The enhanced process is defined in sections 2.1 and 2.5. Additionally, the outer bag must carry a bold legend stating 'INFECTIOUS LINEN'

Assessment of evidence
Limitations • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Social Care. 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”. On the categorisation of linen, the document states the following: “The ‘Management and provision’ volume of this HTM uses the term infectious linen to denote a category of linen that is distinct from ordinary soiled or fouled linen. However, to simplify this process and to make it more appropriate for the type of linen experienced in many small social care settings, this HTM recommends a different categorisation from that used in healthcare settings: The principle adopted in this HTM is that most service-users in an adult social care setting are well or stable most of the time. This will mean that a standard process (see Chapter 5, ‘Categorisation and segregation of linen’) is implemented most of the time. Where a care worker believes that a service-user poses an infection risk, this would necessitate a change in the standard process to an enhanced process (see Chapter 5). (Care homes are also free choose to use the categorisations outlined in the ‘Management and provision’ volume (for example, if they were to outsource their linen processing.)” “It is the responsibility of the person handling linen to ensure that it is segregated appropriately. For the large-scale processing of linen in a commercial setting, the advice offered in ‘Classification of linen’ (in the ‘Management and provision’ volume) should be followed. If a commercial or hospital laundry is used, the appropriate categorisation and segregation option from ‘Classification of linen’ should be agreed with the laundry contractor.” “In the simple on-site care-home setting, two categories should be used relating to the process, and these can be colour-coded as follows: • **Standard process – off white or white**. Soiled and fouled items should be placed into a water-soluble bag(s) (and additionally within a white cotton sack if required) or alternatively placed directly in a white impermeable bag. Heavily soiled items should have

Assessment of evidence
any solids removed prior to being placed into the bag. In larger premises, patients' clothing may sometimes be bagged separately to bed linen. • **Enhanced process – red**. These items should be sealed in a red water-soluble bag immediately on removal from the bed. This primary container should then be placed in an impermeable or nylon/ polyester bag. The enhanced process is defined in Chapter 6, 'Linen processing'. Additionally, the outer bag must carry a bold legend stating "Infectious linen". **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Management and provision.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2013 March [updated 2016 June 8; cited 2024 January 24]					

Assessment of evidence

This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”. The document provides the following on sorting of used linen:

“Although pre-wash sorting is not considered BP, where it does occur, staff in sorting areas must wear PPE (for example, waterproof coverage of chest and forearm areas, gloves, and possibly visors, face-masks or hats, depending on the task being undertaken).”

“1.15 Essential Quality Requirements (EQR) for the purposes of this best practice guidance is a term that encompasses all existing statutory and regulatory requirements. 1.16 Every healthcare linen processor should be capable of meeting the following EQR and communicate these local provisions to the providers of care such that they may be agreed and incorporated into local policy: • There is a duty of care to carry out a hazard and risk assessment and to reduce risk to an acceptable level. As part of this, laundry staff should not undertake the pre-sorting of infectious linen.”

“Linen processors who process infectious linen should adopt postwash sorting of linen (for example, after processing through the washing equipment) for production purposes or limit pre-wash sorting to choice of machine type only. (Note that this refers to production/batch sorting and not necessarily to the adoption of option 2 detailed in the ‘Classification and sorting options’ section.)”

“5.20 Sorting fabrics into different drying types is an essential economic part of linen processing. Sheets, for example, require far less energy to dry them than would towels. In some linen processes/facilities, progression from the washing to the drying phases is automatic;

Assessment of evidence
therefore, fabrics have to be sorted before washing (“pre-wash sorting”). Some processes will allow sorting between washing and drying (“post-wash sorting”). All washer-extractor processes allow pre- or post-wash sorting. 5.21 This HTM considers two differing scenarios on which any classification and sorting agreement can be based. Option 1: Infectious linen is segregated by the service-users 5.22 Categorisation of linen should be done at local level with the appropriate colour-coded bags. 5.23Infectious linen in this category should not be sorted, but should be sealed in a watersoluble1 bag, which should then be placed in an impermeable bag immediately on removal from the bed or before leaving a clinical department. 5.26 Water-soluble bags should be transferred to the designated washer without opening, followed by any washable, reusable laundry outer bag, which should be washed in a similar fashion. If a CTW is used, it should be validated to determine its ability to process and breakdown adequately the water-soluble bag. Option 2: Standard precautions by the user with no segregation of linen 5.27 Linen is not segregated at the local level (subject to the laundry being able to meet processing guidelines), and all linen is presumed to be infectious. 5.28 Immediately on removal from the bed or before leaving a clinical department, linen should be either: • sealed in a water-soluble bag, which should then be placed in an impermeable bag; or • sealed in an impermeable reusable bag having the infectious-linen colour code in accordance with the ‘Colour coding of linen bags’ section, and labelled, if considered necessary locally” “5.32 It is not acceptable for staff to manually open bags containing infectious linen.”

Assessment of evidence
"5.37 Whichever option is chosen, post-wash sorting of linen for production purposes (production batch sorting) is encouraged and would count as BP. If any form of pre-wash sorting for operational or performance reasons is required within the laundry, option 1 above should be adopted. It is not appropriate for laundry staff to undertake sorting of infectious linen." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland. National Guidance for Safe Management of Linen in NHSScotland. 2018 [cited 2024 February 02]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This Scottish document aimed to provide guidance to ensure safe and consistent linen management and reprocessing practice in health and care environments within NHS Scotland. The document provides the following on used linen sorting: *Puncture resistant gloves used to prevent sharps injuries when decanting and sorting used linen are not required to be single-use disposable as there is no crossover with clean, processed linen." "All linen should be appropriately segregated, bagged and labelled, and stored separately at ward and other service levels/areas prior to collection or distribution. This would be either a dirty area e.g. sluice or a designated dirty linen store. Used/infectious linen must not be stored in the domestic services room (DSR)." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Question 11: How should ‘used’ linen be sorted?

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland. National Guidance for Safe Management of Linen in NHSScotland. 2018 [cited 2024 February 02]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This Scottish document aimed to provide guidance to ensure safe and consistent linen management and reprocessing practice in health and care environments within NHS Scotland. The document provides the following on used linen labelling: “All linen arriving at the laundry must be identified by the hospital, care area/ward/department, and dated. Portering, transport and laundry staff should not accept delivery or collect linen that is not appropriately bagged and labelled.”					

Assessment of evidence
Limitations • Method of producing guidance not stated. • Update process or schedule not provided.

Question 12: How should ‘used’ linen be stored?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Rathore MH, Jackson MA; Committee on Infectious Diseases. Infection Prevention and Control in Pediatric Ambulatory Settings. Pediatrics. 2017; 140(5):e20172857. Doi:10.1542/peds.2017-2857.	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
The American Academy of Pediatrics produced this guidance document as a policy statement and reaffirmed it in December 2022. The document states the following on storage of soiled linen: “Soiled linens should be contained or placed in a soiled linen bag at the point of use.” **Limitations** • Method of producing guidance not stated.					

Assessment of evidence
• Update process or schedule not provided. • Some part of the guidance may not be wholly applicable to Scottish health and care settings.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Aucamp, Marina. "Housekeeping and Linen Management (Chapter 23)." In IFIC Basic Concepts of Infection Control, 3rd edition. International Federation of Infection Control 2016 [cited 2024 January 25]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This document, a chapter in the IFIC Basic Concepts, provides the following recommendations on how used linen should be stored. “Dirty linen must be stored in closed bags in a designated area (dirty linen room) until it is collected from the clinical area to be taken to the laundry. The door of the dirty linen room must be kept closed and access to the room must be restricted. Dirty linen must be transported to the laundry in closed containers. Linen handlers must wear heavy-duty rubber gloves for their protection and wash their hands after removal of gloves.”

Assessment of evidence
Limitation • May not apply to Scottish health and care settings. • Unable to access full book to ascertain the method of development. • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Clinical Excellence Commission Infection prevention and control practice handbook. 2020 [cited 2024 June 27]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This Australian document aims to "provide practical, day-to-day guidance to support the implementation of the NSW Health Infection Prevention and Control Policy, which establishes the infection prevention and control mandatory standards for NSW health organisations (HOs) including Affiliated Health Organisations". It provides the following points on the storage of used linen: "The following principles apply when handling linen used for all patients: i.e. whether or not transmission based precautions are required. • Used, soiled or wet linen should be placed into appropriate laundry receptacle at the point of generation; water-soluble bags and double-bagging are not necessary and are not recommended.					

Assessment of evidence

- Clear leak-proof bags are to be used to contain linen that is heavily soiled with blood, other body substances or other fluids (including wet with water).
- Linen bags should be tied securely and not be filled completely as this will increase the risk of rupture in transit and injury to bag handlers.
- Reusable linen bags must be laundered before re-use.
- Hand hygiene must be performed following the handling of used linen."
- "Laundry carts or hampers used to collect or transport soiled linen need not be covered.
- Containers (including carts, bags, and plastic bins) for collecting, storing, or transporting soiled linen should be waterproof, leak-proof, nonporous, and in good repair, and should be decontaminated after use"

Limitations

- Although systematic reviews were conducted for different topic areas, there was none for linen related subjects.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Carraro V, Sanna A, Pinna A, et al. Evaluation of Microbial Growth in Hospital Textiles Through Challenge Test.	Experimental study	**Level 3**	Dry and wet textiles transported at 4°C	Dry and wet textiles transported at 22 and 37°C	Total mesophilic count TMC and other bacterial concentration (CFU/cm^2)

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Adv Exp Med Biol. 2021; 1323:19-34. Doi:10.1007/5584_2020_560					

Assessment of evidence

Objectives: This Italian study aimed to evaluate the effect of transport time and temperature on microbial growth in textiles.

Methods: The study was conducted in two sequential Phases.

Phase I: Microbial evaluation of used linen upon arrival at reconditioning station from the hospital. This phase was conducted from 2015-2016 at an Industrial laundry. A total of 126 textile sample swabs from 12 hospitals were collected across the seasons during this time. The sampled textiles were divided into two groups viz 'textiles with no visible dirt' and 'textiles with visible dirt and presence of organic material'. Four types of textiles were examined – mattress covers, bedsheets, cotton pillowcases and trilaminate drapes used in the operating theatres. Sampling was performed using a cotton swab moistened with buffered peptone water (BPW) swiped across a pre-marked surface (using a sterile 10x10cm2 template) from left to right and from top to bottom using an even pressure with the swab flat against the surface. The swabs were thereafter placed in test tubes containing 10ml of diluent/neutraliser and stored at a controlled temperature. Bacterial concentration expressed as CFU/cm^2 was evaluated using viable plate counting (spread plating and pour plating). Selective agars were used to incubate each organism – TBX agar incubated at 44°C for 24h (E. coli); Baird-Parker agar base with added egg-yolk tellurite emulsion incubated at 37°C for 48h (S. aureus); Cetrimide agar base with added glycerol incubated at 37°C for 48h (P. aeruginosa); Sabouraud dextrose agar incubated at 25°C for 3-5 days for Molds and yeast; and plate count agar (PCA) incubated at 37C for 48h for total mesophilic count (TMC).

Phase II: Textile challenge test. Standard 10x10cm^2 samples of the different types of textiles (cotton mattress covers, cotton bedsheets, trilaminate theatre drapes) were artificially inoculated with an inoculum composed of reference ATCC strains and wild-type microorganisms (E. coli, P. aeruginosa, S. aureus, Saccharomyces cerevisiae and Candida albicans) previously isolated from textile matrices. The challenge test was conducted according to the international experimental protocols (EURL Lm 2014 and ISO 11930:2012) which provides that challenge tests are performed with a mixture of at least 2 strains to account for growth variations among the strains.

Assessment of evidence
One of them must be a strain with known growth characteristics (ATCC or NTCC strains). The other strain(s) can be freely chosen, and it is not mandatory for these that their growth characteristics are known. An inoculum of multiple strains is preferred as it helps to capture the variability among bacteria. Suspensions for each strain were mixed in equal parts and scalar dilutions were done to obtain a suspension with a microbial concentration of 10^4 CFU/ml. 1 ml of this solution was used as the inoculum for the textile matrix of dry textiles. Wet textiles (textiles with nutrient material) were also evaluated with 4ml of nutrient broth added alongside the inoculum. In both experimental conditions, the textiles were stored at either of three different temperatures (4°C, 22°C and 37°C) to simulate the average temperatures to which textiles are exposed during transport in the autumn/winter and spring/summer seasons. Evaluation of bacterial concentration was done in well-defined time phases (0, 8, 24, 48 and 72 hours) to simulate the time it took to transport textiles from the hospital facilities to the laundry based on variability in the distances between hospitals and the laundry facility. At each time interval, the textile samples were suspended in 100ml of physiological solution (0.9% NaCl) using a stomacher for 2 min. Change in bacterial concentration was assessed by means of viable plate counting using selective media as described in phase I. The analysis was done using values from T=0 (immediately after inoculation), T=8 and T =72h. Microbial challenge test for Molds underwent the same procedure already described with a mixed inoculum with a concentration of 10^3 CFU/ml containing a reference strain of *Aspergillus brasiliensis* (ATCC 16404) and a wild-type strain previously isolated from a textile. Sabouraud dextrose agar was used for assessing concentration as already described. The experiment was repeated three times. The difference between means was compared using the T-test, and the difference between means between groups was compared using ANOVA. All analysis was performed using Excel. Results Phase I: Average TMC during the spring-summer season was 260±4, 67±4, 51±3 and 4±1±4 CFU/cm^2 for trilaminate drapes, mattress covers, bedsheets and cotton pillowcases respectively. Of the listed pathogenic organisms, only S. aureus was detected and only in the mattress cover matrix. All the other listed organisms were not detected in all the textiles. In the autumn-winter season, the mattress cover was the most contaminated with mean TMC of 3.6 x10^4 ±145 CFU/cm^2 ($7.5x10^3$ ±252 CFU/cm^2 for E. coli, $6.5x10^3$ ±577 CFU/cm^2 for P. aeruginosa, and 10^3 ±30 CFU/cm^2 for S. aureus). All the other textiles showed significantly lower mean TMC values (ranging from 1 CFU/cm^2 to $1.8x10^2$ CFU/cm^2) ($p<0.05$). There were also no listed pathogenic organisms detected except S. aureus which was detected in the trilaminate drape matrix with a mean concentration of 15 CFU/cm^2.

Assessment of evidence

Phase II:

At 4°C, there was a general lowering in the mean concentration for all organisms at 72h compared to T=0. The mean TMC for dry and wet mattress covers dropped from 12±2.5 and 14±2 to 11±1 and 11±3.5 CFU/cm^2 respectively. The trend was the same for both dry and wet bedsheets with a reduction from 14±1 to 13±1.5 CFU/cm^2 for each. The trend was the same for dry trilaminate drapes where the mean TMC dropped from 14±0.6 to 12±0.6 CFU/cm^2. There was a slight rise, however, in the wet drapes, with the mean TMC and yeasts concentration rising from 25±5 to 26±4.5 and 2±1.5 to 3±2 CFU/cm2, respectively, at T=72h. The concentration for all other organisms showed a downward trend from 0 to 72h.

At 22°C, A gradual rise was observed from T=0 to T=8, reaching statistically significantly high levels at T=72h ($P<0.05$). The TMC for dry and wet mattress covers at 0h, 8h and 72h went from 11±1 to 12±3.5 to 9.4x10^4±10^3; and 20±5 to 63±5 and 9.9x10^4±5.8x10^2 CFU/cm^2 respectively. P. aeruginosa and E. coli concentrations rose the highest in dry and wet mattress covers, reaching 10^3 after 72 h. Yeasts also rose from 1±0.6 and 1±1 to 5±1.5 and 1.3x10^2±20 CFU/cm^2 in dry and wet covers respectively. For moulds, however, there was a decrease in both dry and wet covers, reaching 0 in both at 72h. A similar result was obtained from the bedsheets with generally higher increases in concentration in wet compared to dry sheets. This trend continued (with even higher increases in concentrations) in the trilaminate drapes with a higher increase in wet compared to dry drapes.

At 37°C, the concentration was highest for each fabric after 72h. For wet and dry mattress covers, the concentrations for E. coli and S. aureus rise at T=8 and then drop to about the same levels as T=0 after 72 h. For TMC, P. aeruginosa and yeasts in both wet and dry covers, the upward trend continued to T=72 even though higher in wet. Moulds also rise in wet covers from 0±1 to 1.48x10^2±7 CFU/cm^2 at T=72. The exact same trend is observed in trilaminate drapes and bedsheets except for S. aureus in both the wet drapes and sheets, which rose from T=0 to T=72.

Limitations

- Statistical significance was selectively reported and not added to tables and figures.

Assessment of evidence
Contribution to question This paper demonstrates that the temperatures at which used/infectious linen is held in storage or during transport can affect the levels of contamination, especially if it is held for up to 72h. It also shows that holding used/infectious linen at 4°C prevents the growth of all organisms tested.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health and Safety Executive. Managing infection risks when handling the decease. 2018 July [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This British guidance “provides guidance on managing the risks of infection from work activities which involve handling the deceased”. On Safe storage of used linen, the document states:					

Assessment of evidence
"Store all used and contaminated linen in a designated safe area while awaiting collection or laundering. The storage should be lockable if it is in a publicly accessible area. A suitable frequency for collection or laundering should be in place to avoid a build-up of linen receptacles." "Do not overfill laundry containers and do not put inappropriate items in them (e.g. needles or used equipment)." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Management and provision.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2013 March [updated 2016 June 8; cited 2024 January 24]					

Assessment of evidence

This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”.

The document provides for the following regarding safe storage of used linen:

“For those not adopting independently certified biocontamination control systems in accordance with BS EN 14065, to achieve BP the soiled linen area should be functionally separated from the clean linen processing areas. This is not required for attainment of EQR.

5.75 Examples of how functional separation may be obtained are:

a. physical barrier;

b. negative air pressure in the soiled linen area; and/or

c. positive airflow from the clean textiles area through the soiled textiles area with venting directly to the outside.”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health & Social Care. Infection prevention and control: resource for adult social care. [updated 2024 March 1; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
"This resource contains general infection prevention and control (IPC) principles to be used in combination with advice and guidance on managing specific infections. It is for those responsible for setting and maintaining standards of IPC within adult social care in England." The documents provide the following on safe storage of used linen: • Avoid: ○ shaking or sorting laundry on removal from beds ○ placing used laundry on the floor or any other surfaces ○ re-handling used laundry once bagged ○ overfilling laundry receptacles (not more than two-thirds full) ○ placing inappropriate items in the laundry receptacle					

Assessment of evidence
Limitations • Method of producing guidance not stated. • Update process or schedule not provided.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland. National Guidance for Safe Management of Linen in NHSScotland. 2018 [cited 2024 February 02]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This Scottish document aimed to provide guidance to ensure safe and consistent linen management and reprocessing practice in health and care environments within NHS Scotland. The document provides the following on used linen storage: • All linen should be appropriately segregated, bagged and labelled, and stored separately at ward and other service levels/areas prior to collection or distribution. This would be either a dirty area e.g. sluice or a designated dirty linen store. Used/infectious linen must not be stored in the domestic services room (DSR) **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Question 13: How should ‘used’ linen be transported?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Clinical Excellence Commission Infection prevention and control practice handbook. 2020 [cited 2024 June 27]	Guidelines	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This Australian document aims to "provide practical, day-to-day guidance to support the implementation of the NSW Health Infection Prevention and Control Policy, which establishes the infection prevention and control mandatory standards for NSW health organisations (HOs), including Affiliated Health Organisations". It provides the following points on the transporting used linen: • "Laundry carts or hampers used to collect or transport soiled linen need not be covered. • Containers (including carts, bags, and plastic bins) for collecting, storing, or transporting soiled linen should be waterproof, leak-proof, nonporous, and in good repair, and should be decontaminated after use. • The vehicles which transport linen to and from the laundry should be clean. Soiled and clean textiles should not be transported in the same vehicle, unless they are separated by a suitable barrier e.g. containers with suitable closures, moisture impermeable bags that would prevent contamination between the soiled and clean linen. If a compartment has carried soiled laundry, that compartment should be thoroughly cleaned before it is used to carry clean linen." **Limitations** • Although systematic reviews were conducted for different topic areas, there were none for linen-related subjects.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Linen for Health and Social Care. Management and provision. 2013 March [updated 2016 June 8; cited 2024 January 24]					

Assessment of evidence

This British document aims to "provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen". The document provides the following on used linen transport:

- "Bags should not be overfilled. They should be of an acceptable weight and should be securely fastened before being sent to the laundry. Care should be taken to prevent linen or foul seepage (body fluids or blood) escaping from laundry bags and contaminating other items or staff.
- If used to transport clean linen after transporting used or infectious linen, all reusable transport containers, cages and the inside hold area of transport vehicles should be decontaminated daily and between uses in order to ensure that the condition and decontaminated status of the linen is not compromised. This should be undertaken according to a documented procedure and the process validated. The use of easy-to-clean impervious smooth surfaces will aid this process.
- There should be a physical barrier between clean and used or infectious linen when carried on a vehicle at the same time. Linen bags that are not securely fastened should not be placed in a vehicle.

Assessment of evidence
• Trolleys for clean linen in transit should be covered with a washable or disposable cover. If fully enclosed and sealed containers with lockable doors are used, these covers are not required.” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Healthcare Laundry Accreditation Council. HLAC Accreditation Standards. 2023 May [cited 2024 January 24]	Standards	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
These American “standards are intended to be used to obtain or maintain accreditation in the HLAC Accreditation Program. The standards represent the collective best judgment of HLAC leaders.” The document provides the following on used linen transport: “The provider must maintain functional separation of clean textiles from soiled textiles in carts and/or vehicles at all times during handling, collection, and transportation of soiled textiles.”					

Assessment of evidence

"Functional separation of clean from soiled textiles must be maintained during transportation by:

- Transport soiled textiles in fluid-resistant containers/bags.;
- Anchoring soiled textile containers in the vehicle to prevent spillage from their containers;
- Training personnel regarding proper bagging and placement of textiles in the transporting truck; and
- Ensuring that all personnel with this responsibility follow Standard/Universal Precautions when necessary (e.g., when handling loose soiled textiles not contained in bags)."

"Carts, containers, covers, and liners used to collect or transport soiled textiles must be properly cleaned and disinfected after the cart is emptied and before any next use, whether to transport clean textiles or soiled textiles."

"Proper cleaning shall include any of the following:

- Steam Cleaning
- Cleaning with a detergent and water or
- Using a hospital grade detergent disinfection
- Alternative method of disinfection such as ultraviolet-C (UV-C) systems

The laundry shall have documentation that supports the efficacy of its process in disinfection of the carts.

All methods shall follow instructions of the manufacturer and documentation is to be available to support the validation of the process used.

Hospital-grade cleaning products shall be used according to label instructions, ensuring that the product remains on surfaces for the full contact time."

Limitations

- Method of producing guidance not stated.

Assessment of evidence
• May not be applicable to Scottish health and care settings • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Aucamp, Marina. "Housekeeping and Linen Management (Chapter 23)." In IFIC Basic Concepts of Infection Control, 3rd edition. International Federation of Infection Control 2016 [cited 2024 January 25]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This document, a chapter in the IFIC basic concepts, provides the following recommendations on how used linen should be transported. “Dirty linen must be stored in closed bags in a designated area (dirty linen room) until it is collected from the clinical area to be taken to the laundry. The door of the dirty linen room must be kept closed and access to the room must be restricted. Dirty linen must be transported to the laundry in closed containers. Linen handlers must wear heavy-duty rubber gloves for their protection and wash their hands after removal of gloves.”					

Assessment of evidence
Limitation: • May not apply to Scottish health and care settings. • Unable to access full book to ascertain the method of development. • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Carraro V, Sanna A, Pinna A, et al. Evaluation of Microbial Growth in Hospital Textiles Through Challenge Test. Adv Exp Med Biol. 2021; 1323:19-34. Doi:10.1007/5584_2020_560	Experimental study	**Level 3**	Dry and wet textiles transported at 4°C	Dry and wet textiles transported at 22 and 37°C	Total mesophilic count TMC and other bacterial concentration (CFU/cm^2)

Assessment of evidence
Objectives: This Italian study aimed to evaluate the effect of transport time and temperature on microbial growth in textiles. Methods: The study was conducted in two sequential Phases. Phase I: Microbial evaluation of used linen upon arrival at the reconditioning station from the hospital. This phase was conducted from 2015 to 2016 at an Industrial laundry. A total of 126 textile sample swabs from 12 hospitals were collected across the seasons during this

Assessment of evidence

time. The sampled textiles were divided into two groups viz 'textiles with no visible dirt' and 'textiles with visible dirt and presence of organic material'. Four types of textiles were examined – mattress covers, bedsheets, cotton pillowcases and trilaminate drapes used in the operating theatres. Sampling was performed using a cotton swab moistened with buffered peptone water (BPW) swiped across a pre-marked surface (using a sterile 10x10cm2 template) from left to right and from top to bottom using an even pressure with the swab flat against the surface. The swabs were thereafter placed in test tubes containing 10ml of diluent/neutraliser and stored at a controlled temperature. Bacterial concentration expressed as CFU/cm^2 was evaluated using viable plate counting (spread plating and pour plating). Selective agars were used to incubate each organism – TBX agar incubated at 44°C for 24h (E. coli); Baird-Parker agar base with added egg-yolk tellurite emulsion incubated at 37°C for 48h (S. aureus); Cetrimide agar base with added glycerol incubated at 37°C for 48h (P. aeruginosa); Sabouraud dextrose agar incubated at 25°C for 3-5 days for Molds and yeast; and plate count agar (PCA) incubated at 37C for 48h for total mesophilic count (TMC).

Phase II: Textile challenge test. Standard 10x10cm^2 samples of the different types of textiles (cotton mattress covers, cotton bedsheets, trilaminate theatre drapes) were artificially inoculated with an inoculum composed of reference ATCC strains and wild-type microorganisms (E. coli, P. aeruginosa, S. aureus, Saccharomyces cerevisiae and Candida albicans) previously isolated from textile matrices. The challenge test was conducted according to the international experimental protocols (EURL Lm 2014 and ISO 11930:2012) which provides that challenge tests are performed with a mixture of at least 2 strains to account for growth variations among the strains. One of them must be a strain with known growth characteristics (ATCC or NTCC strains). The other strain(s) can be freely chosen, and it is not mandatory for these that their growth characteristics are known. An inoculum of multiple strains is preferred as it helps to capture the variability among bacteria. Suspensions for each strain were mixed in equal parts and scalar dilutions were done to obtain a suspension with a microbial concentration of 10^4 CFU/ml. 1ml of this solution was used as the inoculum for the textile matrix of dry textiles. Wet textiles (textiles with nutrient material) were also evaluated with 4ml of nutrient broth added alongside the inoculum. In both experimental conditions, the textiles were stored at either of three different temperatures (4°C, 22°C and 37°C) to simulate the average temperatures to which textiles are exposed during transport in the autumn/winter and spring/summer seasons. Evaluation of bacterial concentration was done in well-defined time phases (0, 8, 24, 48 and 72 hours) to simulate the time it took to transport textiles from the hospital facilities to the laundry based on variability in the distances between hospitals and the laundry facility. At each of the time interval, the textile samples were suspended in 100ml of physiological solution (0.9% NaCl) using a stomacher for 2 min. Change in bacterial concentration was assessed by means of viable plate counting using selective media as described in phase I. The analysis was done using values from T=0

Assessment of evidence

(immediately after inoculation), T=8 and T =72h. Microbial challenge test for Molds underwent the same procedure already described with a mixed inoculum with a concentration of 10^3 CFU/ml containing a reference strain of *Aspergillus brasiliensis* (ATCC 16404) and a wild-type strain previously isolated from a textile. Sabouraud dextrose agar was used for assessing concentration as already described.

The experiment was repeated three times. The difference between means was compared using the T-test, and the difference between means between groups was compared using ANOVA. All analysis was performed using Excel.

Results

Phase I: Average TMC during the spring-summer season was 260±4, 67±4, 51±3 and 4±1±4 CFU/cm^2 for trilaminate drapes, mattress covers, bedsheets and cotton pillowcases respectively. Of the listed pathogenic organisms, only S. aureus was detected and only in the mattress cover matrix. All the other listed organisms were not detected in all the textiles. In the autumn-winter season, the mattress cover was the most contaminated with mean TMC of 3.6 x10^4 ±145 CFU/cm^2 ($7.5x10^3$ ±252 CFU/cm^2 for E. coli, $6.5x10^3$ ±577 CFU/cm^2 for P. aeruginosa, and 10^3 ±30 CFU/cm^2 for S. aureus). All the other textiles showed significantly lower mean TMC values (ranging from 1 CFU/cm^2 to $1.8x10^2$ CFU/cm^2) ($p<0.05$). There were also no listed pathogenic organisms detected except S. aureus which was detected in the trilaminate drape matrix with a mean concentration of 15 CFU/cm^2.

Phase II:

At 4°C, there was a general lowering in the mean concentration for all organisms at 72h compared to T=0. The mean TMC for dry and wet mattress covers dropped from 12±2.5 and 14±2 to 11±1 and 11±3.5 CFU/cm^2 respectively. The trend was the same for both dry and wet bedsheets with a reduction from 14±1 to 13±1.5 CFU/cm^2 for each. The trend was the same for dry trilaminate drapes, where the mean TMC dropped from 14±0.6 to 12±0.6 CFU/cm^2. There was a slight rise, however, in the wet drapes, with the mean TMC and yeasts concentration rising from 25±5 to 26±4.5 and 2±1.5 to 3±2 CFU/cm2, respectively, at T=72h. The concentration for all other organisms showed a downward trend from 0 to 72h.

At 22°C, A gradual rise was observed from T=0 to T=8, reaching statistically significantly high levels at T=72h ($P<0.05$). The TMC for dry and wet mattress covers at 0h, 8h and 72h went from 11±1 to 12±3.5 to $9.4x10^4$±10^3; and 20±5 to 63±5 and $9.9x10^4$±$5.8x10^2$ CFU/cm^2 respectively. P. aeruginosa and E. coli concentrations rose the highest in both dry and wet mattress covers, rising to 103 concentrations after 72 h. Yeasts also rose from 1±0.6 and 1±1 to 5±1.5 and $1.3x10^2$±20 CFU/cm^2 in dry and wet covers, respectively. For moulds,

Assessment of evidence
however, there was a decrease in both dry and wet covers, reaching 0 in both at 72h. A similar result was obtained from the bedsheets with generally higher increases in concentration in wet compared to dry sheets. This trend continued (with even higher increases in concentrations) in the trilaminate drapes, with a higher increase in wet compared to dry drapes. At 37°C, the concentration was highest for each fabric after 72h. For wet and dry mattress covers, the concentrations for E. coli and S. aureus rise at T=8 and then drop to about the same levels as T=0 after 72 h. For TMC, P. aeruginosa and yeasts in both wet and dry covers, the upward trend continued to T=72 even though higher in wet. Moulds also rise in wet covers from 0±1 to $1.48x10^2$±7 CFU/cm^2 at T=72. The exact same trend is observed in trilaminate drapes and bedsheets except for S. aureus in both the wet drapes and sheets, which rose from T=0 to T=72. **Limitations** • Statistical significance was selectively reported and not added to tables and figures. Contribution to question This paper demonstrates that temperatures in which used/infectious linen are held in storage or during transport can affect the levels of contamination especially if they are held for up to 72h. It also shows that holding used/infectious linen at 4°C prevents the growth of all organisms tested.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
National Guidance for Safe Management of Linen in NHSScotland. 2018 [cited 2024 February 02]					

Assessment of evidence

This Scottish document aimed to provide guidance to ensure safe and consistent linen management and reprocessing practice in health and care environments within NHS Scotland. The document provides the following on used linen transport:

"Water soluble bags (also referred to as alginate bags) are used for the storage and transport of infectious linen. The entire inner bag is made from either a soluble material or the bag is impermeable but has soluble seams so that linen is released on contact with water. These bags are intended to be placed directly into the washing machine to minimise operator contact with infectious linen. The capabilities of the equipment and composition of the load should be determined in advance of linen reprocessing. Alginate bags must be placed in a clear polythene bag before being secured in a linen bag (hamper)."

"All linen bags (hampers) must be labelled with the hospital, care area/ward/department, and dated. Portering, transport and laundry staff will not accept delivery or collect linen that is not appropriately bagged and labelled."

The document also provides the following recommendations for transporting linen in vehicles:

- "Clean and used/infectious linen should not be transported in the same vehicle unless they can be physically separated, i.e. in a separate, covered cage or trolley.
- Drivers should have access to hand washing facilities at pickup and delivery points and carry a personal alcohol-based hand rub.
- Spill kits for managing body fluids spillages should be available in all linen transfer vehicles.
- All vehicles must have a documented cleaning schedule in place for both internal and external cleaning."

Assessment of evidence
Limitations • Method of producing guidance not stated. • Update process or schedule not provided.

Question 14: Is there any specific evidence on the effective laundering of Uniforms/scrubs?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health & Social Care. Infection prevention and control: resource for adult social care. [updated 2024 March 1; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
"This resource contains general infection prevention and control (IPC) principles to be used in combination with advice and guidance on managing specific infections. It is for those responsible for setting and maintaining standards of IPC within adult social care in England." The document provides the following on laundering of uniforms and scrubs: "Uniforms and workwear should be washed at the hottest temperature the fabric will tolerate. Heavily soiled items should be washed separately to eliminate the risk of cross contamination." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
NHS England and NHS Improvement. Uniforms and workwear: guidance for NHS employers. 2020 April [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This English guidance "addresses the interaction between infection control requirements relating to uniform and workwear and the public sector Equality Duty, with specific consideration given to the needs of faith groups".					

Assessment of evidence
On washing uniforms and workwear, the document states: “All elements of the washing process contribute to the removal of micro-organisms on fabric. Detergents (washing powder or liquid) and agitation release any soiling from the clothes, which is then removed by sheer volume of water during rinsing. Temperature also plays a part. Scientific observations and tests, literature reviews and expert opinion as stated in the 2007 suggests that: • there is little effective difference between domestic and commercial laundering in terms of removing micro-organisms from uniforms and workwear • washing with detergents at 30ºC will remove most Gram-positive micro-organisms, including methicillin-resistant Staphylococcus aureus (MRSA) • a ten-minute wash at 60ºC is sufficient to remove almost all micro-organisms. In tests, only 0.1% of any Clostridioides difficile spores remained. Microbiologists carrying out the research advise that this level of contamination on uniforms and workwear is not a cause for concern.” **Limitations** • Although the document notes that two extended literature reviews were conducted, no further information is provided. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Bearman G, Bryant K, Leekha S, et al. Healthcare personnel attire in non-operating-room settings.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Infect Control Hosp Epidemiol. 2014;35(2):107-121. doi:10.1086/675066					
Assessment of evidence					
Objectives: This Society for Healthcare Epidemiology of America (SHEA) guidance was aimed at helping acute care hospitals develop or modify HCP attire related policies. On home laundering of HCP attire, the document states the following: “Whether HCP attire for nonsurgical settings should be laundered at home or professionally remains unclear. If laundered at home, a hot-water wash cycle (ideally with bleach) followed by a cycle in the dryer is preferable, i. Rationale: A combination of washing at higher temperatures and tumble drying or ironing has been associated with elimination of both pathogenic gram-positive and gram-negative bacteria.” **Limitations** • Although the document notes that a literature review were conducted, no further information is provided. • Update process or schedule not provided.					

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Association of Surgical Technologists. AST Guidelines for Best Practices for	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Laundering Scrub Attire. 2017 [cited 2024 June 26]					

Assessment of evidence

This American guidance aims to “provide information OR supervisors, risk management, and surgical team members can use in the development and implementation of policies and procedures for laundering scrub attire in the surgery department.”

The document provides the following recommendations on laundering scrub attire:

“Scrub attire should be laundered in an accredited HDO or commercial laundry facility to reduce the risk of cross-contamination at home, community, and perioperative environment. The facility or commercially laundered scrub attire should be donned by all surgery personnel prior to entering a semi-restricted or restricted area of the surgery department.”

“Home laundering scrub attire is not recommended. AST concludes there is enough evidence to support home laundering does not sufficiently reduce the number of microbes to a safe level on used scrub attire creating the possibility of transferring pathogens in the following ways:

- pathogens are transferred from the used scrub attire to clothes contained in the washer or dryer load that are worn daily by family members,
- pathogens are transferred to the inner surfaces of the home washing machine or dryer that can survive and contaminate subsequent laundry loads,
- hands of family members can be contaminated when transferring wet laundered clothes to the dryer,
- surgical patients are exposed to cross-contamination when surgical personnel wear home-laundered scrub attire that is still contaminated.”

Assessment of evidence
“Home laundering creates the possibility of causing harm by not protecting the HCW performing home laundering, family members, HCP, patients, and the community from exposure to life-threatening bloodborne pathogens or OPIM.” “Home laundering cannot be properly monitored and therefore, cannot meet the rigorous standards that apply to accredited HDO or commercial laundry facilities. Using an HDO or commercial laundry facility that is Healthcare Laundry Accreditation Council (HLAC) accredited is recommended.” “Typical home washers have few settings for water temperature, and most individuals use cold or warm setting for washing and rinsing to prevent the fading of colored fabrics, such as scrub attire. Warm water setting is a combination of cold water and the hot water from the home water heater that is typically at a temperature of 482.2° C (900° F) to 593° C (1100° F). In comparison, HDO or commercial laundry facilities typically launder scrub attire at 871.1° C (1600° F) that will eliminate microbes such as E. coli and S. aureus. Additionally, detergents may be used to eliminate bacteria, but the amount and type of detergent used at home cannot be monitored, and there is no guarantee of the effectiveness of the detergents against the strains of bacteria encountered in HDOs. This underscores the crucial factor that home laundering cannot be monitored for adherence to consistent standards and safety and left up to the discretion of surgery personnel as to how they complete the laundering process. A person may only use cold water and/or skip drying to prevent the scrub attire from fading or shrinking. Few, if any, home laundering situations or appliances have the capability of duplicating commercial processes. Therefore, home laundering is not appropriate since laundry conditions cannot be effectively controlled.” **Limitations** • Method of producing guidance unclear. • Update process or schedule not provided. • May not be fully applicable to Scottish health and care settings.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Scottish Government. National uniform policy, dress code and laundering policy. DL (2018) 4 [cited 2024 January 24]	Mandatory	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This Scottish Government document sets out the policy on uniform laundering for health and social care staff. For laundry purposes, it categorised uniforms into two groups: Used uniforms and contaminated uniforms. It also provides guidance on how both categories should be laundered. “For laundering classification purposes, we have therefore identified 2 categories: a. Used uniform, which has been worn in conjunction with appropriate PPE b. Contaminated uniform, which following a PPE failure or other incident is visibly contaminated with blood or other body fluids, or uniform which Infection Control advise should be treated as contaminated following an outbreak.” Used Uniform: “Where a uniform has been worn in conjunction with appropriate PPE and is not visibly contaminated with blood or other body fluids, there is no evidence that it poses any risk to healthcare workers or the public. • Hospital/facility laundries should be used to launder uniforms if they are available. Uniform should be laundered in accordance with local laundering policy. • Where hospital laundry facilities are not available, used uniforms should be laundered at home in accordance with the Home Laundering Guidelines (Section 3.2). There is no evidence to suggest that home laundering is a less effective method of laundering used uniform.”					

Assessment of evidence
Contaminated Uniform: “Contaminated uniform includes uniform which has become contaminated with blood or other body fluids, or uniform which Infection Control advise should be treated as contaminated following an outbreak. Staff should change out of uniform contaminated with blood or other body fluids immediately. Staff should wash themselves and change into new uniform. Staff should change out of uniform used during an outbreak at the end of their shift. Contaminated uniform may pose a higher risk of infection to healthcare workers and the public. • Hospital/facility laundries must be used to launder contaminated uniforms. Home laundering is not appropriate for contaminated uniform. • The uniform should be placed directly into a water-soluble/alginate bag. This prevents further handling and potential contamination, particularly for those performing laundering procedures. The bag should be secured using a neck tie. • A secondary bag (clear plastic or laundry bag) should be used to store and transport the water-soluble bag. The bag must be appropriately tagged for identification and should either be disposed of, or laundered immediately after use. • Boards will have local policy in place to label uniforms for collection and return to staff. Should the uniform be disposed of, then staff will be notified and provided with a replacement. • The minimum standards for infected linen set out in the National Guidance for Safe Management of Linen in NHSScotland should be adhered to for contaminated uniform. A copy should be available from your local Laundry Manager or from the enquiry point for this CEL. Where uniform is heavily contaminated, following laundering, the Laundry may condemn it as unfit for re-use. In these circumstances, it should be placed in a healthcare waste sack and disposed of as healthcare (including clinical) waste.”

Question 15: Is there any evidence regarding washing used/infectious personal clothing at home?

Evidence added to current update of Literature Review v4.0:

No evidence found.

Question 16: What is the risk of infections transmission associated with linen in health and care settings?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Vaughan A, et al. Human-to-Human Transmission of Monkeypox Virus, United Kingdom, October 2018. Emerg Infect Dis. 2020 Apr;26(4):782-785. doi:	Outbreak study	**Level 3**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
10.3201/eid2604.191164					

Assessment of evidence

This British outbreak study describes a human-to-human transmission of Monkeypox virus from a patient to a healthcare worker in a hospital in England.

Setting: Acute medical unit in a Hospital in England.

Organism: Monkeypox

Background: A male patient with a recent travel history to Nigeria presented in a hospital in England with maculopapular rash, fever, lymphadenopathy, and a 1-week history of feeling generally unwell. He was admitted to a single-occupancy room in the acute medical unit. Staff attending to him wore standard PPE – consisting of disposable gloves and aprons. The patient was transferred to an Isolation room the next day on account of his travel history. A clinical diagnosis of suspected monkeypox was made three days later, and IPC precautions for HCID were implemented (disposable gown, gloves, filtering facepiece 3 (FFP3) respirator and face shield or goggles). The patient was transferred to an airborne HCID Treatment Centre, and monkeypox was confirmed by laboratory testing.

Although the risk to the public was considered low, possible hospital and community contacts of the Patient were identified and assessed for risk. A single dose of Invanex, a 3rd – 3rd-generation smallpox vaccine (smallpox vaccine provides some cross-protection against monkeypox), was offered as postexposure prophylaxis to contacts at intermediate and high risk. The target vaccination window for these contacts was within 4 days of exposure, up to a maximum of 14 days from exposure. Preexposure prophylaxis with a single dose of Invanex was offered to HCID staff involved in the care of confirmed patients. For risk classification, 158 contacts were deemed low risk, 125 as intermediate risk and five were classed as high risk.

Low risk: HCW involved in care of monkeypox case-patient while wearing appropriate PPE (with no known breaches) for all contact episodes OR HCW involved in the care of monkeypox case-patient while not wearing appropriate PPE for all contact episodes but not within 1 m of case-patient and with no direct contact with body fluids or potentially infectious material OR Community contact not within 1 m of case-patient.

Assessment of evidence
Intermediate risk: Intact skin-only contact with a symptomatic (with rash) monkeypox case-patient, their body fluids, or potentially infectious material# or contaminated fomite OR no direct contact but within 1 m of symptomatic monkeypox case-patient without wearing appropriate PPE (including disposable FFP3 respirator or equivalent). High risk: Direct exposure of broken skin or mucous membranes to monkeypox symptomatic case-patient, patient's body fluids, or potentially infectious material** (including clothing or bedding) without wearing appropriate PPE (including disposable FFP3 respiratory or equivalent). Exposure includes inhalation of respiratory droplets or material from scabs from cleaning rooms where a monkeypox case-patient has stayed, mucosal exposure to splashes, penetrating injury from used sharps, device or through contaminated gloves or clothing. Of the five high-risk contacts, 3 HCWs were assessed as having the same single exposure risk: ≥1 episode of close contact with the bedding and clothing of the case patient before monkeypox was diagnosed. No breaches of standard PPE were identified, but all 3 contacts were placed under active surveillance and offered postexposure vaccination. One of these was a healthcare assistant who received the smallpox vaccine on September 14, which was 5 days after the most recent exposure and possibly 6 to 7 days after the earliest exposure. On September 22, the healthcare assistant noticed a small number of facial lesions while off duty and stayed home for the next 2 days but did not report the illness to PHE. Two days after (September 24), the healthcare assistant (now Patient 2) sought care with a GP for headache, sore throat, skin lesions on the chin, earache and eye pain. Patient 2 then reported the illness to PHE. On September 25, monkeypox was confirmed by PCR testing of multiple sample types, after which Patient 2 was admitted to an Airborne HCID treatment centre. A total of 134 possible contacts of patient 2 were identified, including staff and patients on the ward where patient 2 worked, family and community contacts, and staff and patients at the general practitioner's office where patient 2 had sought care. "A total of 4 contacts of patient 2 became ill within the incubation period and required medical assessment. No further cases of monkeypox were identified in relation to this incident, and after clinical improvement, patient 2 was discharged on October 29, 2018". Transmission link: The only link identified during the assessment of patient 2 was that Patient 2 was involved in **changing potentially contaminated bedding when Patient** 1 had skin lesions but before a diagnosis of monkeypox had been considered.

Assessment of evidence
The investigation theorised that "The use of standard PPE may not have afforded sufficient protection against monkeypox, particularly if skin lesion debris containing virus had been disturbed and inhaled when bedsheets were changed". Genotyping: Not done **Limitations** • Lack of genotyping; however, since monkeypox is a relatively rare disease, it is very unlikely that the HCW got it from a different source.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Sundermann AJ, Clancy CJ, Pasculle AW, et al. Remediation of Mucorales-contaminated Healthcare Linens at a Laundry Facility Following an Investigation of a Case Cluster of Hospital-acquired Mucormycosis. Clin Infect Dis. 2022;74(8):1401-	Outbreak	**3**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
1407. Doi:10.1093/cid/ciab638					

Assessment of evidence

This American outbreak study aimed “to describe an investigation and remediation of Mucorales contamination at the laundry supplying our center”.

Country: United States of America

Setting: Solid Organ transplant Unit/ External Laundry facility

Organism: Mucormycosis (*Rhizopus microsporus, R. arrhizus var delemar, Lichtheimia corymbifera*)

Background: Over an 11-month period (May 2015 – April 2016), four solid organ transplant (SOT) recipients at the center were diagnosed with likely healthcare-associated mucormycosis. All four patients were housed exclusively in one of two hospitals separated by a walkway and were infected with *Rhizopus microsporus (n=2), R. arrhizus var delemar (n=1), Lichtheimia corymbifera (n=1).*

Healthcare linens (HCLs) were identified by October 2015 as a likely source by the infection prevention team. Surveillance cultures of freshly laundered HCLs and carts taken immediately upon delivery to the medical centre and at the offsite HCL processing facility showed extensive contamination by Rhizopus, Lichtheimia and other Mucorales. In contrast with this, Mucorales or other fungi were rarely recovered from cultures of the hospital environment and non HCL associated supplies.

Genetic relatedness: “Comprehensive core protein phylogenetic and global genome feature analyses of 72 clinical and environmental Mucorales strains revealed that R. microsporus infecting 2 patients in separate hospitals seven months apart were highly similar, suggesting a common source exposure.” “The strains were most closely related to an HCL strain from the offsite facility, which was virtually identical in core genome but distinct by whole genome size and global protein content. All other clinical and environmental Mucorales strains were genetically distinct.”

Assessment of evidence
Interventions: Multi-faceted – including temporary introduction of antifungal prophylaxis with isavuconazole, dedicated gamma-irradiated HCLs for SOT recipients and remediation of potential sources of Mucorales contaminated HCL at the offsite processing facility. The paper also stated that a detailed description of IPC interventions initiated, and epidemiologic investigation of cases will be provided in a future report. **Remediation** Although no cases were reported by the authors after April 2018 when the IPC interventions (earlier described) were deployed, surveillance cultures of freshly laundered HCLs on arrival at the center continued to be taken. Single Replicate Organism Detection and Counting (RODAC) agar plates (25 cm^2) with malt extract, lecithin and Tween 80 were stamped 10 times at different locations on a given HCL article. Seven articles of seven types of HCL (bath blanket, thermal blanket, fitted sheet, flat sheet, pillowcase, wash cloth and patient gown) were sampled, totalling 49 articles each month. The RODAC plates were immediately sealed and incubated at 35°C. Between October 2016 and January 2017, five site visits were made by a dedicated team to the offsite laundry facility, the latter four of which were unannounced. In those last 4 visits, cultures were performed at different stations of the laundering process – articles of HCL were cultured using the 10-stamp RODAC method immediately after post-washing/pressing, post-dryer removal, post-ironing/folding, pre-transport (before delivery to hospital) and upon arrival at the hospital. Cultures were incubated as previously described. Percentages of plates contaminated with fungi were compared between stations using the Fischer exact test. (significant at $p<0.05$) The investigators discovered that the intake vents, which delivered unfiltered air into the driers, were facing the exhaust vents (which carried air expelled from the driers) in proximity. The openings and internal surfaces of both vents were covered with thick layers of lint, and swabs cultured from them grew confluent Mucorales (*Syncephalastrum spp*.) and other Molds (Aspergillus niger and Curvularia spp) after 24 hours. Significant lint accumulation was also found in the four subsequent unannounced visits on the ceiling, indoor vents, and press and fold machines. They also noted that carts holding laundered and folded HCLs were uncovered as they awaited transport. The percentage of samples that were positive for Mucorales (Rhizopus spp) was 0% after the wash and rose significantly to 12% (P=0.04) post-drier, dropped to 7% (p=0.49) post-iron/fold, and rose to 17% pre-transport. At the time of hospital arrival, it was 13%, a significant rise from the post-wash values (p=0.02).

Assessment of evidence
The situation was similar for any fungal positivity. It was 5% post-wash and rose significantly to 29% (p=0,01) post-drier, dropped to 14% (p=0.12) post-iron/fold, and rose again to 43% pre-transport. It was 45% at the time of hospital arrival, a significant rise from post-wash values (p=0.0001). Interventions in the facility included placing a large filter device around exhaust vents to catch lint, moving air intake vents away from exhaust vents, frequent lint removal on the roof, enhanced environmental cleaning and frequent removal of lint from floors, walls, and ceiling, covering over carts with freshly laundered HCLs, and education on and assessments of adherence to HLAC and CDC guidelines. For 27 months after the remediation intervention, only 0.3% (3/980) of samples collected were positive for Mucorales, a significant reduction compared to 20% (19/95) before the remediation (p=0.0001). **Limitations** • No culturing was reported after gamma irradiation of freshly laundered HCL • Gamma irradiation was also part of a bundle, so it is impossible to tell how much of a role it had in stopping the outbreak.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Patterson CA, Wyncoll D, Patel A, et al. Cloth Lanyards as a Source of Intermittent Transmission of Candida auris on an ICU.	Outbreak study	**Level 3**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Crit Care Med. 2021;49(4):697-701. Doi:10.1097/CCM.0000000000004843					

Assessment of evidence

Objectives: To “describe a small *C. auris* outbreak and how it was terminated.”

Settings: Two general adult ICUs at a UK teaching hospital.

Organism: *Candida auris*

Background: The outbreak, which took place in an 11-bed specialist ICU (ICU1) that provides a severe respiratory failure service and a linked 15-bed general ICU (ICU2) located five floors below, included seven patients. Both ICUs were served by a single pool of nursing and medical staff. No cases of *C. auris* were identified in the 12 months before the outbreak. However, admission screening was only performed on international transfers or from UK hospitals with known *C. auris* outbreaks. Monthly hand hygiene audit was undertaken throughout the outbreak and compliance was 76.7-90.3%. The Index case was an international transfer from the Middle East from whom *C. auris* was isolated from a radial arterial catheter site four days after admission. The authors report that although a *C. auris* admission screen was completed for this patient, being an international referral, it was not processed due to overgrowth. Patient 2 was admitted to ICU1 21 days after the first patient died of unrelated causes. Following the identification of this second Case, weekly *C. auris* screening was commenced in all ICUs. Patient 3 was admitted to ICU2 10 days after Patient 2 left ICU1 and had *C. auris* isolates that were typed to be of the same clade (Indian clade) as the first two cases. After this discovery, contact tracing and admission screening were introduced (it is unclear if this is for all patients as the authors already stated that admission screening was done for international referrals and transfers from UK hospitals with known outbreaks). Nine days after Patient 3 left ICU2, there was a cluster of three overlapping cases in ICU2. An outbreak was declared, and C. auris-positive patients were moved to a designated wing of ICU1. A final case occurred in ICU1 after the *C. auris* colonised patients were moved there. Due to the intermittent nature of the outbreak, an environmental reservoir was suspected. Environmental screening commenced with 43 samples collected over a 2-day, five of which were positive for *C. auris*. The positive

Assessment of evidence
samples were from bed rails and the floor of an empty room which had been deep cleaned following the discharge of a *C. auris* case; IV administration equipment, echocardiogram leads, and bed rails in a room occupied by a *C. auris* colonised patient. Cleaning procedures were enhanced following these findings. A second environmental screen was performed with 46 samples collected. During sample collection, concern was raised by an ICU staff about a lanyard attached to a key used to access the control drugs locker. This lanyard was constantly handled by nursing staff working across ICU1 and ICU2. The Lanyard was removed, cultured and found to be positive or C, auris. No other sample collected during this round of environmental screening was positive. This finding led to the removal of all staff lanyards and a random selection of 100 were cultured. Fourteen of them were positive, one grew *C. auris*, 12 *C. parapsilosis* and one *Candida guilermondii*. No further cases of *C. auris* were detected in the ICU after the removal of lanyards. **Limitations** • Although the first three cases were identified as being of the same clade, no typing was reported for the other cases. • No typing was done to link the C. auris found on the key lanyard to those found in patient samples. The authors state the following: "The first 3/7 outbreak isolates were typed as Indian Clade. Subsequent isolates were not typed by the reference laboratory, in keeping with National Reference Laboratory policy at the time of the outbreak".

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Hosein IK, Hoffman PN, Ellam S, et al. Summertime Bacillus cereus colonization of hospital newborns traced to	Outbreak study	**Level 3**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
contaminated, laundered linen. J Hosp Infect. 2013;85(2):149-154. Doi:10.1016/j.jhin.2013.06.001					

Assessment of evidence

Objectives: To determine the source of Bacillus cereus colonisation of hospital newborns.

Settings: Special Care baby unit (SCBU) and Labour ward in a University Hospital in the UK.

Organism: Bacillus cereus

Background: In the first two weeks of August 2009, B. cereus colonization was detected in three newborns following routine umbilical screening swabs which had been previously introduced for newborns in the SCBU in 2002. The swabs from the three newborns showed moderate to heavy growth on blood agar plates. This prompted a review of the laboratory database for any further isolates of the organism throughout the hospital. The database showed sporadic B. cereus isolation in umbilical swabs as far back as March of the same year (2209) at a rate of about one per month with four other newborns with the organism. Visible dust contamination in the labour ward environment, thought to be from external and internal hospital construction works was suspected as the cause of the colonization. As a result, targeted IPC measures were implemented, including cleaning of labour ward to remove dust, replacement of containers and bottles for handwashing liquids and vaginal creams, reinforcement of hand hygiene, replacement of hand drying towels with new batches, discarding of non-sterile gloves in open boxes, use of only sterile gloves when handling newborns, temporary halting of internal building works to implement better dust controls with plastic sheeting, shutting all windows to the labour ward and installation of portable ventilation units because of the hot weather. The labour ward air was sampled using an Oxoid air sampler. Dust in in-use or exposed healthcare products and equipment in the labour ward were sampled, including gloves, liquid handwashing agents, vaginal lubricants, and neonatal resuscitation equipment. Environmental sampling of dry surfaces was done using pre-moistened, sterile cotton-tipped swabs, which were then plated directly onto blood agar plates and B. cereus selective medium. Containers were sampled by swirling sterile dry swabs in the

Assessment of evidence

containers, while vaginal lubricants were sampled by placing dry swabs into them and plating them as already described. Loose soil outside the labour ward windows was sampled by moving two pre-moistened sterile swabs within an area of 10cm^2 at 1cm depth. Top and middle stacks of linen in the labour ward storage cupboard were also sampled, as the cupboard walls were visibly dusty, and the linen on top had traces of dust on them. This was done using sterile gloves and pressing on an area of the linen (about 8cmx8cm) onto blood agar plates. Subsequently, linen was sampled similarly using B. cereus selective agar to expedite laboratory processing. Isolates that were mannitol-negative and lecithinase-positive were further identified as B. cereus by standard laboratory methods. The Hospital got their linen supplies from an external laundry which used continuous tunnel washing (CTW) machines – a rapid, low water consuming machine in which batches of dirty linen flow counter current to clean water, with detergent and heat added at specific stages. Linen was delivered to the hospital in 2mx1.5mx1.5m metal mesh crates which were themselves enclosed in protective plastic sheeting from the laundry. Freshly received linen was sampled as already described by impression onto blood agar and B. cereus selective agar using sheets selected from the middle of the stack. Blood agar and B. cereus samples of freshly washed and dried linen ready for dispatch were also obtained from the external laundry. Following the hospital's alert, the external laundry reviewed the maintenance programme for washing machines and commenced monitoring for B. cereus in washed linen in August 2009. The hospital policy of screening only premature babies was extended to include all newborns.

Findings: Samples of dust and dust-contaminated surfaces on the labour ward were negative for B. cereus. Agar impression plate sampling of unused linen in the storage cupboard in the labour ward yielded mainly confluent growth of B. cereus after 24 hours. Following these findings, the main linen storage location in the hospital (located in a different location separated from the labour ward by two floors) was sampled, and these also yielded very high numbers (mainly confluent growth) of B. cereus per linen item. Linen samples from the external laundry from August to November 2009 showed high levels of linen contamination (>300 cfu per 100cm^2 of washed linen on 24 August) which dropped off significantly to 20 -50cfu/100cm2 on 2 September and further to <5cfu/100cm2 on 7 September, again on 1 October and 2 November. The soil outside the labour ward was also positive for B. cereus. There was no clinical infection throughout the incident, only colonization. Routine umbilical screening of all newborns at birth continued until B. cereus was no longer detected. (September to October 2009). However, the wider screening was re-introduced in May 2010, together with environmental and linen sampling, when B. cereus was detected again in newborn umbilical samples.

Assessment of evidence
Genetic relatedness: “Amplified fragment length polymorphism typing of 15 representative isolates of B. cereus cultured from unused hospital linen and newborn umbilical swabs showed several types with some concordance among both groups of isolates; types A, B and D in the newborns could be matched with types A, B and D from linen isolates at the hospital.” Interventions: The authors note that one measure that reduced B. cereus in freshly laundered linen was a ‘laundry-stated but undetermined increase in freshwater used in the CTWs’. However, because of the increased cost, the laundry was unable to sustain this and changed to selectively laundering labour ward linen in a washer-extractor, which uses far higher dilutions than CTWs. The authors also noted that the use of sporicidal agents in the laundry had no apparent effect on B. cereus contamination. The authors also noted a correlation between the number of positive newborns and the number of positive linen with a rise in temperature. They postulated that B. cereus was highest in the warmer months and dropped progressively lower as the ambient temperatures dropped. **Limitations** • No samples of the CTW were taken.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Balm MN, Jureen R, Teo C, et al. Hot and steamy: outbreak of Bacillus cereus in Singapore associated with construction work and laundry practices.	Outbreak report	**Level 3**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
J Hosp Infect. 2012;81(4):224-230. Doi:10.1016/j.jhin.2012.04.022					

Assessment of evidence

Objectives: This Singaporean study describes the investigation and management of an outbreak of *Bacillus cereus* in a National University Hospital.

Setting: A 950-bed teaching hospital providing tertiary care for all patients. Clinical facilities include a mix of air-conditioned (AC) wards with single or two-person rooms and non-AC wards with shared rooms housing up to eight patients. The hospital has no burns unit.

Organism: *Bacillus cereus*

Background: Following a sudden increase in invasive infections caused by B. cereus group organisms in March 2010, when rates went above two standard deviations above the average of the last two years, an extensive report was launched. Prior to the noted increase, building work had been underway beside the hospital in 2008 which was expected to run until 2014. The project involved the construction of an underground railway station and three multi-storey buildings. The work began in 2008, with deep drilling phases in the early parts of 2009, 2010 and mid-2010 at three different sites around the hospital. A case was defined as an inpatient with B. cereus group-type organism isolated from clinical cultures after 1 March 2010. Clinicians collected data on patient location and movements, IV devices and therapeutic interventions. Patients were grouped into the outbreak phase (March to August 2010), intervention phase (September 2010 to February 2011) and monitoring phase (March to August 2011).

Terminal cleaning was performed using a phenolic compound during the outbreak after the discharge of a patient with bacterial colonisation or infection requiring contact precautions. A 1.0% solution of sodium hypochlorite (10,000 ppm, household beach) was used following the discharge of patients with tuberculosis or viral illness requiring contact or droplet precaution. Routine cleaning was generally performed twice daily for acute wards using a quaternary ammonium-based disinfectant regimen. Equipment cleaning was done daily by nursing staff using alcohol wipes.

Assessment of evidence
Linen in the hospital was laundered by a commercial laundry located at the national prison. Most of the linen is laundered in continuous tunnel watchers at 70°C with 198 ppm hydrogen peroxide for 12 minutes of each cycle. A 50kg batch of linen enters the tunnel washers every 3 minutes, spending 3 minutes in each of the 14 wash compartments. Baby linen and infectious linen were washed separately in 300kg capacity drum washers. Linen is dried using industrial tumble driers at 110°C for 12 minutes and gowns and sheets are pressed at ~135°C for 10 seconds after which they are packaged in plastic bags for storage until use. Blankets and towels are not pressed. From August 2010, linen processing was contracted to another commercial laundry due to reasons unconnected to the outbreak. This laundry used 500kg capacity drum washers using >200ppm sodium hypochlorite with a peak temperature of 65°C for all type of linen. **Investigations:** Settle plates were placed in patient rooms, nursing stations, linen trolleys, and preparation areas on the most affected wards. Plates were read and B. cereus group species were identified using matric-assisted laser desorption/ionisation-time of flight-mass spectrometry (MALDI-TOF-MS). Settle plates were placed at two, four and eight months according to a predetermined protocol during a series of interventions. Ventilation systems were reviewed by hospital engineers and an external contractor and air sampling was done using an SAS 100 portable microbiological air sampler. Plates were examined to determine the proportion of B. cereus group colonies present. Air exchanges were measured, a smoke test was performed in two rooms, one with positive pressure ventilation and the other with standard air-conditioning. Following heavy contamination on settle plates from linen trolleys, laundry practices were examined closely. Semiquantitative assessment of linen was done using an immersion method, repeated at intervals to assess the effect of washing linen with >200 ppm sodium hypochlorite. Strips of 4x4cm fabric squares were cut from separate pieces of linen each was sonicated in 10ml of nutrient broth for two minutes and removed. The broth was centrifuged at 3000 rpm for five minutes after which the supernatant was removed and 25µl of the pellet was inoculated as a lawn on to a blood agar plate and incubated aerobically at 36°C. Batches of 20 – 30 pieces of similar type of linen were processed at the same time. Freshly laundered linen at the hospital were usually stored in airtight plastic bags until use. Given the high ambient temperature and humidity in Singapore, it was postulated that storage in those conditions might encourage the propagation of B. cereus spores. To test this, linen from the same watching batch was stored for 24h in either plastic bags or porous canvas bags. Both laundries were visited on separate days in August. Settle plates were placed throughout both laundries and swab samples from inside the drum washers at both laundries were collected. Water samples from the CTWs at the primary laundry were also taken. In addition, pieces of autoclaved linen were washed in a batch of dirty linen to evaluate whether transfer of spores was occurring during the wash process. Cultures were also obtained from gloves used for accessing IV devices, infusion flush fluids and infusion tubing sets. Hospital environmental cleaning procedures were reviewed.

Assessment of evidence
Statistical analysis was performed using STATA using tests of two proportions to calculate Z-scored with $p<0.05$ considered significant. **Findings:** Routine surveillance showed a 10-fold increase in B. cereus group organisms in clinical samples during a 5-month period in 2010. Although B. cereus predominated, other species of the B. cereus group were represented. Blood cultures with B. cereus group increased a mean monthly rate (±SD) or 24 ± 14 (range 0-50) to 122 ± 48 (range: 60-200) per 10,000 blood cultures performed. Increased isolation was also noted in wound, fluid, and sterile sites but not in respiratory or urine cultures. Cases were reported in 33 of 37 wards. Among these, 52/171 (30.4%) cases occurred in haematology or oncology patients, some of whom had evidence of sepsis without any alternative explanation. The mean number of patients with B. cereus group organisms recovered from clinical cultures which was seven per month (±3.58, range 1-11) in 2008-2009 rose steadily to 51 in August 2010, the peak of the outbreak. During the outbreak period, 201 positive cultures for B. cereus group organisms were recovered from 171 patients (0.71% of admitted patients). Median age of patients was 51 years (range 0-97) and 65.5% were male. 34.9% (51/146) of patient bacteraemia episodes occurred in immunocompromised patients, 39% (57) in patients that had intravascular devices and 26.7% (39) in patients who were both immunocompromised and had intravascular devices. Deep tissue involvement was evident in 20 patients and 29 patients required therapeutic interventions including IV vancomycin, removal of 18 central lines or portacaths and two external ventricular drains. Multiple Bacillus spp were identified as B. cereus group organisms from air samples after settle plates were exposed for a 1h period. An index of B. cereus group air contamination derived from the index of microbial air contamination (IMA) was calculated and showed highest contamination from inner surfaces of linen trolleys and within patient rooms in all wards. Active air sampling showed extremely high bacillus counts in outside air (~600 cfu/m^3) but low counts within empty rooms without linen (0-5 cfu/m^3). Particle counts and air exchanges per hour complied with hospital guidelines. Bacillus spp, mostly B. cereus – were isolated from all types of linen sampled at the beginning of the investigation in August 2010. The density of contamination increased with more absorbent materials. Towels had an average contamination density of 7403 ± 1054 cfu/cm^2, cotton blankets 840 ± 386 cm^2, patient gowns 585 ± 356 cfu/cm^2, fitted sheets 370 ± 191 cfu/cm^2, and flat cotton sheets 80 ± 36 cfu/cm^2. Settled plates in areas where linen was handled in both laundry sites showed semiconfluent growth of bacillus. Water sampling showed high bacillus counts in partially recycled pre-wash water (7.2 x10^2 cfu/ml), 2.4 x 10^2 cfu/ml and 4.1 x 10^4 cfu/ml in the compress water post-final extraction from each tunnel washer. Water recycled to the washers showed 3.9 x 10^2 cfu/ml, demonstrating that bacillus remained viable after water treatment. Internal surfaces of washing machines were however not contaminated with Bacillus spp and co-washing with sterile linen showed minimal transfer of viable spores during the wash process. Only one colony of B. cereus was found in one of the four samples tested. No growth was observed in samples from glove, infusion fluid or infusion tubing samples. The investigators

Assessment of evidence

also found that storage of freshly laundered linen in plastic bags encouraged the propagation of spores compared to storage in porous canvas bags. After a 24-hour storage period, there was a significantly higher contamination in the towels stored in the plastic bags (10 per bag) (4437 cfu/cm^2; CI: 3125-5750) compared to those stored in the canvas bags (166 cfu/cm^2; CI: 76-256; P<0.001).

Interventions:

Non-Laundry: Initial interventions targeted the haematology-oncology units at the beginning of the outbreak as patients there were most likely to have bacillus isolated from clinical specimens associated with clinical symptomatic infection. The disinfectant used for terminal cleaning was changed to 0.5% acidified bleach (5000ppm, one part 5% sodium hypochlorite, eight parts water and one part vinegar) throughout the hospital. Oncology wards were cleaned thoroughly with bleach and cleaned terminally after each patient's discharge. Aseptic technique for IV device access was reviewed and reinforced by directly observed assessment. Removal of IV devices was advised if there was recurrence of bacteraemia despite treatment with vancomycin, if B. cereus group was isolated from paired peripheral and line cultures, or if the patient was septic with no organism implicated. Additional filters were also placed in the ventilation system and all re-usable filters were cleaned every month.

Laundry:

Autoclaved towels were used in the four haematology – oncology wards from 28 August when linen contamination was suspected. At both commercial laundries, switching to a bleach-based protocol for white linen by September 2010 led to a reduction in contamination of towels from 7403 ± 1054 to 4437 ± 1128 cfu/cm^2 (P<0.001) after eight weeks.

Laundered linen was thereafter stored in canvas bags from December 2010, and this led to a sustained reduction in bacillus contamination of the towels. During a retest in February 2011, the contamination level was (107 cfu/cm^2; CI:58-157).

Outcomes: Case numbers rapidly declined following interventions and returned to pre-outbreak levels (≤7 cases/month) by November 2010. “During the intervention period (September 2010 to February 2011), 63 positive cultures were obtained from 51 patients (0.23% of admitted patients, P < 0.01). Positive blood or line cultures comprised 38 patient episodes (74.5%), of which 24 (63.1%) occurred in immunocompromised patients or those with intravascular devices.” Reduction in contamination of the clinical environment was evidenced by reduced cfus in both settle plate and linen cultures during the intervention period. Interventions were thereafter relaxed at the end of February 2011. Autoclaving of towels for the haematology-oncology wards and terminal cleaning following patient discharge were ceased.

Assessment of evidence
Case numbers rose from five per month to 11-17 almost immediately and was sustained at this level for six months following. In April, towel cultures showed that there had been another significant contamination of linen (2160 cfu/cm2; CI: 1128 – 3292). Investigation showed that the external laundry was still using an incorrect concentration of sodium hypochlorite and that only towels had been stored in the canvas bags due to cost constraints (other linen were still being stored in plastic). The external laundry was advised on the need to achieve 200ppm sodium hypochlorite in the rinse phase and to clean the environment thoroughly with 5000ppm sodium hypochlorite. The laundry made no changes, despite these recommendations, and case numbers stayed up. At July 2011, towel cultures showed ongoing dense contamination with B. cereus (4093 cfu/cm2; CI: 2755-5340; compared to 107 cfu/cm2; CI: 58-157 in February 2011; P<0.001). At the time of the report, the outbreak team was still working with the external laundry to address the problems while monitoring the Bacillus spp contamination within the hospital as the construction work continued. Genetic relatedness: None performed. **Limitations:** • Genetic relatedness not done. • Outbreak was still ongoing at the time of the report.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Hino C, Ozaki M, Kitahara T, et al. Peripheral Parenteral Nutrition Solutions and Bed Bath Towels as Risk Factors for Nosocomial	Experimental (before-and-after) study	**Level 3**	Inoculation of forearm using contaminated bed bath towels and inoculation of peripheral parenteral nutrition solutions	N/A	cfu/cm^2

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Peripheral Venous Catheter-related Bloodstream Infection by Bacillus cereus. Int J Med Sci. 2023;20(5):566-571. Published 2023 Mar 5. Doi:10.7150/ijms.82054					

Assessment of evidence

Objectives: The authors state that, in this study, they examined the etiology of a high incidence of B. cereus-induced peripheral venous catheter related blood stream infection (PVC-BSI) in the summer.

Setting: Japanese Hospital

Organism: Bacillus Cereus

Background: The authors note that administering peripheral parenteral nutrition (PPN) and the summer season are risk factors for B. cereus-related PVC-BSI. The aim of the study is to evaluate the risk of B. cereus-related PVC-BSI from bed bath towels inpatients on PPN.

Methods: B, cereus ATCC 11778, Escherichia coli ATCC 25922, Klebsiella pneumoniae IFO 3318, Pseudomonas aeruginosa ATCC 27853, Serratia marcescens IFO 3046 and Candida albicans IFO 1386 were cultured on trypticase soy agar for 1-2 days at 35°C, scraped into sterile phosphate-buffered saline (PBS) and centrifuged thrice for 10 min at 3,000 rpm to remove the growth medium. It was then resuspended in PBS, yielding a concentration of approximately 10^4 – 10^5 colony-forming units (CFUs)/ml. 0.05ml of the resuspension was

Assessment of evidence

added to 4.95ml each of three types of PPN solution (Bfluid® injection, Paresafe® and Pareplus®); 5% albumin, soybean oil, normal saline, acetated Ringer's solution, 5% glucose and total parenteral nutrition. The test solutions were incubated at 20°C and 30°C, and plate counts were performed at 6, 24, and 48h. Each sample was diluted 10-, 10^2-, 10^3-, 10^4- 10^5- and 10^6- fold in normal saline. 0.25 ml of undiluted and diluted samples were transferred into TSA using a pipette. The plates were streaked with glass 'hockey stick' and incubated at 35C for 1-2 days, and afterwards, the number of viable microorganisms was measured. Each of these experiments was repeated in triplicates, and the mean of each repeat was calculated.

The authors state that they had previously noted that 'clean' hospital bed bath towels shipped from the laundry service factory yielded B. cereus. Freshly laundered hospital bed bath towels ((washed at 80 degrees Celsius for 10 minutes, as per national regulations), which yielded approximately 1.3 x 10^3 cfus/$cm^{2,}$ were used for this experiment. Twelve volunteers were screened for the presence or absence of B. cereus on the skin of their forearms by wiping bilateral forearms with a wet 5x5cm sterile gauze. The gauze was then placed in a bottle containing 20ml of sterile physiological saline, after which they were treated ultrasonically for 5 min at 37kHz. The solution in the bottle was then diluted 10-fold in normal saline, and 1ml (0.25ml x 4) of the undiluted and diluted solution was transferred to PBCW agar containing egg yolk. The plates were streaked with a glass hockey stick and incubated for 24h at 35°C. The residual solution was filtered through 0.22µm membrane filters, 5cm in diameter. The filters were placed on egg-containing - PBCW agar. Colonies of B. cereus were counted after incubation for 24 h at 35°C. Nine of the twelve subjects' forearms were found to be negative for B. cereus and were therefore included in the study. Two 5x5cm pieces of bed bath towel that were found to be contaminated with 1.3x103 cfus/cm2 of B. cereus were each dampened with 2ml of sterile water and used to wipe each volunteer's bilateral forearms (5x10cm). After natural air drying, one forearm was wiped with sterile water-drenched gauze, and the amount of B. cereus was evaluated to calculate the amount of contamination on the forearm. The other forearm was disinfected by wiping twice with a medical-grade absorbent cotton (4x8cm) containing 1.6ml ethanol (76.9 – 81.4 vol%) and, after one minute, wiped with a piece of sterile water-drenched gauze. The amount of contamination on the disinfected forearm was then evaluated as earlier described. This test was conducted twice in each of the nine volunteers.

Results: At 30°C, B. cereus rapidly proliferated in all the PPN solutions, rising from 10^2 cfu/ml to 10^6-10^7cfu.ml after 24 h and rising to 10^7-10^8cfu/ml after 48 hours. The authors note that B. cereus also grew in soybean oil or albumin but not in Ringer's solution, normal saline, 5% glucose or TPN. However, the exact values cannot be stated because the graph on which they are presented is not clear. The situation was similar at 20°C, except that the proliferation was slower (10^3-10^5 at 24 h and 10^6-10^7 at 48 h for the three PPN solutions). A

Assessment of evidence
rise like B. cereus at 30°C and 20°C described above was seen for the other organisms in PPN solutions except for Candida albicans, which rose only very slightly. All forearms were contaminated after wiping with B. cereus-contaminated bath towels. The number of organisms transferred was 240 – 1260 CFUs/50cm^2 (median = 540) on the left forearm and 260 – 3200 CFUs/50cm^2 (median = 760) on the right forearm. After disinfection with alcohol, there was a statistically significant reduction in the level of contamination of the forearms to 120 – 660 CFUs/50cm^2 (median = 320) on the left forearm and 80 – 620 CFUs/50cm^2 (median = 240) on the right forearm. The median values for B. cereus after ethanol disinfection were 6.4 CFUs/cm^2 and 4.8 CFUs/cm^2 for the left and right forearm, respectively. **Limitations:** • Some values are presented in crowded graphs which makes it difficult to tell one value from the other. • Although the authors say that the experiments on the forearms were conducted in duplicate, only one value was provided for each arm. No explanation was provided as to whether the values provided were the means. • Conducted in Japan and focused on seasonal increases in summer. Therefore, may not be generalisable to Scottish health and care settings.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Tsai AL, Hsieh YC, Chen CJ, et al. Investigation of a cluster of Bacillus cereus bacteremia in neonatal care units. J Microbiol Immunol Infect.	Outbreak study	**Level 3**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2022;55(3):494-502. Doi:10.1016/j.jmii.2021.07.008					

Assessment of evidence

Objectives: This Taiwanese study reports the investigation of a cluster of Bacillus cereus bacteraemia in neonatal care units of a medical centre and the infection control interventions implemented to tackle it.

Setting: A tertiary care hospital in Northern Taiwan, with 144-bed neonatal care units (NCUs), which includes 50 intensive care beds, 54 step-down intermediate care beds and 40 baby-room beds. Most of the patients in the intensive care beds were premature infants. Linen sterilization at the neonatal care unit had been discontinued in May 2019.

Organism: *Bacillus cereus*

Background: Four premature infants hospitalised in the NCUs developed B. cereus sepsis (defined as isolation of B. cereus from the bloodstream of a patient with clinical symptoms and signs of infection) between August 18 and November 7, 2019. Before this, there had not been any case of B. cereus bacteraemia in the previous 3 years. Patient 1 was a late preterm neonate born at 36 weeks with a birth body weight of 300g. The neonate had been intubated since delivery with the initial impression of transient tachypnoea of the newborn. Ampicillin and gentamicin had been empirically administered since birth because of maternal group B Streptococcus colonisation without adequate intrapartum prophylaxis. He developed a fever on Aug 18th when he was 4 days old. Blood culture from a peripheral blood vessel yielded B. cereus, sputum yielded Pseudomonas aeruginosa, while cerebrospinal fluid was sterile. Clinical illness improved after treatment with vancomycin for 14 days and anti-pseudomonas antimicrobial agent for 7 days.

Two other extremely preterm neonates, Patients 2 and 3, had similar septic illnesses on August 31st and September 19^{th,} respectively. Patient 2 was born at 24 weeks with a birth body weight (BBW) of 673g, and Patient 3 was born at 23 weeks with a BBW of 540g. Both were receiving a lot of care – patient 2 had been intubated since birth, and patient 3 was on ventilator support. Patient 2 developed symptoms of B. cereus bacteraemia on Aug 31 and Patient 3 on Sept 19, and both had B. cereus-positive blood cultures. Patient 4 was born at 32 weeks and was admitted with a diagnosis of apnoea of prematurity and neonatal hyperbilirubinemia. Patient 4 developed symptoms on Nov 7. Although all four patients were in different neonatal units, a cluster was suspected because of the rarity of the

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pathogen. An investigation commenced on Nov 26, 19 days after the onset of symptoms of patient 4. A total of 48 specimens were collected using damp sterile swabs from the environment, including baby linen, linen cabinet, bedside cabinet, incubators, new diapers, pacifiers, bed rails, sonography probe and jelly, milk and milk warming instruments, water dispenser, handwashing fluids and surfaces of computer devices. Swabs from the skin and umbilicus of patient 4 were also collected. The swabs were seeded in 5% sheep blood and then into Thio medium. The Bacillus species isolated were identified by matrix-associated laser desorption/ionization-time of-of-flight mass spectrometry (MALTI-TOF MS) using the ethanol-formic acid extraction method according to the Bruker protocol. PFGE with Smal digestion and MLST were used to compare the genetic relatedness of the isolates. Strains with identical banding patterns in terms of size and number of bands were considered indistinguishable and assigned to the same type while strains with banding patterns that differed only by three or fewer bands were considered closely related and described as subtypes of a given pulsotype. If the banding patterns differed by four or more bands, they were considered different and assigned into separate pulsotypes. MLST was used to characterise 7 alleles (glpF, gmk, ilvD, pta, pur, pycA and tpi) and their phylogenetic lineage based on sequence type using the B. cereus MLST website.

Findings: Twenty-six (54.1%) of the 48 environmental samples were positive for B. cereus. The bacteria growth was relatively higher in linen and linen cabinet samples. Positive samples were also obtained from the skin and umbilicus of patient 4, as well as from the bed rail, incubator, bedside cabinets, keyboards, computer mice, milk warmers, water dispenser buttons, handles of a formula milk cart, and a refrigerator.

Genetic relatedness: A total of 32 isolates were characterised including one isolate from Case 4, five control isolates from unrelated patients and the 26 isolates from the investigation. Eleven pulsotypes were identified. Seven isolates, including the samples from Case 4, were not successfully typed by PFGE. All 5 control samples belonged to 5 different pulsotypes. Using MLST, all four linen-associated isolates were included in one cluster, which comprised sequence type (ST) 177, ST73, ST1969 and ST427. The isolate from patient 4 (although un-typable by PFGE) shared identical characteristics with one of the sequence types in the linen cluster (ST427), which was isolated from one of the linen storage cabinets in the unit where patient 4 developed the illness.

Interventions: Between November 27th and 29th, various IPC measures were implemented, including extensive cleaning of all objects in the neonatal units with disinfectants and detergents, covering keyboards and mice in the nursing station with plastic wrap, and sending all unused linen to the laundry for washing. Extensive cleaning of the milk supply room was also done on December 5th. On review of the

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processing of hospitalised baby linen, it was discovered that sterilisation of linen had been discontinued in May 2019, 3 months before the onset of the first case. This was reinstituted. Outcomes: In the following 14 months, no more cases of B. cereus sepsis were recorded in the neonatal units. **Limitations** • Interventions were bundled, so it is impossible to tell the contribution of each to resolving the outbreak. • Samples from the first three cases were not available, so they were not compared to the environmental isolates and that from patient 4. Hence, it is impossible to prove that all four cases were related. • Although the authors state that there was relatively higher contamination in linen compared to other environmental samples, there was no baseline to compare with. Thus, it is impossible to tell whether linen contamination increased after the cessation of linen sterilisation before the commencement of the outbreak. • Bacterial counts not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Schmithausen RM, Sib E, Exner M, et al. The Washing Machine as a Reservoir for Transmission of Extended-Spectrum-Beta-Lactamase (CTX-M-15)-Producing Klebsiella	Outbreak study	**Level 3**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
oxytoca ST201 to Newborns. Appl Environ Microbiol. 2019;85(22):e01435-19. Published 2019 Oct 30. Doi:10.1128/AEM.01435-19					

Assessment of evidence

Objectives: This German paper reports a cluster of cases Klebsiella oxytoca colonisation of newborns spread by clothing laundered using a contaminated domestic washer-extractor machine.

Setting: Paediatric Hospital Ward in Germany

Method: Twenty-seven (27) children in a Level 1 Perinatal Center and in several wards in a connected children's hospital were found to have been colonized (not infected) with K. oxytoca between April 2012 and May 2013. This was discovered after implementing a standard screening procedure for incoming patients/individuals with risk factors (newborns, children and mothers) to reduce MDR bacteria. These included isolates with no extended-spectrum beta-lactamase (ESBL) activity and ESBL-producing ones. Fourteen children tested positive for ESBL-producing K. oxytoca PFGE type 00531. These included 13 newborns (1-4 weeks old) and 1 child aged 4 years old who, unlike all the others, had no direct contact with the PNC. K. oxytoca was identified in rectal samples and throat swab samples.

From October 2012 to February 2013, K oxytoca was detected on other wards and among older paediatric patients having only been found previously among nwborns in the PNC or infants in the ICU. An extended screening of 428 persons (a total of 695 swabs – vaginal and rectal) was conducted in the obstetrics ward. Four mothers were identified to be colonised with K. oxytoca, five with ESBL E. coli and

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1 with ESBL-producing K. pneumoniae. However, none was positive for PFGE type 00531 ESBL-producing K. oxytoca. Mother-to-child transmission was not documented. **Findings:** All environmental samples obtained during 2 onsite inspections (May and October 2012) were negative for K. oxytoca. In a third on-site inspection in June 2013, drinking water, wastewater samples and liquid medium swabs were sampled, and Enterobacterales and nonfermenting bacteria were detected. All K. oxytoca isolates were identical to the ESBL-producing strains and belonged to PFGE type 00531. “Identical clones of PFGE type 00531/ST201 K. oxytoca were isolated from the siphons of two sinks in the HCW staff room and in the room used for cleaning and disinfection. The same clone was also isolated at high concentrations from samples of residual water in the rubber seal and a swab sample (in addition to P. aeruginosa) from the detergent compartment of one of the two washing machines (Table 1) located on the ground floor of the same ward”. Following identification of the washing machine as a potential reservoir, newborn clothing, hats and socks that had been washed in the said machine were microbiologically analysed and PFGE type 00531/ST201 K. oxytoca of the same specific clone was isolated, with total counts of $>10^9$ CFU/ml. Retrospective analysis also demonstrated that only newborns who had worn clothing washed in the said machine were colonized with the specific K. oxytoca clone. No staff members were identified as carriers of ESBL-producing Enterobacterales despite the siphons of the staff sinks also being identified as a potential reservoir. **Genetic relatedness:** “All clinical and environmental isolates of PFGE type 00531/ST201 K. oxytoca displayed identical PFGE banding patterns and thus were considered clonally identical. This clone was specific for the newborns/infants and some environmental samples”. **Outcomes:** After the washing machine was removed from use, no further colonisation of newborns was detected. All garments were laundered by an external professional laundry. The colonised sinks were also replaced with a specialized thermosiphon system.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Cheng VCC, Chen JHK, Leung SSM, et al. Seasonal Outbreak of Bacillus Bacteremia Associated With Contaminated Linen in Hong Kong. Clin Infect Dis. 2017;64(suppl_2):S91-S97. Doi:10.1093/cid/cix044	Outbreak study	**Level 3**	N/A	N/A	N/A

Assessment of evidence

Objectives: This Chinese study reported a high summer seasonal incidence of Bacillus bacteremia associated with the use of contaminated hospital linen.

Setting: A 1700-bed university-affiliated tertiary referral centre.

Organism: *Bacillus cereus*

Background: From June to July 2015, there was a cluster of pulmonary and/or cutaneous infections by *Rhizopus microsporus* infection among immunosuppressed patients associated with direct inhalation and skin contact with contaminated linen items supplied by a designated laundry. Freshly laundered clothing and other linen items (such as pillowcases and bed sheets) were found to be contaminated by *R. microsporus,* which was phylogenetically related to the samples obtained from patient specimens. Following environmental

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surveillance, which showed heavy contamination of the designated laundry by zygomycetes, an alternative laundry provider was secured for the hospital, and the outbreak was terminated. In response to the outbreak, a retrospective analysis of hospital blood culture isolates was performed, and a high number of patients were found to have Bacillus species in blood cultures during the period of the *R. microsporus* outbreak.

Investigation: Microbiological data on the blood cultures processed between January 1, 2012, and July 31, 2016, were retrieved from the laboratory information system. Demographic, admission and clinical data were also obtained for patients with positive Bacillus blood cultures. Bacillus bacteraemia was defined as positive Bacillus blood culture without distinction from pseudo or genuine bacteraemia. The incidences of Bacillus bacteraemia per 1000 patient admissions and 1000 patient days were calculated for the baseline period (June and July 2012 - 2014, the years before the outbreak), outbreak period (June and July 2015), and post-outbreak period (June and July 2016). The total aerobic count of linen samples during the outbreak and post-outbreak period was evaluated. This was done using Replicate organism detection and counting (RODAC) plates with plate mean surface area of 25cm^{2,} which were pressed onto linen samples with a contact time of 10 seconds. Bacillus-like species from the plates were identified using MALDI-TOF MS.

Results: A total of 113207 blood cultures from 43,271 patients were obtained across the three periods, and Bacillus species were identified in 978 (0.86%) specimens from 744 (1.72%) patients. The authors reported that the incidence of Bacillus bacteraemia per 10,000 patient admissions and per 10,000 patient days showed statistically significant seasonal variation, with the highest incidence in the summer months (July to September) (p=0.00012). They were, however, not clear as to whether this statistic was being compared with the rest of the year. Bacillus species were isolated from 2.4% of the blood cultures in the outbreak period, significantly higher compared to 1.1% in the baseline period (Rate ratio=2.3, 95% CI: 1.7-2.9; p<0.001). The incidence of Bacillus bacteraemia per 10,000 admissions (39.97 vs 18.21; rate ratio, 2.20; 95% CI, 1.68–2.86; P<0.001) and per 10,000 patient days (rate ratio=2.38; 95% CI, 1.82–3.11;13.36 vs 5.61; P<0.01) was also significantly higher for the outbreak period compared to baseline. The patients with positive Bacillus blood cultures (n=87) were more evenly distributed among the 37 wards during the outbreak period compared to the baseline period, where most of the patients were from the adult ICU). The incidence of Bacillus bacteraemia was also significantly lower during the post-outbreak period (after switching to an alternative laundry supplier) compared to the outbreak period (2.27 vs 39.97 per 10,000 admissions) (rate ratio, 0.06; 95% CI, .02–.13; P<0.001) and (0.73 vs 13.36 per 10,000 patient-days) (rate ratio, 0.05; 95% CI, .02–.12; P < .001).

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Genetic relatedness: This was done using MALDI Biotyper 3.1 and showed that the B. cereus group in blood cultures from 14 of 87 patients (16.1%) were shown to be phylogenetically associated with 9 linen sample isolates. **Limitations** • Bacteraemia, as defined by the study, does not distinguish between genuine and pseudo bacteraemia, which could result from exogenous blood culture contamination by the contaminated linens at the time of sample collection.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Cheng VCC, Chen JHK, Wong SCY, et al. Hospital Outbreak of Pulmonary and Cutaneous Zygomycosis due to Contaminated Linen Items from Substandard Laundry. Clin Infect Dis. 2016;62(6):714-721. doi:10.1093/cid/civ1006	Outbreak study	**Level 3**	N/A	N/A	N/A

Assessment of evidence
Objectives: This Chinese paper reports a cluster of Rhizopus microsporus pulmonary and cutaneous zygomycosis among immunosuppressed patients caused by contaminated linen items. Organism: Rhizopus microsporus Setting: A 1700-bed university-affiliated tertiary referral centre Background: Over a two-month period, a cluster of pulmonary and cutaneous zygomycosis was identified among immunosuppressed patients in the hospital. Investigation: “A case was defined as a patient with Zygomycetes isolated from their clinical specimens during hospitalisation between 1 January and 31 July 2015”. Laboratory microbiology data were retrieved to identify unrecognised cases and establish the infection's background rate. Patient medical records, clinical data and changes in nursing care practices were also reviewed by the clinical microbiologists and infection control team. Staff and patients were also interviewed to establish a likely infection source. Air and environmental sampling were done on 16 July 2015, and because of the cutaneous nature of the infection and the fact that it had been identified in two different wards, linen items, dressings, and adhesive tapes applied directly on patients’ skin were investigated further. Findings: Many laundered linen items in Ward storage were positive for zygomycetes. Air and other environmental samples were negative. A visit to the central linen storage rooms and environmental sampling was done on 18th July 2015. Laundered items were also tested on arrival from the designated laundry which were also positive for zygomycetes. The mean TVC of newly delivered freshly laundered linen was 1028 ± 611 CFU/100cm^2, most of which were Bacillus spp on the RODAC plates. As a result of this, linen supply from the said laundry was discontinued immediately, and a site visit was conducted on July 20th. Clinical and laboratory surveillance of immunosuppressed patients continued after the laundry provider was replaced. On a visit to the laundry facility, poor general hygiene was noted. All fans on the walls and the surface of the calendaring machines were covered with a thick layer of dust. Linens were moist and warm to touch upon packing on the day of inspection, a situation which could have encouraged fungal growth. 61% of 195 environmental samples taken at the laundry were positive for zygomycetes, indicating widespread contamination. These included samples from filters of tumble and batch dryers, airflow machine filters, and inlet conveyor belts, interior surfaces, exhaust vents and receiving tables for post-iron items of calendaring machines.

Assessment of evidence

Genetic relatedness: There was a clustering of the R. micropsorus isolates from patients, linen and environmental samples on the phylogenetic tree of their ITS1-5.8s-ITS2 rRNA gene cluster (ITS) region.

Outcomes: No new cases were identified after changing the laundry service provider.

A **case-control study** was thereafter conducted to identify risk factors for zygomycosis among immunosuppressed patients. The incidence of zygomycosis and the rate of linen contamination with zygomycetes were evaluated in the case hospital (the hospital where the outbreak occurred) and the control hospitals (hospitals supplied by other laundries).

Methods: Linen and environmental samples were collected using poly-wipe sponge swabs, which were used to swab a 50x30cm area of the linen. Replicate Organism Detection and Counting (RODAC) plates were also used for sampling by pressing on the fabric's surface for 10 seconds. A surface area of 50x30cm was also swabbed for environmental samples except for conveyor belts and machine wheels adjacent to the conveyor belts of the calendaring machines, which were swabbed according to the available surface areas at different locations in the designated laundry facility. Air sampling was also done. Fungal colonies were examined under the microscope, and identification was further confirmed using MALDI-TOF MS or fungal internal transcribed spacer (ITS) gene sequencing.

Results: A total of six cases were identified. All adults were immunocompromised – three presented with pulmonary infection, two with cutaneous and one with both infections caused by R. microsporus. Case-control analysis with age and sex-matched immunosuppressed patients revealed the duration of hospitalisation was the most significant risk factor for nosocomial zygomycosis. A total of 695 and 451 laundered line items were sampled from those supplied by the designated laundry facilities and from the storage of control hospitals supplied by nine other laundries, respectively. Of the 695 items, 70 (27.8%) of the 252 clothing and 15 (3.4%) of the 443 non-clothing linen items were positive for zygomycetes, compared to 0% of the 451 linen items from the other facilities ($P<0.001$). The incidence of zygomycetes per 100,000 patient admission in the case hospital was 14.8, significantly higher than that of the control hospitals (0; $p<0.001$).

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Duffy J, Harris J, Gade L, et al. Mucormycosis outbreak associated with hospital linens. Pediatr Infect Dis J. 2014;33(5):472-476. doi:10.1097/INF.0000000000000261	Outbreak study	**Level 3**	N/A	N/A	N/A

Assessment of evidence

Objectives: This American study reports an outbreak of mucormycosis in a paediatric hospital in the United States.

Setting: Pediatric Hospital

Organism: *Rhizopus spp*

Background: In June 2009, several cases of hospital-onset mucormycosis were identifies during a short period. A case was defined as a patient of the hospital with a mucormycete organism identified by either a) histopathologic, cytopathologic or direct microscopic examination of a tissue specimen or b) culture of a specimen obtained from a clinically abnormal body site consistent with an infectious disease process, from January 2008 – July 2009.

Investigation: Retrospective case-finding was done to identify additional cases and to determine the baseline frequency of the disease in the hospital. Five databases were searched: microbiology, pathology, mortality records, ICD-9 coded discharge diagnoses and pharmacy amphotericin dispensing records. Open-ended interviews were also conducted with staff who worked with case patients to identify possible exposures and risk factors. A visual inspection of the hospital was conducted to identify possible sources of mold; the heating, ventilation and air conditioning systems were reviewed, as was the recent construction history within the hospital premises. Initial results suggested a possible link with linen which prompted a visit to the off-site laundry facility that supplied linens to the hospital, and their

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processes and workflows were observed. Another laundry supply facility (not involved with the hospital) was also visited for comparison. Environmental samples were collected from the hospital areas where the case patients had spent time or where linen was stored or transported. Samples were also collected from hospital areas not associated with case patients or linen to serve as comparison. Samples were also taken from the laundry facility from areas involved in the different stages of the workflow: washing, drying, folding and packing. An initial sampling at the hospital was done using dry swabs, while laundry sampling and post-intervention sampling at the hospital was done using three different methods: a) hard surfaces were swabbed using a sterile sponge pre-moistened with 10ml neutralizing buffer b)linen and porous samples were sampled with a high flow vacuum pump with 0.8µvm pore filter cassettes c) air samples were collected using a SAS Super 90 air sampler.

Findings: A total of 5 cases (/aged between 35 days to 13 years) were identified from August 2008 through July 2009 – all of whom subsequently died. No cases were identified prior to this time. The five cases spent time in seven different wards, but none of them were admitted to the same ward at the same time as any other case. All five had cutaneous mucormycosis, had one or more mucormycosis risk factors and had lesions with varied anatomical locations but none near a wound or surgical site. Three patient cultures yielded *Rhizopus delemar*, but no fungal species could be identified from the 4th patient and no specimens were available for the 5th who was diagnosed by histopathology (like the other four). One of the three patients with positive *R. delemar* cultures also yielded *Candida parapsilosis* from samples obtained during autopsy. Rhizopus spp were isolated from 42% of linen and items directly in contact with clean linen. These included linens, linen bins, linen delivery truck, linen storage room and closets. Of the non-linen related items, only one of 25 samples was positive; that was the air vent of an equipment room, which was close to the linen room and was supplied by the same air handling unit. Following these results, the hospital ordered and received linen from two other linen companies. Samples were taken from the clean linen, linen bins and delivery trucks from all three companies at the hospital loading dock over a two-day period. In the end, *Rhizopus spp* was recovered from 9 (56%) of 16 samples from the linen and associated items supplied by the initial linen company' and 1 (4%) of 27 and 1 (13%) of 8 samples from the two other linen companies. A control (unused) swab yielded no growth. Five of 13 samples collected from the premises of the initial linen company yielded *Rhizopus microsporus*; two samples yielded *Lichtheimia corymbifera,* but the facility was found to have a standard working process. At the comparison laundry facility, two of 14 samples yielded Rhizopus spp (R. oryzae and R. spp). A point or renewing source was not found.

Assessment of evidence
Limitation • Samples were not taken from freshly processed linen at the initial laundry facility – this would have helped to demonstrate that the laundering process in the facility was adequate and that the contamination happened afterwards.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Sasahara T, Hayashi S, Morisawa Y, Sakihama T, Yoshimura A, Hirai Y. Bacillus cereus bacteremia outbreak due to contaminated hospital linens. Eur J Clin Microbiol Infect Dis. 2011;30(2):219-226. Doi:10.1007/s10096-010-1072-2	Outbreak study	**Level 3**	N/A	N/A	N/A
Assessment of evidence					
Objectives: This Japanese study describes the investigation of an outbreak of *Bacillus cereus* bacteraemia in a university hospital. Setting: Tertiary care center with 1,130 beds.					

Assessment of evidence

Organism: *Bacillus cereus*

Background: From 2004 – 2005, Bacillus spp were isolated from blood cultures at a rate of about two patients per month. However, between spring and summer 2006, the number of Bacillus-positive patients rose. In August alone, Bacillus spp was isolated from blood samples of 15 patients suggesting an outbreak was in progress.

Investigations: Retrospective reviews of the charts of patients from whose blood Bacillus spp had been isolated between April 2004 and August 2006 were carried out. False positive results were excluded based on the CDC definition of nosocomial infections. The blood cultures of Bacillus-positive patients from April to August 2006 were retrieved (this is possible because blood cultures were preserved in the hospital laboratory for up to 4 months), and the Bacillus spp isolated was identified. The hospital environment was also investigated, specifically the neurology and trauma wards. Environmental surfaces were swabbed with sterile cotton swabs moistened with sterile physiological saline (PS). The swabs were then streaked directly into Mannitol Egg York Polymyxin (MYP) agar plates and incubated overnight at 35°C. Mannitol-negative, lecithinase-positive, large, flat and granular colonies were identified as B. cereus. Samples of disinfectants and hand sanitizers used in the aforementioned wards were taken and cultured. Sample pieces (4x4cm) cut from linens stocked in the linen room of the investigated wards and in the central linen room of the hospital were placed in 50ml screw-cap tubes containing 20ml sterile PS and 30 sterile glass beads. These tubes were vortex-mixed for 2 minutes and the resulting suspension was diluted 10-fold with sterile PS and inoculated into MYP agar plates, and treated as described above. Water samples, which were recycled and used for washing and rinsing, were collected from the continuous washing machine (with 3 wash compartments and 4 rinse compartments) and cultured as already described.

Genetic relatedness: Clonal relationships between the B. cereus isolates were evaluated using Pulsed-field gel electrophoresis (PFGE).

Findings: In 2004, there were 18 patients with cultures positive for Bacillus spp (two of which were diagnosed of Bacillus bacteraemia), in 2005, there were 33 patients with positive cultures (with five cases of bacteraemia). Between January and August 2006, there were already 37 patients aged 0-85 years with positive cultures, 11 of whom had bacteraemia. Most of them were immunocompetent. Three of the 11 patients died of bacteraemia, and another developed endophthalmitis. All isolates from the 11 bacteraemia patients were identified as *B. cereus*. Patients with positive Bacillus cultures but without bacteraemia were considered false positives, and of these, some of the cultures were identified as B. cereus and some as B. subtilis. B. cereus was isolated from all samples obtained from bed sheets (n=15) and towels (n=15). The towels were 80 times more contaminated than the bedsheets. B. cereus was found in half the samples from

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tourniquets (n=2), 67% of nurse carts (n=6), 78% of washstands in patient rooms (n=7) and in one of three IV fluid samples from bacteraemia patients. Samples from disinfectants, hand sanitizers and top of culture bottles were all negative. Large amounts of B. cereus were recovered from drain water from the washing machine. The PFGE profiles differed for all isolates from the hospital linens. The isolates from the blood and IV fluid samples were classed into five types (A-E). Isolates from four bacteraemia patients, two IV fluid samples and one linen sample were found to be type C. Interventions: In September 2006, all hospital linens were autoclaved, the washing machine compartments were cleaned with an alkaline detergent, and the linen supplier stopped recycling water for wash and rinse. Hospital staff were also required to wear gloves during intravenous infusion procedures. B. cereus contamination in linen was then evaluated one month after the implementation of these measures. Outcomes: After the interventions were implemented, linen *B. cereus* contamination dropped to 1 per thousand. The number of new cases per month was also said to rapidly decrease, but no figures were provided. In the following years, 2007 and 2008, only four and five patients, respectively, were diagnosed with *B. cereus*. **Limitations** • Some numbers reported in tables did not match what was reported in the text.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Boonstra MB, Spijkerman DCM, Voor In 't Holt AF, et al. An outbreak of ST307 extended-spectrum beta-	Outbreak study	**Level 3**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
lactamase (ESBL)-producing Klebsiella pneumoniae in a rehabilitation center: An unusual source and route of transmission. Infect Control Hosp Epidemiol. 2020;41(1):31-36. Doi:10.1017/ice.2019.304					

Assessment of evidence

Objective: This Dutch paper reports an outbreak of extended spectrum beta lactamases (ESBL) - producing *Klebsiella pneumoniae* on a single ward of a rehabilitation centre.

Setting: 40-bed Rehabilitation centre for spinal injuries and other complex chronic impairments. September 2016 to January 2017.

Organism: ESBL-producing K. pneumoniae

Background: In October 2016, ESBL-K pneumoniae were isolated from the clinical cultures of three patients; two of the three isolates had identical genotypes (the outbreak strain). Following this finding, 36 other patients admitted to the ward were screened. A case was defined as a patient colonised or infected with ESBL-K. pneumoniae with a strain genetically indistinguishable from the outbreak strain as determined by multiple-locus variable number tandem repeat analysis (MLVA) and amplification fragment–length polymorphism (AFLP), isolated during the study period.

Assessment of evidence
Investigation: Patients and the environment were screened using sterile cotton swabs with Amies medium without charcoal. Samples were taken from doorknobs, wash hand basins, light switches, shower chairs and shower mats. Samples were also taken from the therapy and recreation rooms and the kitchen and staff rooms. The swabs were thereafter plated on Brilliance ESBL agar and incubated for 2 days. Tryptic soy broth (TSB) containing 50mg/l vancomycin and 2mg/l ceftazidime was used as a selective medium for samples from cotton cloths. 10µl of the broth was subcultured into ESBL agar after overnight incubation at 35°C. Bacteria identification and susceptibility testing were done using MALDI typer (Bruker Daltonik GMbH, Bremen Germany) and VITEK2 (bioMerieux, Marcy l'Etoile, France), respectively. ESBL production was confirmed in isolates with reduced susceptibility to cefotaxime and/or ceftazidime. Genetic relatedness: Slightly modified MVLA and AFLP were used for genotyping. Selected ESBL-K pneumoniae isolates with identical MVLA and AFLP genotypes but with different susceptibility to gentamycin were subjected to whole genome sequencing MLST. Findings: Apart from the initial three cases, seven other patients were found to be colonised with ESBL-K pneumoniae. Six of these patients had isolates that were genetically indistinguishable from the outbreak strain on AFLP and MVLA. There were, however, some differences in gentamycin susceptibility. All four isolates (one each of gentamycin susceptible and resistant clinical isolates and two environmental isolates) subjected to whole genome MLST were of sequence type (ST)397. The gentamycin-susceptible isolates from the machine and one patient were genetically closely related, differing only in 3 core genes. The gentamycin-resistant isolates from the machine and another patient differed only in 5 core genes. Despite all belonging to the same sequence type, the gentamycin-resistant and susceptible isolates differed in 39 core genes, which is beyond the cluster alert of 15 gene differences. Of the total of 163 environmental cultures taken, only cultures taken from a single household washing machine were positive for the outbreak strain. The strain was repeatedly cultured from the filter and inner surface of the machine which was used to wash lifting slings and patient clothing soiled with faeces. As the centre has a 'no absorbent material or diaper policy' to reduce the risks of pressure ulcers, lifting slings and patient clothing were frequently soiled with faeces. These were washed in the washing machine often at low temperatures (30-40°C despite existing protocol requiring a minimal temperature of 60°C) with a laundry detergent but without activated oxygen bleach (AOB). The laundered items were then air-dried in an unventilated room. Following this, samples from another domestic washing machine (used for personal clothing not contaminated with faeces) and a professional washing machine (used for bed linens and towels) were cultured. These were repeatedly negative for the outbreak strain.

Assessment of evidence
Further investigations: A further experiment was conducted with the contaminated washing machine to investigate its role in transmitting the outbreak strain and to develop a laundering protocol that removes the risk of ESBL-K transmission. The experiment consisted of two schedules performed twice (Sessions 1 and 2). The first schedule involved sequentially performing the following processes before and after running a wash cycle. A) Culturing three sites of the machine (filters – drain pump and water filters; inner surface – rubber and basket; outer surface – control buttons, door handle and detergent drawer) prior to washing at 60°C; B) culturing faeces of patient prior to washing at 60°C; C) sampling and culturing the same three sites after washing at 60°C; D) and sampling and culturing a piece of cotton cloth after washing at 60°C. This was repeated twice in the exact same way. The second schedule involved A) culturing the same three sites of the machine prior to a 30°C wash; B) culturing faeces of patient prior to washing at 30°C; C) culturing the same three sites after washing at 30°C; D) culturing a piece of cotton cloth after washing at 30°C; E) culturing the same three sites after washing at 90°C; D) culturing a piece of cotton cloth after washing at 90°C. In one of the sessions, ESBL-K was detected in the cloth after washing at 30°C but was absent in both sessions after washing at 60°C. However, the filter was positive after washing at 60°C in one of the sessions but was negative after the 30°C wash sessions. In response to this finding, a reinforced laundry protocol was established. Clothing and medical aids used by different patients were to be washed separately on full wash cycle time at 60°C. If certain clothes could not be washed at 60°C, they could be washed at 30-40°C, followed by an additional empty basket washing cycle at 95°C. The rubber ring and exterior surfaces of the door and buttons were to be cleaned and disinfected after every washing program. Interventions: Infected or colonised patients with the outbreak strain were cohorted (because of the limited number of single rooms) with contact precautions which involves wearing a disposable gown and gloves before touching patients or their immediate environment. This is in addition to standard infection control measures. Patients cared for in the same room as an unexpected case (contact patients) were screened weekly throughout the outbreak period. The entire ward was also cleaned and disinfected using a chlorine-based disinfectant 250ppm for large surfaces or 70% alcohol for smaller surfaces. New patient admission was stopped in the first four weeks of the outbreak. The offending washing machine was temporarily removed from use. Outcomes: The outbreak ended after eight weeks. However, one case was unexpectedly identified afterwards—this patient missed two weekly screenings due to being hospitalised for 10 days with pneumonia. As a result, no reinforced control measures were taken.

Assessment of evidence
Limitations • Only four out of over 170 isolates were subjected to wgMLST.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Dohmae S, Okubo T, Higuchi W, et al. Bacillus cereus nosocomial infection from reused towels in Japan. J Hosp Infect. 2008;69(4):361-367. Doi:10.1016/j.jhin.2008.04.014	Outbreak study	**Level 3**	N/A	N/A	N/A
Assessment of evidence					
Objectives: This Japanese study reports an outbreak of B. cereus in hospitalised patients in a Japanese Hospital. Setting: Japanese Hospital – other details unclear. Organism: Bacillus cereus Background: A detailed study of the cases following an increase in B. cereus cases in 2005 was carried out. Investigation: Environmental samples from washed (wet) towels in steam boxes (maintained at 80°C) in the wards and washed (dried) towels from a linen room in the hospital. Samples were also taken off the floor using Petan check NGKG Aagar. Multilocus sequence					

Assessment of evidence

typing (MLST) and Pulsed-field gel electrophoresis (PFGE) with computer-aided analysis were used to determine the clonal relatedness of the isolates.

Findings: A review of cases showed that there had been one B. cereus bacteraemia case each in 2000 and 2001, three each from 2002-2004 and five in 2005. The five cases in 2005 ranged from 21 – 82 years. The first was identified on 12th August, and the last on 19th September. All five patients had fever, were receiving treatments via a central venous catheter and had B. cereus isolated from both their blood cultures and the catheters. B. cereus was isolated from washed dried and washed wet towels with an estimated 106 CFU/towel. Samples from washing machines, final rinse water, and driers in the hospital linen room were also positive for B. cereus. Floors and computer keyboards in each hospital ward were also positive for B. cereus, but the levels were comparable to those of the rooms in the university buildings, which were next to the hospital buildings. No B. cereus (<102 CFU/towel) was detected in the towels after they were disinfected with sodium hypochlorite and laundered by an external laundry service.

Genetic relatedness: The five patient strains exhibited four distinct sequence types (365 – 368). The two strains with the same ST type were distinguished by PFGE analysis. The strains from the blood culture and catheter were the same for each patient. The isolates from the towels belonged to seven strains. One of which was identical to one patient strain on PFGE analysis, another showed high similarity (86%) to another patient strain, and the others were determined to constitute subclusters with the other patient samples but with lower similarity (<50%).

Limitations

- The unclear reporting format of the paper made it difficult to identify a sequence of events.
- The location of the outbreak is unclear.
- The source of the infection is unclear.
- Vague about towel reuse and no information about laundering conditions of towels implicated.
- Whilst interventions involving linen (towels disinfected with sodium hypochlorite and laundered by an external company) saw no subsequent *B. cereus* detected, unknown if/what other IPC changes/interventions took place during the outbreak that may have contributed.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Engineering, equipment and validation. 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This British document aims to "provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen".

The document provides the following recommendations to reduce contamination of Bacillus spores (especially B. cereus) if tests show that number of Bacillus spores has exceeded the trigger level.

"Actions to reduce the contamination on processed linens should be initiated at a trigger level below this customer-notice alert level. It is recommended that an increase in the dilution during the wash process should be considered as a control measure. Sporicidal biocides should only be considered if they have been shown to be effective at the concentrations achieved in the wash process, and at the temperatures and contact times that would occur."

Assessment of evidence
Limitations • Method of producing guidance not stated. • Update process or schedule not provided.

Question 17: How should infectious linen be safely handled?

Evidence added to the current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
National Center for Emerging and Zoonotic Infectious Diseases. Basic Infection Control and Prevention Plan for Outpatient Oncology Settings. CDC, 2011 December [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This American document was “developed for outpatient oncology facilities to serve as a model for a basic infection control and prevention plan. It contains policies and procedures tailored to these settings to meet minimal expectations of patient protections as described in the CDC Guide to Infection Prevention in Outpatient Settings. The elements in this document are based on CDC’s evidence-based guidelines and guidelines from professional societies (e.g., Oncology Nursing Society)”. The document provides the following guidance on handling and laundering soiled linen: • “Handle all contaminated linens with minimum agitation to avoid contamination of air, surfaces, and persons • Do not sort or rinse soiled linens in patient-care areas • In the laundry area, appropriate PPE (e.g., gloves) are worn by laundry personnel while sorting soiled linen, and hand hygiene supplies are available for their use” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
MacCannell, T., Umscheid, C., Agarwal, R., Lee, I., Kuntz, G., Stevenson, K. & Healthcare Infection Control Practices	Guidance	**AGREE recommend**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Advisory Committee (HICPAC) Guideline for the Prevention and Control of Norovirus Gastroenteritis Outbreaks in Healthcare Settings. Infection Control & Hospital Epidemiology, 2011 32(10), 939-969. doi:10.1086/662025					

Assessment of evidence

This American guideline provides “specific recommendations for implementation, performance measurement, and surveillance” for the prevention and control of norovirus gastroenteritis outbreaks in healthcare settings.

The document provides the following on handling soiled linen.

“Use Standard Precautions for handling soiled patient-service items or linens, including the use of appropriate PPE. (Category IB)”

“Handle soiled linens carefully, without agitating them, to avoid dispersal of virus. Use Standard Precautions, including the use of appropriate PPE (e.g., gloves and gowns), to minimize the likelihood of cross-contamination. (Category IB)”

“Double bagging, incineration, or modifications for laundering are not indicated for handling or processing soiled linen. (Category II)”

“During outbreaks, change privacy curtains when they are visibly soiled and upon patient discharge or transfer. (Category IB)”

Assessment of evidence
It also provides the following consideration “Consider discarding all disposable patient-care items and laundering unused linens from patient rooms after patients on isolation for norovirus gastroenteritis are discharged or transferred. Facilities can minimize waste by limiting the number of disposable items brought into rooms/areas on Contact Precautions. (Category II).” **Limitations** • Limited details provided for the guideline development group. • No statement regarding editorial independence from funding body is provided. • Link provided for formulation of recommendations and finalisation of guidance seems out of date and did not work.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Management and provision 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”. It provides the following on infectious linen handling: “Linen processors who process infectious linen should adopt post-wash sorting of linen (for example, after processing through the washing equipment) for production purposes or limit pre-wash sorting to choice of machine type only. (Note that this refers to production/batch sorting and not necessarily to the adoption of option 2 detailed in the ‘Classification and sorting options’ section.)” “Linen processors who process infectious linen should adopt bag handling and opening procedures that: (i) do not use liquid permeable bags (ii) minimise manual handling/ opening of infectious linen and any other exposure of staff to the linen prior to decontamination; -are fully automated for washer loading (once the technology has been developed to allow this); and -are capable of being adequately disinfected” “Impermeable bags are bags that a liquid does not leak or pass through at any time during their use or during the washing process. Liquid permeable bags are bags that a liquid may leak or pass through at any time. They are not to be confused with water-soluble bags (and bags with water-soluble seams), which only become permeable when processed in a washing machine. Traditional linen-style laundry bags often fall into this category. Water-soluble bags (sometimes referred to as “alginate” bags) are (1) bags that dissolve or break apart when processed in a washing machine and/or (2) impermeable bags with a water-soluble seam. Throughout this volume, both types are referred to as “water-soluble bags”. “Linen from patients infected with, or at high risk of having, hazard group 4 organisms (haemorrhagic fever viruses such as Lassa Fever) should not be returned to a laundry.” On colour coding of linen bags, the document states the following: “Infectious linen: All linen identified as infectious should be placed in a red water-soluble bag (with an optional bold legend stating “infectious linen”), which should then be placed inside a white impermeable bag which is identified as “infectious linen”

Assessment of evidence
Limitations • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health & Social Care. Infection prevention and control: resource for adult social care. [updated 2024 March 1; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
"This resource contains general infection prevention and control (IPC) principles to be used in combination with advice and guidance on managing specific infections. It is for those responsible for setting and maintaining standards of IPC within adult social care in England." The document provides the following on linen handling: "The key principles for safely handling laundry are: • wash hands between handling clean and used or infectious laundry • prevent cross-contamination between clean and used or infectious laundry • use separate containers for clean and used or infectious laundry

Assessment of evidence

- do not shake used or infectious laundry
- do not place used or infectious laundry on the floor or on surfaces
- use an apron to protect worker clothing from used or infectious laundry
- infectious laundry:
    - do not wash by hand
    - use the appropriate pre-wash cycle
    - launder separately from other items
    - launder at appropriate temperatures”

• “Seal infectious laundry in a water-soluble bag (appropriate for the washing machine used) immediately on removal from the bed, and then place this within an impermeable bag.

• Place water-soluble bags containing infectious laundry directly into the washing machine without opening the bags.

• Use separate containers for transporting clean laundry, and used or infectious laundry, and wash infectious laundry separately.

• Clean hands between handling different categories of laundry.

• […] Within care homes, consider processes that will help ensure dirty laundry will not contaminate clean laundry. Consider having a dirty to clean flow system in laundry rooms so clean and used laundry are physically separated and ensure hand washing facilities are available where possible to do so.”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
European Centre for Disease Prevention and Control. Factsheet for health professionals on mpox (monkeypox). Stockholm: ECDC; 2023 April [cited 2023 November 28]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

The purpose of the document is for general information.

On “Special Considerations in Healthcare Settings and Home Isolation”, the document states:

“The principal mode of MPXV transmission is thought to be direct contact with mpox lesions or objects contaminated with lesions, such as clothing and bed linen (fomites). Therefore, caregivers and members of the household should avoid touching skin lesions with their bare hands, wear disposable gloves when handling materials which were in contact with the bare skin of a patient (including clothes, bed linen and towels), and observe strict hand hygiene before and after the use of gloves.”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Public Health Agency of Canada. Clostridium difficile infection; Infection Prevention and Control Guidance for Management in Long-term Care Facilities. 2013 [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Canadian guidance aims “to provide infection prevention and control guidance to healthcare organizations and healthcare workers for the management of patients with Clostridium difficile (C. difficile) infection in acute care settings”.

The document provides the following recommendations on infectious linen handling:

“No special precautions are required for linen; routine practices are sufficient and include the following: Soiled linen should be handled in the same way for all residents without regard to their infection status; Soiled linen should be placed in a no-touch receptacle at the point of use; Soiled linen should be handled with a minimum of agitation to avoid contamination of air, surfaces and persons; Soiled linen should be sorted and rinsed outside of the resident's care area; and Heavily soiled linen should be rolled or folded to contain the heaviest soil in the centre of the bundle.”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Public Health Agency of Canada. Infection Prevention and Control Guidance for Middle East Respiratory Syndrome Coronavirus (MERS-CoV) in Acute Care Settings. 2016. [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Canadian guidance aims to "provide infection prevention and control (IPC) guidance to healthcare organizations and healthcare workers (HCWs) for Management of patients presenting to acute care settings2 in Canada, who have travelled to an affected area3 and/or been in contact with someone who has travelled to an affected area, within 14 days before onset of illness; Management of HCWs and inpatients who have been exposed to a symptomatic confirmed case of MERS-CoV infection; and Management of asymptomatic HCWs and inpatients who are RT-PCR1 positive for MERS-CoV."

"No special precautions are recommended; routine practices are sufficient."

Limitations

- The method of producing guidance is unclear.
- Update process or schedule not provided

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Centre for Communicable Diseases & Public Health Agency of Canada. Infection control guideline for the prevention of Healthcare-Associated Pneumonia. 2010 [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Canadian guidance aims "to provide a framework within which those responsible for developing systems to reduce healthcare-associated pneumonia in all settings may develop policies and procedures that are consistent with national guidelines."

The document notes this on linen handling:

"Routine practices should be applied in the handling of soiled linen and clinical waste."

Limitations

- No update has been done even though the document states that a review will be done in 2014.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Public Health Agency of Canada. Infection prevention and control for COVID-19: Interim guidance for acute healthcare settings. 2021 [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Canadian guidance aims "to provide updated interim IPC guidance to healthcare organizations and HCWs to prevent the transmission of COVID-19 in acute healthcare settings."

"Routine practices should be applied in the handling of soiled linen and clinical waste."

Limitations

- The method of producing guidance is unclear.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Public Health Agency of Canada. Infection prevention and control measures for Ebola disease in acute care settings. 2021. [cited 2024 June 27]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Canadian guidance aims "to provide guidance on the minimum level of IPC measures in healthcare settings in the event that a person under investigation for EBOD or patient with EBOD is identified within a Canadian healthcare facility."

On Linen management, the document states:

"Patient bed linen should be changed regularly and when soiled, upon discontinuation of precautions and following patient discharge. Linen should:

- Be handled with minimum agitation to avoid contamination of air, surfaces and persons
- Not be sent to the laundry
- Be disposed of in a designated no-touch biohazardous waste receptacle at the point-of-use"

"All EBOD-associated waste is considered biohazardous (or infectious) waste and includes items (including linen and sharps) contaminated with human blood and body fluids (i.e., respiratory secretions, saliva, emesis, feces, urine, dialysate/effluent) that warrants special handling and disposal as they may in certain situations present a risk of disease transmission."

Assessment of evidence

The document also recommends on management of EBOD-associated waste generated in healthcare settings that

“All HCWs (i.e., nurses, doctors) and environmental services personnel handling EBOD-associated waste should wear appropriate PPE, including enhanced PPE based on a risk assessment, along with following guidance for safe removal of PPE, according to the organization's policy.” The document lists “Linen - bedding, towels, washcloths, gowns, and curtains (privacy, shower, window)” as part of waste generated.

“Only personnel trained and wearing appropriate PPE should be managing linen (handling, containing and on-site transport).”

“Handling and containing linen should only occur in the patient-care room and in the room/area where PPE is removed by trained HCWs (i.e., nurses, doctors) wearing appropriate PPE.”

“The following measures should be taken:

- Consider all linen in the patient-care room contaminated, whether used or not
- Contain linen at point of use
- Fold linen inward and handle with minimal agitation and shaking to avoid contamination of air, surfaces and persons
- Place disposable linen into waste container
- Place reusable linen immediately into a sturdy, leak resistant container lined with a leak and tear resistant plastic biohazard bag
- Do not manually compact linen into the bags
- When the bag is two-thirds full, seal securely preventing tearing/puncturing the bag and ensuring no leaks
- Remove the bag from the container (Note: this container should stay in the patient's room until discharge and relined with a new biohazard bag for next fill)
- Clean and disinfect the entire outside of the bag by wiping using a disinfectant with a broad spectrum virucide claim with a Health Canada DIN and used according to the manufacturer's instructions

Assessment of evidence

- Place the decontaminated bag into a second biohazard bag and seal securely, preventing tearing/puncturing the second bag and ensuring no leaks
- Wipe the entire outside of the second bag using a disinfectant with a broad spectrum virucide claim with a Health Canada DIN and used according to the manufacturer's instructions, immediately before removing it from the room”

“To move the double-bagged linen from the patient-care room, personnel should place the double-bagged linen in a leak-proof/impervious, puncture-resistant plastic or metal single-use container.

The linen container should be:

- Located at the periphery/outside of the area for taking off PPE to avoid risk of recontamination of the container during PPE removal
- Securely sealed, clearly labelled and identified as EBOD-associated biohazardous material
- Decontaminated by wiping the entire outside of the container using a disinfectant with a broad spectrum virucide claim with a Health Canada DIN and used according to the manufacturer's instructions, immediately before removing the container from the area
- Personnel removing the linen container from the area should only handle the outer container and transport carts.
- Containers should not be re-opened once sealed.
- For moving large or heavy containers, carts with guard rails or raised edges should be used and loaded in a manner that will prevent items from tipping.
- Carts should be disinfected after each use with a disinfectant with a broad spectrum virucide claim with a Health Canada DIN and used according to the manufacturer's instructions.
- The container should be moved immediately and directly to a designated locked holding area with restricted access and stored as per the organization's biohazardous materials policy until test results that confirm whether or not the patient has EBOD are available.”

Assessment of evidence
Limitations • The method of producing guidance is unclear. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Public Health Agency of Canada. Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Healthcare Settings 2017 [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This Canadian guidance aims “to identify and promote infection prevention and control (IPC) practices and precautions for preventing the transmission of microorganisms in healthcare settings, with the exception of bone marrow transplant settings.” The document provides the following recommendations on linen handling: • Patient bed linen should be changed regularly and when soiled, upon discontinuation of contact precautions and following patient discharge.

Assessment of evidence
• Soiled linen from healthcare settings should be handled in the same way for all patients without regard to their infection status. Soiled linen should be placed in a no-touch receptacle at the point-of-use. • Soiled linen should be handled with a minimum of agitation to avoid contamination of air, surfaces and persons. • Soiled linen should be sorted and rinsed outside of patient care areas, except specialized items (e.g., antiembolic stockings) and personal clothing in specific healthcare settings. • Heavily soiled linen should be rolled or folded to contain the heaviest soil in the centre of the bundle. Large amounts of solid soil (e.g., feces or blood clots) should not be removed by spraying with water. A gloved hand and toilet tissue should be used to place the solid soil into a bedpan or toilet for flushing. • Hand hygiene should be performed after handling soiled linen. • In the glossary, under the entry for 'terminal cleaning', the document states that bed linens should be removed before terminal cleaning. **Limitations** • Unclear methodology – although the document states that a 'thorough search' was performed from 1999 onwards, no further detail is provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Public Health England. Middle East Respiratory Syndrome (MERS-	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
CoV) Infection Prevention and Control Guidance. 2016 [cited 2024 January 24]					
Assessment of evidence					
This English Document aims to provide “infection control and other general advice for those involved in investigating, receiving and caring for patients within healthcare settings, who are, or suspected to be, infected with MERS-CoV.” On linen, it states: “Bag linen inside patient isolation room in accordance with procedures for infectious linen; this should not be carried through ward or other clinical area” **Limitations** • Method of producing guidance was not provided. • Update process or schedule not provided.					

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Royal College of Physicians of Ireland. Guidelines for the Prevention and	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Control of Multi-drug resistant organisms (MDRO) excluding MRSA in the healthcare setting. 2012 [cited 2024 January 25]					

Assessment of evidence

This Irish document "produces national guidelines for the prevention and control of multi-drug-resistant organisms (MDRO) in the Irish healthcare setting."

On linen handling, it provides the following recommendations:

"All linen from patients infected with or colonised with MDRO should be considered to be contaminated/ infected, including bedding and adjacent curtains. Linen should be removed from the bed with minimal agitation and should be further managed in accordance with local policy and national guidance, where provided"

Limitations

- Although the document noted the 'consideration of published literature', it is not clear how these were used.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
National Disease Surveillance Centre (Ireland). Scientific Advisory Committee. Viral Gastroenteritis Subcommittee. National guidelines on the management of outbreaks of norovirus infection in healthcare settings. 2004 [cited 2024 January 25]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Irish guidance "provides a framework to address the challenge of outbreaks of illness due to norovirus. It is intended for use and adaptation in hospitals and other healthcare settings."

On 'general guidance on cleaning', the document states the following:

- "Contaminated linen and bed curtains should be placed carefully into laundry bags (as per guidelines for infected linen) without generating further aerosols.
- Contaminated pillows should also be laundered as infected linen unless they are covered with an impermeable cover, in which case they should be disinfected with 0.1% hypochlorite solution."

Assessment of evidence
Limitations • Method of producing guidance was not provided. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
World Health Organization. Infection prevention and control guideline for Ebola and Marburg disease. 2023 [cited 2024 March 13]	Guidance	**AGREE Recommend with modifications.**	N/A	N/A	N/A
Assessment of evidence					
This WHO guideline aims “to provide clarity on key IPC recommendations as they pertain to settings that pose different risks to the health and care worker, including screening, triage and providing care to patients with Ebola disease or Marburg disease.” It provides the following on handling of infectious linen: Good practice statement “Cleaners/hygienists1 and mortuary/burial workers2 should wear the same PPE recommended for other health and care workers, with the exception that 1) the outer pair of gloves should be heavy-duty (utility) gloves; 2) aprons should be heavy duty; and 3) their shoes should be waterproof boots.					

Assessment of evidence
1. Cleaners/hygienists includes health and care workers handling linens or waste, cleaning the environment. 2. Mortuary/burial workers include health and care workers involved in handling dead bodies.” Conditional recommendation for, Very low certainty evidence: "WHO suggests that heavily soiled linens resulting from care of patients with Ebola disease or Marburg disease in health-care facilities, TCs or community settings be safely disposed of (e.g. incinerated rather than disinfected/decontaminated) following existing WHO guidelines on waste management." Practical implementation considerations: "In health-care settings and TCs, a risk assessment should be conducted to determine if soiled linens can be safely decontaminated (safely handled, washed and disinfected by machine or by hand) or if they should be eliminated. “Staff should have access to the required PPE for handling soiled linens for patients suspected/confirmed to have Ebolavirus or Marburgvirus.” ◦ Training of health and care workers should include how to handle, wash and disinfect linens, how to use PPE appropriately and how to perform hand hygiene. ◦ Linen/laundry should be washed and then disinfected. " **Limitations** • The methodology section was unclear, particularly with respect to the systematic and rapid reviews.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
World Health Organization. Practical guidelines for infection control	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
in health care facilities. 2003. [cited 2024 January 25]					

Assessment of evidence

These international “guidelines have been prepared specifically to assist infection control practitioners in the management and prevention of hospital-associated infections and to ensure that health care administrators understand the significance of infection control programmes”. The document provides the following on safe handling of infectious linen:

“Handle, transport and process used linen that is soiled with blood, body fluids, secretions or excretions with care to ensure that there is no leaking of fluid.”

“Handle all linen with minimum agitation to avoid aerosolization of pathogenic micro-organisms.”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.
- May not be applicable to Scottish health and care settings.
- Unclear how recommendations were reached.
- Document is also quite old.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
WHO Patient Safety and World Health Organization. WHO guidelines on hand hygiene in health care. World Health Organization; 2009 January [cited 2024 January 25]	Guideline	**AGREE Recommend with modifications**			

Assessment of evidence

This international guideline "provides a comprehensive review of scientific data on hand hygiene rationale and practices in health care."

The document recommends the following on handling contaminated linen:

"Washing of clothing (including staff uniforms), bed linen, etc. – both in health-care settings using industrial processes and, in the home, – is also important when someone has C. difficile infection. Careful handling of contaminated clothing is essential in order to prevent the spread of any of the bacteria or its spores to hands or other items. Key points to consider for laundering include:

- always hold laundry away from yourself;
- do not sort through laundry unless absolutely necessary and do not shake it;

Assessment of evidence
• perform hand hygiene after handling laundry; • use normal detergent to wash the laundry; • dry laundry either in a tumble dryer or on a washing line; • iron clothes according to their instructions, using a hot steam iron if possible; • keep clean the machines or sink areas where laundry has been washed.” **Limitations** • Full search strategy and time periods searched not provided. • Inclusion and exclusion criteria not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Surveillance Centre (HPSC) Public Health & Infection Prevention & Control Guidelines on Prevention and Management of Cases and Outbreaks of COVID-19, Influenza	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
& other Respiratory Infections in Residential Care Facilities V1.13 [Updated 2023 December 13; cited 2024 January 24]					

Assessment of evidence

This Irish document aims to provide guidance for the prevention and management of cases and outbreaks of COVID-19 in residential care facilities where residents are provided with overnight accommodation. On safe handling of infectious linen, the document provides the following:

- "Linen must be handled, transported and processed in a manner that prevents exposure to the skin and mucous membranes of staff, contamination of their clothing and the environment;
- Disposable gloves and an apron should be worn when handling linen;
- All linen should be handled inside the resident room/cohort area. A laundry skip/trolley should be available as close as possible to the point-of-use for linen deposit, for example immediately outside the cohort area/isolation room;
- When handling linen, the HCW should not:
  a. rinse, shake or sort linen on removal from beds/trolleys;
  b. place used/infectious linen on the floor or any other surfaces (e.g., a bedside locker/table top);
  c. handle used/infectious linen once bagged;
  d. overfill laundry receptacles; or

Assessment of evidence

e. Place inappropriate items in the laundry receptacle (e.g., used equipment/needles).

- When managing infectious linen, the HCW should:
  a. Place linen directly into a water-soluble/alginate bag and secure;
  b. Place the alginate/water-soluble bag into the appropriately coloured linen bag (as per local policy);
  c. Store all used/infectious linen in a designated, safe area pending collection by a laundry service;
  d. If there is no laundry service, laundry should be washed using the hottest temperature that the fabric can withstand and standard laundry detergent;
  e. Laundry may be dried in a dryer on a hot setting”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.
- May not be applicable to Scottish health and care settings.
- Unclear how recommendations were reached.
- References not provided.
- Specific to COVID-19

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
National Clinical Effectiveness Committee. Prevention and control methicillin-resistant Staphylococcus aureus (MRSA) national clinical guideline No. 2." 2013 [cited 2024 January 24]	Guidelines	**AGREE Recommend with modifications**	N/A	N/A	N/A

Assessment of evidence

This Irish guideline aims “to provide guidance and standards for improving the quality, safety and cost effectiveness of healthcare in Ireland. The implementation of National Clinical Guidelines will support the provision of evidence based and consistent care across Irish healthcare services.”

The document provides the following recommendations when caring for residents colonised or infected with MRSA in residential care facilities.

- “There must be no manual washing of soiled clothing.
- Personal clothes should be machine-washed.
- Hand washing after handling all used linen is essential.”

Assessment of evidence
"All linen soiled with bodily fluids should be treated as contaminated by placing in a water-soluble or alginate stitched bag prior to placing in a laundry bag which is designated for contaminated linen by label or colour." **Limitations** • Unclear link between evidence and recommendations

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Lemass H, McDonnell N, O'Connor N, Rochford S. Infection Prevention and Control for Primary Care in Ireland. A Guide for General Practice. 2013 [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This Irish document "is in response to the HIQA standards and aims to highlight the relevant issues for infection prevention and control in Irish general practice." The document provides the following in respect to handling infected linen: "Staff handling soiled linen should wear gloves and a disposable plastic apron. Foul/infected linen must be placed carefully into a soluble alginate bag in line with the national linen segregation policy."

Assessment of evidence
Limitations • Although the document stated that review of the scientific literature and consultations were done, no further detail was provided. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Centers for Disease Control and Prevention. Infection Prevention and Control Recommendations for Patients in U.S. Hospitals who are Suspected or Confirmed to have Selected Viral Hemorrhagic Fevers (VHF). [updated 2024 May 9; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This American guidance aims “to help healthcare personnel follow recommended infection prevention and control practices when caring for a patient suspected or confirmed to have VHF”. The document provides the following on linen handling: “HCP should perform hand hygiene frequently, including before and after all patient contact, contact with potentially infectious material, and before putting on and upon removal of PPE, including gloves.” (HCPs in the document include those who handle laundry) **Limitations** • Unknown methods for producing guidance or consensus recommendations. • Some provisions may not be applicable to Scottish health and care settings • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Centers for Disease Control and Prevention. Interim Guidance for Environmental Infection Control in Hospitals [updated 2024 March 13; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This American guidance is for “U.S. hospital personnel caring for a patient who is suspected or confirmed to have one of the selected viral hemorrhagic fevers (VHFs) to help healthcare personnel follow recommended infection prevention and control practices when caring for a patient suspected or confirmed to have VHF”. On safe handling of infectious linen, the document states the following: “To reduce exposure among staff to potentially contaminated textiles (cloth products) while laundering, discard all linens, nonfluid-impermeable pillows or mattresses, and textile privacy curtains into the waste stream and dispose of appropriately.” **Limitations** • Unknown methods for producing guidance. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Advisory Committee on Dangerous Pathogens. Management of Hazard Group 4 viral haemorrhagic fevers and similar human infectious diseases of high consequence.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2015 November [cited 2024 January 24]					

Assessment of evidence

This British document “provides guidance on the risk assessment and management of patients in the United Kingdom in whom infection with a viral haemorrhagic fever (VHF) should be considered or is confirmed”. The document states the following on linen handling:

“The use of disposable linen should always be considered when appropriate, in particular when caring for a patient with a ‘high possibility of’ or ‘confirmed’ VHF infection. Subject to risk assessment, this linen may need to be treated and disposed of as category A waste. "All re-useable linen from patients with a ‘confirmed’ VHF infection should not be returned to a laundry and must therefore be treated and disposed of a category A infectious waste as set out by Health Technical Memorandum HTM 07-01 Safe Management of Healthcare Waste." All re-usable linen from patients classified as ‘high possibility’ may be segregated and safely stored whilst awaiting PCR test results if facilities are available. However, if it is not practicable to segregate and store pending PCR results then waste from ‘high possibility’ cases must be treated as Category A. If PCR results subsequently confirm the patient as negative for VHF, re-usable linen can then be treated as Category B." The return of the deceased’s clothing and personal effects to relatives

16. The family of the deceased should be consulted and as far as is reasonably practicable their needs and wishes should be respected. In principle clothing, personal effects and valuables may be returned to

relatives in accordance with normal health service procedure following decontamination.

17. However: Items of clothing visibly contaminated should be safely disposed of, other items of clothing should be autoclaved prior to laundering;”

Limitations

- Unknown methods for producing guidance.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
World Health Organisation. Clinical management and infection and prevention and control for Monkeypox. Interim rapid response guidance. 2022. November [cited 2024 March 13]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This international document “aims to provide interim guidance for clinicians, health facility managers, health workers and IPC practitioners including but not limited to those working in primary care clinics, sexual health clinics, emergency departments, dental practices, infectious diseases clinics, genitourinary clinics, maternity services, paediatrics, obstetrics and gynaecology, and acute care facilities that provide care for patients with suspected or confirmed MPX”. The document states the following on linen handling:

Patients with confirmed MPX: "Workers in laundry area should follow standard and transmission-based precautions including:

- ✓ minimize handling, in particular avoid shaking of linen and laundry;
- ✓ wear gloves, apron or gown, a respirator (e.g. N95, FFP2) and eye protection."

“Infection prevention and control at health facilities

WHO recommends:

Assessment of evidence
Linens, hospital gowns, towels and any other fabric items should be handled and collected carefully. All bodily fluids and solid waste of patients with MPX should be treated as infectious waste. Patients with confirmed MPX: "WHO recommends that linens, hospital gowns, towels and any other fabric items should be handled and collected carefully. Remarks: Carefully lift and roll linens. Do not shake linen or laundry. These items should be carefully placed into designated container or bag for transport to laundry services. Linens can be machine washed with hot water at > 60°C with laundry detergent and dried according to routine procedures, preferably at high heat (25,26,38). If machine washing is not possible and hot water is not available, linens can be soaked in a large drum using a stick to stir with care taken to avoid splashing. The linens should be soaked in chlorine*, rinsed with clean water and allowed to fully dry." **Limitations** • Unknown methods for producing guidance. • Update process or schedule not provided. • Some parts do not apply to Scottish settings.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Scottish Government. National uniform policy, dress code and laundering policy.	Regulation	Mandatory			

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
DL (2018) 4 [cited 2024 January 24]					
Assessment of evidence					
This Scottish Government document sets out the policy on uniform laundering for health and social care staff. The document provides the following on handling infectious linen: “Contaminated uniform may pose a higher risk of infection to healthcare workers and the public. • Hospital/facility laundries must be used to launder contaminated uniforms. Home laundering is not appropriate for contaminated uniform. • The uniform should be placed directly into a water-soluble/alginate bag. This prevents further handling and potential contamination, particularly for those performing laundering procedures. The bag should be secured using a neck tie.” **Limitations** • Unknown methods for producing guidance. • Update process or schedule not provided					

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
NHS England and NHS Improvement. Uniforms and workwear: guidance for NHS employers.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2020 April [cited 2024 January 24]					
Assessment of evidence					
This English guidance “addresses the interaction between infection control requirements relating to uniform and workwear and the public sector Equality Duty, with specific consideration given to the needs of faith groups”. On handling infectious uniforms, the document states: “Change immediately if uniform or clothing becomes visibly soiled or contaminated.” **Limitations** • Although the document notes that two extended literature reviews were conducted, no further information is provided. • Update process or schedule not provided.					

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland. National Guidance for Safe Management of	Guidance	**Level 4**			

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Linen in NHSScotland. 2018 [cited 2024 February 02]					

Assessment of evidence

This Scottish document aimed to provide guidance to ensure safe and consistent linen management and reprocessing practice in health and care environments within NHS Scotland.

The document provides the following on infectious linen handling:

“Infectious linen from suspected or confirmed category 4 infections (e.g. viral haemorrhagic fevers) should not be returned to the laundry. These items should be disposed of as category A waste and incinerated. The laundry department should be informed if any items of linen are sent for incineration.”

“Perform hand hygiene after handling used/infectious linen.”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Centers for Disease Control and Prevention. Guidelines for environmental infection control in health-care facilities: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). MMWR 2003; 52 (No. RR-10): 1–482004. [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This American guideline aims “to provide useful information for both health-care professionals and engineers in efforts to provide a safe environment in which quality health care may be provided to patients.”

The document provides the following recommendations for handling contaminated laundry

A. “Handle contaminated textiles and fabrics with minimum agitation to avoid contamination of air, surfaces, and persons. Category IC (OSHA: 29 CFR 1910.1030 § d.4.iv)

Assessment of evidence
B. Bag or otherwise contain contaminated textiles and fabrics at the point of use. Category IC (OSHA: 29 CFR 1910.1030 § d.4.iv) 1. Do not sort or prerinse contaminated textiles or fabrics in patient-care areas. Category IC (OSHA: 29 CFR 1910.1030 §d.4.iv) 2. Use leak-resistant containment for textiles and fabrics contaminated with blood or body substances. Category IC (OSHA: 29 CFR 1910.1030 § d.4.iv) 3. Identify bags or containers for contaminated textiles with labels, color coding, or other alternative means of communication as appropriate. Category IC (OSHA: 29 CFR 1910.1030 § d.4.iv) C. Covers are not needed on contaminated textile hampers in patient-care areas. Category II D. If laundry chutes are used, ensure that they are properly designed, maintained, and used in a manner to minimize dispersion of aerosols from contaminated laundry. Category IC (AAMI: ANSI/AAMI ST65:2000) 1. Ensure that laundry bags are closed before tossing the filled bag into the chute. Category II 2. Do not place loose items in the chute. Category II E. Establish a facility policy to determine when textiles or fabrics should be sorted in the laundry facility (i.e., before or after washing). Category II” **Limitations** • No mention of plan or process for update – page also states “This page last reviewed 5/27/2003” • Unknown methods for producing guideline or consensus recommendations. • Some provisions may not be applicable to Scottish health and care settings

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Siegel JD, Rhinehart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee, 2007 Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. [Last updated July 2023; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This American guideline aims to provide infection control recommendations for all components of healthcare, reaffirm standard precautions as foundation for preventing transmission during patient care, and reaffirm the importance of transmission based precautions. The document provided the following on handling contaminated linen.					

Assessment of evidence
“Soiled textiles, including bedding, towels, and patient or resident clothing may be contaminated with pathogenic microorganisms. However, the risk of disease transmission is negligible if they are handled, transported, and laundered in a safe manner. Key principles for handling soiled laundry are 1. not shaking the items or handling them in any way that may aerosolize infectious agents; 2. avoiding contact of one’s body and personal clothing with the soiled items being handled; and 3. containing soiled items in a laundry bag or designated bin. When laundry chutes are used, they must be maintained to minimize dispersion of aerosols from contaminated items” The following recommendations are provided: IV.G.1. Handle used textiles and fabrics with minimum agitation to avoid contamination of air, surfaces and persons. Category IB/IC IV.G.2. If laundry chutes are used, ensure that they are properly designed, maintained, and used in a manner to minimize dispersion of aerosols from contaminated laundry. Category IB/IC **Limitations** • Lack of detail to determine if a systematic literature review was conducted to obtain evidence. • May not be fully applicable to Scottish health and care settings.

Question 18: How should infectious linen be sorted?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Management and provision. 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This British document aims to "provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen". The document provides the following on linen sorting: "There is a duty of care to carry out a hazard and risk assessment and to reduce risk to an acceptable level. As part of this, laundry staff should not undertake the pre-sorting of infectious linen." Sorting fabrics into different drying types is an essential economic part of linen processing. Sheets, for example, require far less energy to dry them than would towels. In some linen processes/facilities, progression from the washing to the drying phases is automatic; therefore, fabrics have to be sorted before washing ("pre-wash sorting"). Some					

Assessment of evidence

processes will allow sorting between washing and drying ("post-wash sorting"). All washer-extractor processes allow pre- or post-wash sorting.

"5.21 This HTM considers two differing scenarios on which any classification and sorting agreement can be based. Option 1: Infectious linen is segregated by the service-users

5.22 Categorisation of linen should be done at local level with the appropriate colour-coded bags."

"5.23 Infectious linen in this category should not be sorted, but should be sealed in a watersoluble1 bag, which should then be placed in an impermeable bag immediately on removal from the bed or before leaving a clinical department."

"5.26 Water-soluble bags should be transferred to the designated washer without opening, followed by any washable, reusable laundry outer bag, which should be washed in a similar fashion. If a CTW is used, it should be validated to determine its ability to process and breakdown adequately the water-soluble bag. Option 2: Standard precautions by the user with no segregation of linen."

"5.27 Linen is not segregated at the local level (subject to the laundry being able to meet processing guidelines), and all linen is presumed to be infectious."

"5.32 It is not acceptable for staff to manually open bags containing infectious linen."

"5.37 Whichever option is chosen, post-wash sorting of linen for production purposes (production batch sorting) is encouraged and would count as BP. If any form of pre-wash sorting for operational or performance reasons is required within the laundry, option 1 above should be adopted. It is not appropriate for laundry staff to undertake sorting of infectious linen."

"5.28Immediately on removal from the bed or before leaving a clinical department, linen should be either: • sealed in a water-soluble bag, which should then be placed in an impermeable bag; or • sealed in an impermeable reusable bag having the infectious-linen colour code in accordance with the 'Colour coding of linen bags' section, and labelled, if considered necessary locally".

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Prevention and control of infection in care homes – an information resource. 2013 February [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This British guidance aims to "assist staff in taking all reasonable steps to protect both residents and staff from acquiring infections and cross infection; and provide information and guidance on infection prevention and control that will assist managers undertaking risk assessments and in developing policies".

The document provides the following information on sorting of infected linen:

- "Enhanced Process – Red. These items should be sealed in a red water-soluble bag immediately on removal from the bed. This primary container should then be placed in an impermeable or nylon/polyester bag. The enhanced process is defined in sections 2.1 and 2.**5. Additionally, the outer bag must carry a bold legend stating 'INFECTIOUS LINEN'"**

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Social Care 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”. On sorting of infectious linen, the document states the following: “It is the responsibility of the person handling linen to ensure that it is segregated appropriately. For the large-scale processing of linen in a commercial setting, the advice offered in ‘Classification of linen’ (in the ‘Management and provision’ volume) should be followed. If a					

Assessment of evidence
commercial or hospital laundry is used, the appropriate categorisation and segregation option from 'Classification of linen' should be agreed with the laundry contractor." "In the simple on-site care-home setting, two categories should be used relating to the process, and these can be colour-coded as follows: Enhanced process – red. These items should be sealed in a red water-soluble bag immediately on removal from the bed. This primary container should then be placed in an impermeable or nylon/polyester bag. The enhanced process is defined in Chapter 6, 'Linen processing'. Additionally, the outer bag must carry a bold legend stating "Infectious linen"." "It is the responsibility of the person handling linen to ensure that it is segregated appropriately. For the large-scale processing of linen in a commercial setting, the advice offered in 'Classification of linen' (in the 'Management and provision' volume) should be followed. If a commercial or hospital laundry is used, the appropriate categorisation and segregation option from 'Classification of linen' should be agreed with the laundry contractor." "In the simple on-site care-home setting, two categories should be used relating to the process, and these can be colour-coded as follows: • **Standard process – off white or white**. Soiled and fouled items should be placed into a water-soluble bag(s) (and additionally within a white cotton sack if required) or alternatively placed directly in a white impermeable bag. Heavily soiled items should have any solids removed prior to being placed into the bag. In larger premises, patients' clothing may sometimes be bagged separately to bed linen. • **Enhanced process – red**. These items should be sealed in a red water-soluble bag immediately on removal from the bed. This primary container should then be placed in an impermeable or nylon/ polyester bag. The enhanced process is defined in Chapter 6, 'Linen processing'. Additionally, the outer bag must carry a bold legend stating "Infectious linen". **Limitations** • Method of producing guidance not stated.

Assessment of evidence
• Update process or schedule not provided.

Question 19: How should infectious linen be labelled?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Management and provision. 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”. The document provides the following on infectious linen labelling: “All linen identified as infectious should be placed in a red water-soluble bag (with an optional bold legend stating “infectious linen”), which should then be placed inside a white impermeable bag which is identified as “infectious linen” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Public Health Agency of Canada. Infection prevention and control measures for Ebola disease in acute care settings 2021. [cited 2024 June 27]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This Canadian guidance aims “to provide guidance on the minimum level of IPC measures in healthcare settings in the event that a person under investigation for EBOD or patient with EBOD is identified within a Canadian healthcare facility.”					

Assessment of evidence
On labelling of infectious linen, the document states: “To move the double-bagged linen from the patient-care room, personnel should place the double-bagged linen in a leak-proof/impervious, puncture-resistant plastic or metal single-use container. The linen container should be: • Securely sealed, clearly labelled and identified as EBOD-associated biohazardous material. EBOD-associated linen storage areas should be clearly marked with a biohazard symbol and kept separate from other storage areas.” **Limitations** • Method of producing guidance is unclear. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
World Health Organization. Infection prevention and control guideline for Ebola and Marburg disease. 2023 [cited 2024 March 13]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This WHO guideline aims “to provide clarity on key IPC recommendations as they pertain to settings that pose different risks to the health and care worker, including screening, triage and providing care to patients with Ebola disease or Marburg disease.” It provides the following on labelling of infectious linen: “Soiled linens that are to be eliminated, should be marked as infectious waste, and transported for elimination to a treatment facility/appropriate elimination facility with the capacity for this.” **Limitations** • The methodology section was unclear particularly with respect to the systematic and rapid reviews.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
National Clinical Effectiveness Committee. Prevention and control methicillin-resistant Staphylococcus aureus (MRSA) national clinical guideline No. 2." 2013 [cited 2024 January 24]	Guidelines	**AGREE Recommend with modifications**	N/A	N/A	N/A

Assessment of evidence
This Irish guideline aims “to provide guidance and standards for improving the quality, safety and cost effectiveness of healthcare in Ireland. The implementation of National Clinical Guidelines will support the provision of evidence based and consistent care across Irish healthcare services.” The document provides the following recommendations when caring for residents colonised or infected with MRSA in residential care facilities. “All linen soiled with bodily fluids should be treated as contaminated by placing in a water-soluble or alginate stitched bag prior to placing in a laundry bag which is designated for contaminated linen by label or colour.” **Limitations** • Unclear link between evidence and recommendations

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Centers for Disease Control and Prevention. Guidelines for environmental infection control in health-care facilities: recommendations of CDC and the Healthcare Infection Control Practices	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Advisory Committee (HICPAC) MMWR 2003; 52 (No. RR-10): 1–48. [cited 2024 January 24]					

Assessment of evidence

This American guideline aims “to provide useful information for both health-care professionals and engineers in efforts to provide a safe environment in which quality health care may be provided to patients.”

The document provides the following recommendations for labelling contaminated laundry:

“B. Bag or otherwise contain contaminated textiles and fabrics at the point of use. … 3. Identify bags or containers for contaminated textiles with labels, color coding, or other alternative means of communication as appropriate.”

Limitations

- No mention of plan or process for update – page also states “This page last reviewed 5/27/2003”
- Unknown methods for producing guideline or consensus recommendations.
- Some provisions may not be applicable to Scottish health and care settings

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health. Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Social Care 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This British document aims to "provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen". The document provides the following on infectious linen labelling:

"Enhanced process – red. These items should be sealed in a red water-soluble bag immediately on removal from the bed. This primary container should then be placed in an impermeable or nylon/ polyester bag. The enhanced process is defined in Chapter 6, 'Linen processing'. Additionally, the outer bag must carry a bold legend stating "Infectious linen".

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Question 20: How should infectious linen be stored?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Public Health Agency of Canada. Infection prevention and control measures for Ebola disease in acute care settings. 2021. [cited 2024 June 27]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Canadian guidance aims "to provide guidance on the minimum level of IPC measures in healthcare settings in the event that a person under investigation for EBOD or patient with EBOD is identified within a Canadian healthcare facility." The document provided the following on infectious linen storage:

"Patient bed linen should be changed regularly and when soiled, upon discontinuation of precautions and following patient discharge. Linen should:

- Not be sent to the laundry
- Be disposed of in a designated no-touch biohazardous waste receptacle at the point-of-use.

"EBOD-associated linen storage areas should be clearly marked with a biohazard symbol and kept separate from other storage areas."

Assessment of evidence
"If test result for EBOV is positive: Stored containers of linen should be packaged and transported separately off-site and disposed of in accordance with applicable legislation for regulated biohazardous waste." When the bag is two-thirds full, seal securely preventing tearing/puncturing the bag and ensuring no leaks." **Limitations** • Method of producing guidance is unclear. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health and Safety Executive. Managing infection risks when handling the deceased. 2018 July [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This British guidance "provides guidance on managing the risks of infection from work activities which involve handling the deceased". On Safe management of linen, including uniforms, the document states: ""Store all used and contaminated linen in a designated safe area while awaiting collection or laundering."					

Assessment of evidence
“The storage should be lockable if it is in a publicly accessible area.” “A suitable frequency for collection or laundering should be in place to avoid a build-up of linen receptacles.” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland. National Guidance for Safe Management of Linen in NHSScotland 2018 [cited 2024 February 02]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This Scottish document aimed to provide guidance to ensure safe and consistent linen management and reprocessing practice in health and care environments within NHS Scotland. The document provides the following on used linen storage: "All linen should be appropriately segregated, bagged and labelled, and stored separately at ward and other service levels/areas prior to collection or distribution. This would be either a dirty area e.g. sluice or a designated dirty linen store. Used/infectious linen must not be stored in the domestic services room (DSR)." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Question 21: How should infectious linen be transported?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
World Health Organization. Practical guidelines for infection control in health care facilities	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2003. [cited 2024 January 25]					

Assessment of evidence

These international "guidelines have been prepared specifically to assist infection control practitioners in the management and prevention of hospital-associated infections and to ensure that health care administrators understand the significance of infection control programmes". The document provides the following on infectious linen transportation:

"Place soiled/contaminated linen in impervious bags for transportation to avoid any spills or drips of blood, body fluids, secretions or excretions."

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.
- May not apply to Scottish health and care settings.
- Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
SHTN 03-01 – NHSScotland Waste Management Guidelines 2023 [cited 2024 February 02]					
Assessment of evidence					
• Signposted for waste management.					

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Centers for Disease Control and Prevention. Basic Infection Control and Prevention Plan for Outpatient Oncology Settings CDC, 2011 December [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This American document was “developed for outpatient oncology facilities to serve as a model for a basic infection control and prevention plan. It contains policies and procedures tailored to these settings to meet minimal expectations of patient protections as described in the CDC Guide to Infection Prevention in Outpatient Settings. The elements in this document are based on CDC’s evidence-based guidelines and guidelines from professional societies (e.g., Oncology Nursing Society)”. The document provides the following on infectious linen transportation: “Use leak-resistant containment for linens contaminated with blood or body substances; ensure that there is not leakage during transport.” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Evidence from previous update(s):

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Management and provision 2013 March [updated 2016 June 8; cited 2024 January 24]					

Assessment of evidence

This British document aims to “provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen”. The document provides the following on infectious linen transportation:

“Bags should not be overfilled. They should be of an acceptable weight and should be securely fastened before being sent to the laundry. Care should be taken to prevent linen or foul seepage (body fluids or blood) escaping from laundry bags and contaminating other items or staff.”

“The majority of used linen that is transported to off-site laundries will not normally be assessed as dangerous for transport. Occasionally, infectious linen will need to be classified as dangerous for transport, such as when a consignment is thought to contain pathogens that pose a significant risk of spreading disease and the load is heavily soiled to the extent that the potential for exposure and infection is high. In such instances, the load should be categorised as infectious, bagged accordingly and packaged as UN 3291 as it is not appropriate for processing in a laundry (see also DH’s ‘Safe management of healthcare waste’ guidance).”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Question 22: What is the available evidence for the effectiveness of antimicrobial impregnated linen in reducing the risk of microorganism transmission?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Fan T, Shao L, Wang X, Ren P. Efficacy of copper-impregnated hospital linen in reducing healthcare-associated infections: A systematic review and meta-analysis. PLoS One. 2020;15(7):e0236184. Published 2020 Jul 20. Doi:10.1371/journal.pone.0236184	Systematic review/meta-analysis	**1++**	Copper-impregnated hospital linen	Similar linen not impregnated with copper	HAI incidence HAI due to MDRO and Clostridioides difficile.

Assessment of evidence
Objectives: “To systematically search literature and pool data from studies evaluating the efficacy of copper-impregnated hospital linen in reducing HAI.” Method: Systematic review and meta-analysis. • Inclusion criteria: Study designs – RCTs, cluster RCTs, before-after studies, case-control studies • Population: Hospitalised patients in acute or long-term care • Intervention: Copper-impregnated hospital linen (including bedsheets, pillow covers, towels, patient clothing, blankets or any other textiles used for hospitalised patients) • Outcomes: HAI incidence • Exclusion criteria: Studies without a control group(s) or evaluating linen impregnated with any other antimicrobial. • Risk of bias: Assessed using the risk of bias assessment tool for non-randomised studies (RoBANS). Results: Six studies were included in review and meta-analysis. There were four before-after studies and two cross-over RCTs. None of the included studies reported data collected during an outbreak and data collection period ranged between six to thirty-seven months. Meta-analysis showed that use of copper-impregnated linen did not reduce risk of HAI (IRR:0.66, 95% CI:0.28–1.58, p = 0.36, I 2 = 100%). Sub-group analysis for studies that reported all HAI (as against organism specific HAI) showed a statistically significant reduction in all-HAI (IRR:0.76, 95% CI:0.75–0.77, p<0.00001, I^2 = 0%). There was however no significant difference in studies reporting organism specific HAI (defined as infections caused by C. difficile and MDROs) s (IRR:0.57, 95% CI:0.12–2.75, p = 0.48, I^2 = 99%). In sensitivity analysis, there was no change in the significance of the results after every study's sequential exclusion. **Limitations:** Most of the included studies were considered low quality. Conclusion: Copper-impregnated linen may reduce HAI but no evidence that they significantly reduce infections due to MDRO or C. difficile infections. NB: IRR – Incidence rate ratios

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Butler JP. Effect of copper-impregnated composite bed linens and patient gowns on healthcare-associated infection rates in six hospitals. J Hosp Infect. 2018;100(3):e130-e134. Doi:10.1016/j.jhin.2018.05.013	Before and after study	**Level 3**	Copper-impregnated composite bed linens and patient gowns	Regular linen	Rates of HAI due to MDRO per patient-days. Rates of HAI due to Clostridium difficile per patient-days. Combined HAI rates per patient-days.

Assessment of evidence

This American study aimed to "assess whether the replacement of the linens resulted in the reduction of healthcare-associated infection (HCAI)."

Setting: Six hospitals (referred to as Facilities 1-6) run by a not-for-profit group (3 rural and 3 urban) in the United States of America with a total of 1019 beds.

Methods: All six facilities replaced their regular linens (including all patient gowns, pillowcases, fitted and flat sheets, washcloths, bath towels, bath blankets and thermal blankets) with copper oxide-impregnated linens (Cupron Medical Textiles; Cupron, Inc., Richmond, VA, USA) in April 2017.

Data from all six hospitals taken from three time periods before (90, 180 and 240 days) and after the replacement were compared and analysed. The 90-day period is a subset of the 180-day period which is a subset of the 240-day period. Similar IPC measures and practice

Assessment of evidence
were in practice according to the standard operating procedures of the not-for-profit group were consistently implemented in all the facilities in both years. Routine daily and terminal cleaning used quaternary ammonium compounds, except for patients with C. difficile infection, where a hypochlorite product was used. UV light or hydrogen peroxide were not used for environmental decontamination. There were also no major changes to hand hygiene compliance rates between the two years (Facility 1: 97% vs 98%; Facility 2: 99% vs 99%; Facility 3: 98% vs 90%; Facility 4: 98% vs 99%; Facility 5: 99% vs 99%; Facility 6: 98% vs 97%). All six facilities also had the Det Norske Veritas/ Germanischer Lloyd (DNV GL) infection risk certification programme by 2016. HAI surveillance was retrospectively performed through existing IPC programmes at the hospitals. The primary endpoint was the incidence rate of hospital-onset infections, using definitions of the National Healthcare Safety Network (NHSN), due to MDROs or C. difficile. MDROs included MRSA, VRE, extended-spectrum B-lactamase, multidrug resistant Acinetobacter baumannii and CRE. Hospital onset was defined as events that occurred on or after hospital day 3, using NHSN rules. The infection location was attributed to the inpatient location where the hospital-onset infection occurred, following (where applicable) the NHSN transfer rule for events that occurred on the day of or after a patient transfer. Patient-days of acute care unit occupancy was used to calculate the hospital-onset infection incidence rates. The three types of infections analysed were C. difficile, all MDROs and total infections. Infection rates at baseline were compared to rates at assessment using Fisher's exact test performed with SAS version 9.4. Statistical testing was done using patient-days and actual counts. Infection rates were normalized to 100 or 10,000 patient-days in hospital. **Results:** There was a significant reduction in incidence rate of HAIs due to C. difficile per 10,000 patient-days in hospital in all three time periods after the replacement compared to before. There was a 61.2% reduction in the 90 days after compared to the 90 days before (p=0.0116), 41% in the 180-day periods (p=0.027) and 42.9% in the 240-day periods (p=0.0096). There were also reductions in incidence rate of HAIs due to MDROs per 1,000 patient-days in hospital in all three time periods after the replacement compared to before; however, none of the reductions were significant. There was a 48.3% reduction in the 90 days after compared to the 90 days before (p=0.286), 36.4% in the 180-day periods (p=0.21) and 19.2% in the 240-day periods (p=0.35). The reduction in combined HAI rates (due to MDRO and C. difficile) per 1000 patient-days were significant in all three time periods. There was a 59.8% reduction in the 90 days after compared to the 90 days before (p=0.0014), 39.9% in the 180-day periods (p=0.0145) and 37.2% in the 240-day periods (p=0.0108).

Assessment of evidence
Limitations • A lack of blinding means there may have been conscious efforts to undertake practices which may contribute to the reduction of HAIs after the replacement. • The follow-up period was 8 months (240 days), a longer period may perhaps demonstrate whether the reduction in rates was sustainable. • There was no discussion of the duration of effectiveness of the impregnated linen in terms of number of washes. **Relevance to question** This study shows that replacement of standard hospital linen with copper oxide-impregnated linen can lead to significant reduction in combined HAI rates and rate of HAIs due to C. difficile in both three months, six months and eight-month periods. Although there was reduction in MDRO rates in all three time periods, the reduction was not statistically significant. This may have been due to the low number of MDRO cases in the time periods.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Albarqouni L, Byambasuren O, Clark J, Scott AM, Looke D, Glasziou P. Does copper treatment of commonly touched surfaces reduce healthcare-acquired	Systematic review/Meta analysis	**1++**	Copper treated textiles/linen	Standard linen	Risk ratio

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
infections? A systematic review and meta-analysis. J Hosp Infect. 2020;106(4):765-773. doi:10.1016/j.jhin.2020.09.005					

Assessment of evidence

This review aimed “to examine the potential effect of copper treatment of commonly touched surfaces in healthcare facilities.”

Method

Inclusion criteria: No restrictions by language or publication date as long as papers were published in full or if only published as abstracts have a clinical trial registry record or other public report.

Participants: Studies of patients of any age with any condition in acute, long-term care settings, rehabilitation centres and aged care facilities.

Interventions: “Studies that evaluated interventions involving copper (or copper alloy)-treated rooms or objects in patient care rooms/ spaces were included in this review. The intervention was expanded to include studies that evaluated copper-treated soft textiles such as bed linens, clothes and gowns as sufficient data were available.” **However, for this review, only the subgroup analysis on linen was needed**.

Comparators: Studies with any comparator as long as the comparator did not involve the use of copper or copper alloy surfaces.

Assessment of evidence
Outcomes: Primary outcomes was the incidence of HAIs (e.g. bacterial or viral infections, not colonisations) in patients. Secondary outcomes include incidence of death, skin reactions and any HAIs in hospital staff and visitors. Studies were excluded if they only report colonization rates. Study designs: Only randomised and pseudo-randomised controlled trials were Included. Results: Although the study looks at all kinds of copper surfaces, it includes a sub-group analysis for copper-treated bed linens and clothes. This sub-group included two studies, one in an ICU (Marik 2020) and another in a long-term care setting (Marcus 2017). The meta-analysis showed significantly lower HAI rates with copper-treated linen compared to standard linen, with a pooled risk ratio of 0.75 (CI: 0.58-0.98). The test for overall effect (Z) was 2.10 (p=0.04). **Limitations** • One of the studies included in the meta-analysis (Marcus 2017) used ATIEs (Antibiotic treatment initiation event per 1000 hospitalization days as a proxy for HAIs. • Only two studies are included in the relevant meta-analysis and both were of relatively low quality. Contribution: This meta-analysis shows that copper-treated linen may be effective in reducing the risk of HAIs.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Marik PE, Shankaran S, King L. The effect of copper-oxide-treated soft and hard surfaces on the incidence of healthcare-	Mixed methods (Prospective cluster cross-over randomised control trial + Before and after study)	**1-**	Copper-impregnated linen	Standard hospital linen	Rate of HCAIs **Second experiment (phase 2 before and after study) excluded due to**

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
associated infections: a two-phase study. J Hosp Infect. 2020;105(2):265-271. doi:10.1016/j.jhin.2020.02.006					**significant limitations.**

Assessment of evidence

Objectives: This American study aimed to evaluate the effectiveness of copper-impregnated linen and their combination with copper hard surfaces in reducing the risk of HCAIs in an ICU setting.

Setting: ICU (general ICU GICU, neuro-ICU NICU and burn-trauma ICU BTU) in an American academic hospital.

Method: The study was conducted in two phases.

Phase 1 is described by the authors as a prospective cluster, cross-over, randomized control trial. It was conducted in the General ICU – a 16-bed unit with two separate pods of eight beds each (Ward A and B). During a 23-week period (Jan 6 – June 13, 2014), Copper oxide treated linens (Cupron Inc, Richmond, Virginia) were used in Ward 'A' while standard linens were used in Ward B. This was followed by a wash-out period of two weeks after which a cross-over was done which saw Ward B use the copper-oxide linen and Ward A, the standard linen for another 23 weeks (June 30th to December 5^{th,} 2014). The linen referred to in this study includes top sheets, fitted sheets, pillowcases, under pads, wash cloths, towels and patient gowns. The only visible difference between the copper-oxide linen and the standard linen was the colour. The former was salmon colour, and the latter was white. Both were washed separately but by the same procedure by the hospital laundry service. Patients were assigned to either ward based on bed availability by hospital personnel not involved in the study and with no knowledge of timeframe or intervention site. Patients and/or their families were provided information on the study on admission to the ICU with the option to be excluded. If a patient did not wish to use copper sheets, they were replaced with standard linen. Both wards were staffed by the same healthcare personnel (nurses, residents and attending physicians). Hand-washing

Assessment of evidence
conditions, IPC measures and antibiotic prescribing was the same for both wards in the study period. All patients were followed daily in the general ICU and for 48 h after transferring out of the ICU. The Hospital infection control team monitors patients who meet the National Healthcare Safety Network (NHSN) definitions for HCAI and supplied a list of HCAIS in the ICU to the research nurses on a weekly basis. Infections documented included CLABSIs, CAUTIs, and C. difficile-associated diarrhoea. The Infection Control staff was blinded to what wards the patients were allocated to. Patient allocation was coded by the study nurses as either 0 or 1 and blinded to study investigators. Phase 2 was a before and after study which commenced after phase 1 ended and involved both wards in the general ICU as well as other hospital beds. All were supplied with copper-oxide treated linen. In 2015, the Hospital infection control program instituted comprehensive measures to reduce HCAI risk. The measures included HCW education, hand washing surveillance, daily chlorhexidine baths and a central line insertion bundle which consisted of a sterile insertion kit – gowns, full-bed drapes, and all-in-one chlorhexidine gel transparent dressing. Period 1: This period involved a retrospective study performed in the GICU, NICU and BTU (all of which were 16-bed units) from July 2017 to June 2018. As in phase 1, all HCAIs were recorded by the Hospitals Infection control team according to NHSN definitions. Data recorded included number of infections, central-line days, foley-catheter days, and patient days. No patient specific data was recorded. On July 17th 2018, all 3 ICUs were transferred to newly constructed 16-bed ICUs in a newly constructed ICUU tower. All touchable hard surfaces (workstations, tables, bathroom fittings, bedrails, door handles etc) in the new ICU tower had copper-oxide enhanced EOS surfaces. The walls, doors and floors were however not enhanced with copper oxide. The new ICUs were also made to use copper oxide linens. Period 2: After a two-month period of settling into the new ICUs, the second period was a retrospective study conducted from September 2018 to August 2019 exactly as in Period 1. Patient admission criteria, HCP teams, infection control practices, or antibiotic prescribing patters were the same throughout both periods. Results In Phase 1, a total of 1282 patients were randomised to either copper-oxide treated linens (n=645) or to standard linen (n=637). No patient requested exclusion from the study and the demographics between each group are very similar. The authors note that there is no statistically significant difference in demographics between both groups, but no p-values were provided. The total HCAIs per 1000 patient-

Assessment of evidence

days in the Copper-oxide linens group (11.4) was slightly lower compared to the standard linen group (13.0). Incidence ratio of standard vs copper oxide linen was 1.1 (95% CI: 0.6 – 2.0; p=0.6). However, this difference was not statistically significant. The same trend was observed for CLABSIs (3.2 vs 4.2), CAUTIs (3.2 vs 3.7) and C. difficile infections (5.03 v 5.1), none of which were statistically significant.

In Phase II, a total of 11, 169 patient days were evaluated in the intervention group (period 2: copper oxide surface + copper oxide linen) and 9890 in the control group (period 1: copper oxide linen only). There was a statistically significant reduction the total HCAI per 1000 patient days in period 2 (intervention group) compared to period one (1.3 vs 3.9 per 10000 patient days). The incidence rate ratio of period 1 vs period 2 was 2.9 (95% CI: 1.5-5.7; p=0.0002). There was also a statistically significant reduction in C. difficile infections in period 2 compared to period 1 (0.7 v 2.4) with an IRR of 3.3 (95% CI: 1.4 – 8.7; p=0.002). Reduction in HCAI rates were also noted in period 2 for CAUTIs and CLABSIs, but these were not significant.

Limitations

- The randomisation process is not systematic and not sufficiently random.
- Disparity in number of patients in each group between what is reported in the summary of result and in the tables. This is unlikely to make much difference though given that the numbers are very close.
- There are also likely to be other differences between period 1 and 2 other than copper-surfaces that could have compounded the result particularly since period 2 was conducted in a completely different ICU tower building with perhaps a better ventilation and other systems.
- No power calculations were provided.
- Phase 1 of the study was supported by a research grant from Cupron, Inc., Richmond, VA, USA – who were the suppliers of the copper-oxide treated linens being tested.
- Authors state no statistically significant findings between groups but provide no p values for Table 1.

Contribution to question: This paper shows that in this ICU, copper impregnated linen was not sufficient to significantly reduce the rate of HCAIs compared to standard hospital linen. However, when combined with copper treated surfaces, a significant reduction was achieved. This, however, must be viewed within the context that moving to a completely new building for period 2, could have provided

Assessment of evidence
other factors that would have benefited a reduction in HCAI which were not accounted for. Phase 2 of the Study excluded because of the limitations stated above.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Madden GR, Heon BE, Sifri CD. Effect of copper-impregnated linens on multidrug-resistant organism acquisition and Clostridium difficile infection at a long-term acute-care hospital. Infect Control Hosp Epidemiol. 2018;39(11):1384-1386. Doi:10.1017/ice.2018.196	Before and after study	**Level 3**	Copper-impregnated woven linen including bed sheets, fitted sheets, pillowcases, towels, wash cloths	Standard hospital linen	Incidence in healthcare facility onset CDI (HO-CDI) and MDRO acquisition.

Assessment of evidence

Objectives: This American study aimed to evaluate the effect of using copper impregnated woven linen on rates of HAIs.

Methods: Copper-impregnated woven linen (Cupron Medical Textiles; Cupron, Richmond VA) were introduced to a 40-bed long-term acute-care hospital in Virgina, USA on Oct 6, 2014. They included bed sheets fitted sheets, pillowcases, towels, and wash cloths. The impregnated linens were withdrawn in January 2017 after monitoring for HO-CDI and MDRO acquisition showed no benefit. HO-CDI events according to the National Health and Safety Network (NHSN) laboratory identified (LabID) definitions and HO-MDRO acquisition were retrospectively analysed. HO-MDRO was defined as 'a new finding compared to known status' and were detected by routine surveillance (perirectal or ostomy swab and MRSA nares swab on admission and every week afterwards). Facility hand hygiene compliance data were also recorded during these periods and was measured using an anonymous auditing program that was the same throughout the study period. The impregnated linen were laundered using standard protocols according to the recommendations of the manufacturer. Universal contact precautions were observed throughout the study periods with >92% compliance that did not significantly change throughout the study periods. Monthly incidence rates were evaluated over a 27-month pre deployment period (July 2012 to September 2014) followed by a 27-month intervention period (October 2014 to December 2016), plus an additional 10-month post-intervention control period (January 2017 to October 2017).

Results: A total of 29,342 and 25,243 patient days were observed for control and intervention periods respectively. Copper linens were associated with significantly higher rates of HO-CDI (2.8 vs 1.5 cases per 1000 patient days; p=0.023); HO-MDRO acquisition (6.3 vs 3.9 cases per 1000 patient days; p=0.001). Subgroup analysis showed that VRE and CRE acquisition rates was largely responsible for the higher rate of HO-MDRO acquisition in the intervention period with a rate of 3.8 (p=0.002) and 0.7 (p=0.044) per 1000 patient days compared to 2.1 and 0.3 in the control period respectively. The mean monthly hand hygiene compliance was poorer during the intervention period compared to the control periods (90.9% vs 95.3%).

Assessment of evidence
Limitations • Without a concurrent group, it is possible that several factors including IPC practices, changed over time which could have affected the outcomes. • Poorer hand hygiene during intervention period means it is not possible to completely attribute all HAI rises to the copper impregnated linens. • Change in the surveillance definition for CDI was changed in January 2016 from infection surveillance reporting to LabID reporting, so that symptoms of CDI no longer needed to be present. This could have led to an overestimation of the cases of CDIs in the last 12 months of the intervention period as well as the post intervention 10-month period. Contribution to question: This paper shows that copper impregnated linen may not lead to reduction in HAI events but may quite significantly lead to an increase. However, the investigation is fraught with several significant limitations.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Marcus EL, Yosef H, Borkow G, Caine Y, Sasson A, Moses AE. Reduction of health care-associated infection indicators by copper oxide-impregnated textiles:	Crossover, double-blind controlled trial	**1+**	Copper oxide impregnated textiles	Untreated textiles	Percentage reduction (%) in specific HAI indicators

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Crossover, double-blind controlled study in chronic ventilator-dependent patients. Am J Infect Control. 2017;45(4):401-403. Doi:10.1016/j.ajic.2016.11.022					

Assessment of evidence

Objectives: This Israeli study aimed to evaluate the effect of using copper-impregnated medical textiles on HAI indicators, particularly antibiotic treatment initiation events (ATIEs), fever days, days of antibiotic treatment, and antibiotic defined daily dose (DDD) per 1,000 hospitalization days (HDs) in chronic ventilator-dependent patients in a long-term care facility.

Methods: This was a double-blind, controlled, crossover study with two 3-months intervention periods and a 1-month washout period. All patients in two similar ventilator-dependent wards in a long-term care hospital were included in the study. In the first intervention period, one ward, received copper-oxide impregnated linen (including patients' clothes ad towels) and the other ward received control untreated textiles. In the second intervention period, following a 1-month washout period, the ward that had received the impregnated linen, were provided with the control linen and vice versa. The textiles were colour coded and all personnel were blind to which were the impregnated linen. Both treated and controlled linen were used and laundered together in the same way and the infection control measures were the same in both wards. The decision to initiate antimicrobial therapy and its duration in all cases in both wards was the responsibility of the same infectious disease consultant and the same attending physician. The infection control nurse, blinded to the intervention allocation, recorded ATIEs, fever (defined as axillary temperatures >37.6°C) days, antibiotic treatment days, and antibiotic DDD per 1,000 HDs. Indicators were only recorded if they started at least 24 hours after the beginning of either intervention periods. DDD was calculated according to the WHO collaborating Centre for Drug Statistics Methodology guidelines. X2 tests were applied to test for differences in rate of the HAI indicators. All tests were 2 tailed and were considered significant at $p<0.05$.

Assessment of evidence
Results: There was no significant difference in patient characteristics in both wards in both periods. There was a 29.3% relative reduction in ATIEs when treated linens were used (p=0.002) and a 55.5% reduction in the number of fever days in patients when treated linens were used (p<0.0001). There was also a 23.0% (p<0.0001) reduction in days of antibiotic treatment, 27.5% (p<0.0001) reduction in DDD administered in the wards using treated linens compared to control. **Limitations** • General or organism specific HAI rates were not evaluated which makes it impossible to compare with similar trials. • Although the paper states that staff and participants were blinded, not much detail was provided on this – only that the linen were color-coded. Contribution to question: This paper shows that copper impregnated linen may lead to beneficial reduction in some specific HAI indicators in ventilator dependent patients.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Lazary A, Weinberg I, Vatine JJ, et al. Reduction of healthcare-associated infections in a long-term care brain injury ward by replacing regular linens with biocidal copper oxide impregnated linens.	Before-and-after study	**Level 3**	Copper oxide impregnated linen	Standard non-biocidal linen	HAI rates per 1000 hospitalisation days Fever days per 1000 hospitalisation days Antibiotic administration per 1000 hospitalisation days

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Int J Infect Dis. 2014;24:23-29. Doi:10.1016/j.ijid.2014.01.022					

Assessment of evidence

Objectives: This Israeli study aimed to evaluate the difference in HAI rates when standard linen was replaced with copper oxide impregnated linen in a long-term care ward.

Setting: The study was conducted in a 35-bed Head injury ward which housed patients with severe head injuries. All the patients were confined to bed and wheelchair and were totally dependent on medical staff for all needs and activities. During both study periods, more than 90% were immunised against seasonal influenza.

Method: The adopted methodology was a before-and-after study. Data was collected over two six-month periods- Period A, December 2010 – June 2011; and period B2, December 2011 – June 2012. In Period A, regular non-biocidal hospital linens were used in the ward. This was replaced in period B with copper-oxide impregnated linen products (bedsheets, pillowcases, patient shirts and pants, patient gowns, towels, under pads and personnel robes). The biocidal products had a different colour but were used and laundered in the same way and facility as the regular linen. The authors report that the routine IPC measures were the same for both study periods, led by the same infection control nurse. Other than the use of biocidal linen, there was no change to treatment or environmental modalities between both study periods. The HCWs who provided patient care (ward doctors, nurses and aides) were not directly involved in the study and were unaware of the parameters being monitored. The authors report that all data was obtained from patient medical files, pharmacy and laboratory notes without the knowledge or involvement of ward medical staff. Forty regular and 40 copper-oxide bed sheets were swabbed between 6-7 hours after being used by patients in a regular ward and in the head injury ward. An area of 10cm2 of each sheet was swabbed in the area in contact with the patient's back. Cultures were analysed and characterised by regular standard microbiology assays.

Assessment of evidence

Results

There were 57 patients in period A and 51 in period B. Patient characteristics were similar but not the same and no statistical analysis was provided on their similarity (or differences). There was a statistically significant 24% reduction in number of HAI events per 1000 hospitalisation days in period B (20.8) compared to period A (27.4) p=0.046. There was statistically significant reduction in the numbers of HAIs of the gastro-intestinal system (13 vs 1 p=0.0013) and those of the eyes (20 vs 9, p=0.0411) in period B compared to Period A. There were more HAIs associated with the upper respiratory tract (18 vs 26 p=0.2278), however this was not statistically significant. There were reductions in numbers of HAIs associated with lower respiratory tract, urinary tract, skin, blood, mouth, or others, but none of these were statistically significant. There was also a 47% reduction in fever days per 1000 hospitalisation days (7.1 vs 13.4; p=0.0085), a 23% reduction in number of times antibiotics were given per 1000 hospitalisation days (16.5 vs 21.44; p=0.052) and total days of antibiotics per 1000 hospitalisation days (257.1 vs 382.7; p<0.0001). Compared to the regular linen, the copper-oxide linen had significantly lower titres of gram positive (p=0.005) and gram-negative organisms (p=0.047).

Limitations

- One of the authors was Chief medical scientist for the company that developed the technology of incorporating copper oxide particles into textiles. This same company also funded the study.
- Statistical differences not tested for patient characteristics such as age which could affect HAI outcomes between the two study periods.
- Copper impregnated textiles were distinguished from regular hospital linens in that they differed visually in colour – although authors claim HCWs were unaware of the parameters of the study, it cannot be guaranteed that they did not know or alter their IPC behaviours accordingly during the study period.

Contribution to question: This paper shows that copper impregnated linen may reduce the rate of HAIs in long term care facilities in patients with low or no mobility compared to standard non-biocidal healthcare linen.

Question 23: What is the available evidence on post-laundry disinfection for linen in healthcare?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Department of Health Health Technical Memorandum 01-04: Decontamination of Linen for Health and Social Care. Management and provision 2013 March [updated 2016 June 8; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This British document aims to "provide a structure that will enable local decision-making regarding the management, use and decontamination of healthcare and social care linen". The document provides the following recommendations for special laundry situations: "The microbiological quality required of textiles should be determined by their intended use. In certain cases where very high microbiological quality is required (for example in operating theatres), processing may need to be completed by sterilization."					

Assessment of evidence
Limitations • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
World Health Organization. Practical guidelines for infection control in health care facilities 2003. [cited 2024 January 25]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This international “guidelines have been prepared specifically to assist infection control practitioners in the management and prevention of hospital-associated infections and to ensure that health care administrators understand the significance of infection control programmes”. The document provides the following recommendations for special laundry situations: “Autoclave linen before being supplied to the operating rooms/theatres and high-risk areas, e.g. burns units and transplant units.” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Assessment of evidence
• May not be applicable to Scottish health and care settings. • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Centers for Disease Control and Prevention. Guidelines for environmental infection control in health-care facilities: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). MMWR 2003; 52 (No. RR-10): 1–48. 2004. [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence
This American guideline aims “to provide useful information for both health-care professionals and engineers in efforts to provide a safe environment in which quality health care may be provided to patients.” The document provides the following recommendations for special laundry situations: “Use sterilized textiles, surgical drapes, and gowns for situations requiring sterility in patient care. Category IB” “Use hygienically clean textiles (i.e., laundered, but not sterilized) in neonatal intensive care units. Category IB” **Limitations** • No mention of plan or process for update – page also states “This page last reviewed 5/27/2003” • Unknown methods for producing guideline or consensus recommendations. • Some provisions may not be applicable to Scottish health and care settings

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Sundermann AJ, Clancy CJ, Pasculle AW, et al. Remediation of Mucorales-contaminated Healthcare Linens at a Laundry Facility Following an Investigation of a Case Cluster of	Outbreak	**3**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Hospital-acquired Mucormycosis. Clin Infect Dis. 2022;74(8):1401-1407. Doi:10.1093/cid/ciab638					

Assessment of evidence

This American outbreak study aimed “to describe an investigation and remediation of Mucorales contamination at the laundry supplying our center”.

Country: United States of America

Setting: Solid Organ transplant Unit/ External Laundry facility

Organism: Mucormycosis (*Rhizopus microsporus, R. arrhizus var delemar, Lichtheimia corymbifera*)

Background: Over an 11-month period (May 2015 – April 2016), four solid organ transplant (SOT) recipients at the center were diagnosed with likely healthcare associated mucormycosis. All four patients were housed exclusively in one of two hospitals separated by a walkway and were infected with *Rhizopus microsporus (n=2), R. arrhizus var delemar (n=1), Lichtheimia corymbifera (n=1).*

Healthcare linens (HCLs) were identified by October 2015 as a likely source of by the infection prevention team. Surveillance cultures of freshly laundered HCLs and carts taken immediately upon delivery to the medical centre and at the offsite HCL processing facility showed extensive contamination by Rhizopus, Lichtheimia and other Mucorales. In contrast with this, Mucorales or other fungi were rarely recovered from cultures of the hospital environment and non HCL associated supplies.

Genetic relatedness: “Comprehensive core protein phylogenetic and global genome feature analyses of 72 clinical and environmental Mucorales strains revealed that R. microsporus infecting 2 patients in separate hospitals seven months apart were highly similar,

Assessment of evidence

suggesting a common source exposure." "The strains were most closely related to an HCL strain from the offsite facility, which was virtually identical in core genome but distinct by whole genome size and global protein content. All other clinical and environmental Mucorales strains were genetically distinct."

Interventions: Multi-faceted – including temporary introduction antifungal prophylaxis with isavuconazole, dedicated gamma-irradiated HCLs for SOT recipients and remediation of potential sources of Mucorales contaminated HCL at the offsite processing facility. The paper also stated that a detailed description of IPC interventions initiated, and epidemiologic investigation of cases will be provided in a future report.

Remediation

Although no cases were reported by the authors after April 2018 when the IPC interventions (earlier described) were deployed, surveillance cultures of freshly laundered HCLs on arrival at the center continued to be taken. Single Replicate Organism Detection and Counting (RODAC) agar plates (25 cm^2) with malt extract, lecithin and Tween 80 were stamped 10 times at different locations on a given HCL article. Seven articles of seven types of HCL (bath blanket, thermal blanket, fitted sheet, flat sheet, pillowcase, wash cloth and patient gown) were sampled making a total of 49 articles each month. The RODAC plates were immediately sealed and incubated at 35°C.

Between October 2016 and January 2017, five site visits were made by a dedicated team to the offsite laundry facility, the latter four of which were unannounced. In those last 4 visits, cultures were performed at different stations of the laundering process – articles of HCL were cultured using the 10-stamp RODAC method immediately post-washing/pressing, post-dryer removal, post-ironing/folding, pre-transport (before delivery to hospital) and upon arrival at hospital. Cultures were incubated as previously described. Percentages of plates contaminated with fungi were compared between stations using Fischer exact test. (significant at $p<0.05$)

The investigators discovered that the intake vents which delivered unfiltered air into the driers were facing the exhaust vents (which carried air expelled from the driers) in close proximity. The openings and internal surfaces of both vents were covered with thick layers of lint and swabs cultured from them grew confluent Mucorales (*Syncephalastrum spp*.) and other Molds (Aspergillus niger and Curvularia spp) after 24 hours. Significant lint accumulation was also found in the four subsequent unannounced visits on the ceiling, indoor vents, and press and fold machines. They also noted that carts holding laundered and folded HCLs were uncovered as they awaited transport.

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The percentage of samples that were positive for Mucorales (Rhizopus spp) was 0% after the wash and rose significantly to 12% (P=0.04) post drier, dropped to 7% (p=0.49) post iron/fold and rose up to 17% pre-transport. At the time of hospital arrival, it was 13%, a significant rise from the post wash values (p=0.02).

The situation was similar for any fungal positivity. It was 5% post wash and rose significantly to 29% (p=0,01) post drier, dropped to 14% (p=0.12) post-iron/fold, rose again to 43% pre-transport. It was 45% at the time of hospital arrival, a significant rise from post wash values (p=0.0001).

Interventions in the facility included – placement of large filter device around exhaust vents to catch lint, movement of air intake vents away from exhaust vents, frequent lint removal on the roof, enhanced environmental cleaning and frequent removal of lint from floors, walls and ceiling, covering over carts with freshly laundered HCLs, and education on and assessments of adherence to HLAC and CDC guidelines.

For 27 months after the remediation intervention, only 0.3% (3/980) of samples collected were positive for Mucorales, a significant reduction compared to 20% (19/95) before the remediation (p=0.0001).

Limitations

- No culturing was reported after gamma irradiation of freshly laundered HCL.
- Gamma irradiation was also part of a bundle so it is impossible to tell how much of a role it had in stopping the outbreak.

Relevance to Research Question

This study shows the use of gamma irradiation as post-laundry treatment for linen during a fungal outbreak. However, it’s effectiveness cannot be demonstrated as post-treatment culture was either not done or reported.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Balm MN, Jureen R, Teo C, et al. Hot and steamy: outbreak of Bacillus cereus in Singapore associated with construction work and laundry practices. J Hosp Infect. 2012;81(4):224-230. Doi:10.1016/j.jhin.2012.04.022	Outbreak report	**Level 3**	N/A	N/A	N/A

Assessment of evidence

Objectives: This Singaporean study describes the investigation and management of an outbreak of *Bacillus cereus* in a National University Hospital.

Setting: A 950-bed teaching hospital providing tertiary care for all patients. Clinical facilities include a mix of air-conditioned (AC) wards with single or two-person rooms and non-AC wards with shared rooms housing up to eight patients. The hospital has no burns unit.

Organism: *Bacillus cereus*

Background: Following a sudden increase in invasive infections caused by B. cereus group organisms in March 2010, when rates went above two standard deviations above the average of the last two years, an extensive report was launched. Prior to the noted increase, building work had been underway beside the hospital in 2008 which was expected to run until 2014. The project involved the construction of an underground railways station and three multi-storey buildings. The work began in 2008, with deep drilling phases in the early parts of

Assessment of evidence

2009, 2010 and mid 2010 at three different sites around the hospital. A case was defined as an inpatient with B. cereus group-type organism isolated from clinical cultures after 1 March 2010. Data was collected on patient location and movements, IV devices and therapeutic interventions by clinicians. Patients were grouped into outbreak phase (March to August 2010), intervention phase (September 2010 to February 2011) and monitoring phase (March to August 2011).

Terminal cleaning, at the time of the outbreak, was performed using a phenolic compound after the discharge of a patient with bacterial colonisation or infection requiring contact precautions. 1.0% solution of sodium hypochlorite (10,000 ppm, household beach) was used following discharge of patients with tuberculosis or viral illness requiring contact or droplet precaution. Routine cleaning was generally performed twice daily for acute wards using a quaternary ammonium-based disinfectant regimen. Equipment cleaning was done daily by nursing staff using alcohol wipes.

Linen in the hospital was laundered by a commercial laundry located at the national prison. Most of the linen is laundered in continuous tunnel watchers at 70°C with 198 ppm hydrogen peroxide for 12 minutes of each cycle. A 50kg batch of linen enters the tunnel washers every 3 minutes, spending 3 minutes in each of the 14 wash compartments. Baby linen and infectious linen were washed separately in 300kg capacity drum washers. Linen is dried using industrial tumble driers at 110°C for 12 minutes and gowns and sheets are pressed at ~135°C for 10 seconds after which they are packaged in plastic bags for storage until use. Blankets and towels are not pressed. From August 2010, linen processing was contracted to another commercial laundry due to reasons unconnected to the outbreak. This laundry used 500kg capacity drum washers using >200ppm sodium hypochlorite with a peak temperature of 65°C for all type of linen.

Investigations: Settle plates were placed in patient rooms, nursing stations, linen trolleys, and preparation areas on the most affected wards. Plates were read and B. cereus group species were identified using matric-assisted laser desorption/ionisation-time of flight-mass spectrometry (MALDI-TOF-MS). Settle plates were placed at two, four and eight months according to a predetermined protocol during a series of interventions. Ventilation systems were reviewed by hospital engineers and an external contractor and air sampling was done using an SAS 100 portable microbiological air sampler. Plates were examined to determine the proportion of B. cereus group colonies present. Air exchanges were measured, a smoke test was performed in two rooms, one with positive pressure ventilation and the other with standard air-conditioning. Following heavy contamination on settle plates from linen trolleys, laundry practices were examined closely. Semiquantitative assessment of linen was done using an immersion method, repeated at intervals to assess the effect of washing linen with >200 ppm sodium hypochlorite. Strips of 4x4cm fabric squares were cut from separate pieces of linen each was sonicated in 10ml of

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nutrient broth for two minutes and removed. The broth was centrifuged at 3000 rpm for five minutes after which the supernatant was removed and 25µl of the pellet was inoculated as a lawn on to a blood agar plate and incubated aerobically at 36°C. Batches of 20 – 30 pieces of similar type of linen were processed at the same time. Freshly laundered linen at the hospital were usually stored in airtight plastic bags until use. Given the high ambient temperature and humidity in Singapore, it was postulated that storage in those conditions might encourage the propagation of B. cereus spores. To test this, linen from the same watching batch was stored for 24h in either plastic bags or porous canvas bags. Both laundries were visited on separate days in August. Settle plates were placed throughout both laundries and swab samples from inside the drum washers at both laundries were collected. Water samples from the CTWs at the primary laundry were also taken. In addition, pieces of autoclaved linen were washed in a batch of dirty linen to evaluate whether transfer of spores was occurring during the wash process. Cultures were also obtained from gloves used for accessing IV devices, infusion flush fluids and infusion tubing sets. Hospital environmental cleaning procedures were reviewed.

Statistical analysis was performed using STATA using tests of two proportions to calculate Z-scored with $p<0.05$ considered significant.

Findings: Routine surveillance showed a 10-fold increase in B. cereus group organisms in clinical samples during a 5-month period in 2010. Although B. cereus predominated, other species of the B. cereus group were represented. Blood cultures with B. cereus group increased a mean monthly rate (±SD) or 24 ± 14 (range 0-50) to 122 ± 48 (range: 60-200) per 10,000 blood cultures performed. Increased isolation was also noted in wound, fluid, and sterile sites but not in respiratory or urine cultures. Cases were reported in 33 of 37 wards. Among these, 52/171 (30.4%) cases occurred in haematology or oncology patients, some of whom had evidence of sepsis without any alternative explanation. The mean number of patients with B. cereus group organisms recovered from clinical cultures which was seven per month (±3.58, range 1-11) in 2008-2009 rose steadily to 51 in August 2010, the peak of the outbreak. During the outbreak period, 201 positive cultures for B. cereus group organisms were recovered from 171 patients (0.71% of admitted patients). Median age of patients was 51 years (range 0-97) and 65.5% were male. 34.9% (51/146) of patient bacteraemia episodes occurred in immunocompromised patients, 39% (57) in patients that had intravascular devices and 26.7% (39) in patients who were both immunocompromised and had intravascular devices. Deep tissue involvement was evident in 20 patients and 29 patients required therapeutic interventions including IV vancomycin, removal of 18 central lines or portacaths and two external ventricular drains. Multiple Bacillus spp were identified as B. cereus group organisms from air samples after settle plates were exposed for a 1h period. An index of B. cereus group air contamination derived from the index of microbial air contamination (IMA) was calculated and showed highest contamination from inner surfaces of linen trolleys and within patient rooms in all wards. Active air sampling showed extremely high bacillus counts in outside air (~600 cfu/m^3) but

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low counts within empty rooms without linen (0-5 cfu/m^3). Particle counts and air exchanges per hour complied with hospital guidelines. Bacillus spp, mostly B. cereus – were isolated from all types of linen sampled at the beginning of the investigation in August 2010. The density of contamination increased with more absorbent materials. Towels had an average contamination density of 7403 ± 1054 cfu/cm^2, cotton blankets 840 ± 386 cm^2, patient gowns 585 ± 356 cfu/cm^2, fitted sheets 370 ± 191 cfu/cm^2, and flat cotton sheets 80 ± 36 cfu/cm^2. Settled plates in areas where linen was handled in both laundry sites showed semiconfluent growth of bacillus. Water sampling showed high bacillus counts in partially recycled pre-wash water (7.2 x10^2 cfu/ml), 2.4 x 10^2 cfu/ml and 4.1 x 10^4 cfu/ml in the compress water post-final extraction from each tunnel washer. Water recycled to the washers showed 3.9 x 10^2 cfu/ml, demonstrating that bacillus remained viable after water treatment. Internal surfaces of washing machines were however not contaminated with Bacillus spp and co-washing with sterile linen showed minimal transfer of viable spores during the wash process. Only one colony of B. cereus was found in one of the four samples tested. No growth was observed in samples from glove, infusion fluid or infusion tubing samples. The investigators also found that storage of freshly laundered linen in plastic bags encouraged the propagation of spores compared to storage in porous canvas bags. After a 24-hour storage period, there was a significantly higher contamination in the towels stored in the plastic bags (10 per bag) (4437 cfu/cm^2; CI: 3125-5750) compared to those stored in the canvas bags (166 cfu/cm^2; CI: 76-256; P<0.001).

Interventions:

Non-Laundry: Initial interventions targeted the haematology-oncology units at the beginning of the outbreak as patients there were most likely to have bacillus isolated from clinical specimens associated with clinical symptomatic infection. The disinfectant used for terminal cleaning was changed to 0.5% acidified bleach (5000ppm, one part 5% sodium hypochlorite, eight parts water and one part vinegar) throughout the hospital. Oncology wards were cleaned thoroughly with bleach and cleaned terminally after each patient discharge. Aseptic technique for IV device access was reviewed and reinforced by directly observed assessment. Removal of IV devices was advised if there was recurrence of bacteraemia despite treatment with vancomycin, if B. cereus group was isolated from paired peripheral and line cultures, or if the patient was septic with no organism implicated. Additional filters were also placed in the ventilation system and all re-usable filters were cleaned every month.

Laundry: Autoclaved towels were used in the four haematology – oncology wards from 28 August when linen contamination was suspected. At both commercial laundries, switching to a bleach-based protocol for white linen by September 2010 led to a reduction in contamination of towels from 7403 ± 1054 to 4437 ± 1128 cfu/cm^2 (P<0.001) after eight weeks.

Assessment of evidence

Laundered linen was thereafter stored in canvas bags from December 2010, and this led to a sustained reduction in bacillus contamination of the towels. During a retest in February 2011, the contamination level was (107 cfu/cm^2; CI:58-157).

Outcomes: Case numbers rapidly declined following interventions and returned to pre-outbreak levels (≤7 cases/month) by November 2010. “During the intervention period (September 2010 to February 2011), 63 positive cultures were obtained from 51 patients (0.23% of admitted patients, P < 0.01). Positive blood or line cultures comprised 38 patient episodes (74.5%), of which 24 (63.1%) occurred in immunocompromised patients or those with intravascular devices.” Reduction in contamination of the clinical environment was evidenced by reduced cfus in both settle plate and linen cultures during the intervention period. Interventions were thereafter relaxed at the end of February 2011. Autoclaving of towels for the haematology-oncology wards and terminal cleaning following patient discharge were ceased.

Case numbers rose from five per month to 11-17 almost immediately and was sustained at this level for six months following. In April, towel cultures showed that there had been another significant contamination of linen (2160 cfu/cm2; CI: 1128 – 3292). Investigation showed that the external laundry was still using an incorrect concentration of sodium hypochlorite and that only towels had been stored in the canvas bags due to cost constraints (other linen were still being stored in plastic). The external laundry was advised on the need to achieve 200ppm sodium hypochlorite in the rinse phase and to clean the environment thoroughly with 5000ppm sodium hypochlorite. The laundry made no changes, despite these recommendations, and case numbers stayed up. At July 2011, towel cultures showed ongoing dense contamination with B. cereus (4093 cfu/cm2; CI: 2755-5340; compared to 107 cfu/cm2; CI: 58-157 in February 2011; P<0.001). At the time of the report, the outbreak team was still working with the external laundry to address the problems while monitoring the Bacillus spp contamination within the hospital as the construction work continued.

Genetic relatedness: None performed.

Limitations:

- Genetic relatedness not done.
- Outbreak was still ongoing at the time of the report.

Contribution to question: This study shows that post-laundry autoclaving of linen has been used during outbreaks especially in immunocompromised populations and those with intravascular devices.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Advisory Committee on Dangerous Pathogens. Management of Hazard Group 4 viral haemorrhagic fevers and similar human infectious diseases of high consequence 2015 November [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This British document "provides guidance on the risk assessment and management of patients in the United Kingdom in whom infection with a viral haemorrhagic fever (VHF) should be considered or is confirmed".

The document provided the following on post-laundry disinfection of linen:

"The return of the deceased's clothing and personal effects to relatives

16. The family of the deceased should be consulted and as far as is reasonably practicable their needs and wishes should be respected. In principle clothing, personal effects and valuables may be returned to

relatives in accordance with normal health service procedure following decontamination.

17. However: Items of clothing visibly contaminated should be safely disposed of, other items of clothing should be autoclaved prior to laundering;"

Assessment of evidence
Limitations • Unknown methods for producing guideline or consensus recommendations. • Update process or schedule not provided.

Question 24: When is linen deemed unfit for reuse?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health and Safety Executive. Managing infection risks when handling the deceased. 2018 July [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This British guidance "provides guidance on managing the risks of infection from work activities which involve handling the deceased".					

Assessment of evidence
On Safe management of linen, including uniforms, the document states: “Store clean linen and clothing appropriately in a designated area and in sufficient supply for the scale of work. Dispose of any linen or work clothing that is unfit for reuse (e.g badly torn).” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Healthcare Laundry Accreditation Council. HLAC Accreditation Standards: Accreditation Standards for Processing Reusable Textiles for Use in Healthcare Facilities	Standards	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2023 May [cited 2024 January 24];					

Assessment of evidence

These American standards were developed by the Healthcare Laundry Accreditation Council (HLAC) and "are intended to be used to obtain or maintain accreditation in the HLAC Accreditation Program. The standards represent the collective best judgment of HLAC leaders."

The document provides for the inspection of clean surgical textiles before they are packed.

"3.2.2. If surgical textile integrity and quality are monitored by the provider, the critical zones of surgical textiles must be visually inspected with the use of light illumination (e.g., table, bar, tube, etc.) for the presence of stains, residue, physical defects, chemical or thermal damage, and foreign debris, and to ensure that appropriate labels are in place and a tracking system is intact."

On stains, the document states:

"3.2.3.1. If, during the inspection process, surgical textiles are determined to be stained, these textiles must be rewashed or retired as appropriate. (ANSI/AAMI ST65:2018; Std. 7.2.2, 7.4.3)

3.2.3.2. Surgical textiles with aesthetic stains that do not adversely affect the functionality of the textile may remain in service unless the end user determines otherwise."

The document recommends retirement for unremovable stains, physical defects, chemical or thermal damage in **surgical textiles**.

"3.2.3.3. Stained surgical textiles must be retired if rewashing cannot successfully remove unacceptable stains or residues (e.g., medicines, lubricants, adhesives, blood and/or body fluids, hard surfaced or foreign matter of unknown composition, and raised or tactile residues). (ANSI/ AAMI ST65:2018; Std. 7.2.2)"

"3.2.4.1. Physical defects (i.e., loose threads, loose or missing ties/ attachments, damaged/missing snaps, cuts, tears, and holes) must be repaired as appropriate with patching and mending before the textile is reused in accordance with Part III Subpart 3 Section 3.3 of this HLAC Standard. (ANSI/AAMI ST65:2018; Std. 7.2.3)"

Assessment of evidence
"3.2.5.1. Surgical textiles must be inspected for evidence of chemical and/or thermal damages (usually apparent as discoloration, stiffening, or compromised structural integrity holes). (ANSI/ AAMI ST65:2018; Std. 7.2.4)" "3.2.5.2. Surgical textiles with chemical and/or thermal damage that adversely impacts the important functional attributes of the textile must be retired or removed from service. (ANSI/AAMI ST65:2018; Std. 7.2.4)" "3.3.4.1. When reusable surgical textile products fail to meet their minimum functional performance criteria, they must be retired from use, downgraded to a less stringent alternate use category (e.g., cover gowns), or remade into a different product (e.g., a smaller wrapper)." "3.3.4.2. Products placed into alternate use or remade into different products shall continue to be safe and effective for their intended use." "3.3.4.3. Items placed into alternate use must be permanently marked in some obvious fashion to prevent mix-ups or inappropriate use." **Limitations** • Method of producing guidance not stated. • May not be applicable to Scottish health and care settings. • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Public Health Agency of Canada. Infection prevention and control measures for Ebola disease in acute care settings	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2021. [cited 2024 June 27]					

Assessment of evidence

This Canadian guidance aims "to provide guidance on the minimum level of IPC measures in healthcare settings in the event that a person under investigation for EBOD or patient with EBOD is identified within a Canadian healthcare facility." The document provides the following on linen unfit for reuse:

"EBOD-associated linen storage areas should be clearly marked with a biohazard symbol and kept separate from other storage areas.

If test result for EBOV is negative: No further special handling of the stored reusable linen required. Regular laundry process for stored reusable linen is appropriate and disposal of reusable linen into waste stream is not necessary.

If test result for EBOV is positive: Stored containers of linen should be packaged and transported separately off-site and disposed of in accordance with applicable legislation for regulated biohazardous waste."

Limitations

- Method of producing guidance is unclear.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
National Guidance for Safe Management of Linen in NHSScotland. 2018 [cited 2024 February 02]					

Assessment of evidence

This Scottish document aimed to provide guidance to ensure safe and consistent linen management and reprocessing practice in health and care environments within NHS Scotland. The document provides the following on linen unfit for reuse:

“Infectious linen from suspected or confirmed category 4 infections (e.g. viral haemorrhagic fevers) should not be returned to the laundry. These items should be disposed of as category A waste and incinerated. The laundry department should be informed if any items of linen are sent for incineration.”

“All processed linen should look visibly clean and should not be damaged or discoloured. Processed linen that does not meet these criteria should be disposed of via the domestic waste stream by the linen services department and the department/ward of origin notified if required.”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Centers for Disease Control and Prevention. Interim Guidance for Environmental Infection Control in Hospitals [updated 2024 March 13; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This American guidance is for “U.S. hospital personnel caring for a patient who is suspected or confirmed to have one of the selected viral hemorrhagic fevers (VHFs) to help healthcare personnel follow recommended infection prevention and control practices when caring for a patient suspected or confirmed to have VHF.”.

“As part of the care of PUIs or patients with confirmed EVD, hospitals are recommended to:

- To reduce exposure among staff to potentially contaminated textiles (cloth products) while laundering, discard all linens, nonfluid-impermeable pillows or mattresses, and textile privacy curtains into the waste stream and dispose of appropriately.”

Limitations

- Unknown methods for producing guideline or consensus recommendations.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Advisory Committee on Dangerous Pathogens. Management of Hazard Group 4 viral haemorrhagic fevers and similar human infectious diseases of high consequence. 2015 November [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This British document “provides guidance on the risk assessment and management of patients in the United Kingdom in whom infection with a viral haemorrhagic fever (VHF) should be considered or is confirmed”.

The document provides the following on linen unfit for reuse:

“The use of disposable linen should always be considered when appropriate, in particular when caring for a patient with a ‘high possibility of’ or ‘confirmed’ VHF infection. Subject to risk assessment, this linen may need to be treated and disposed of as category A waste. "All re-useable linen from patients with a ‘confirmed’ VHF infection should not be returned to a laundry and must therefore be treated and disposed of a category A infectious waste as set out by Health Technical Memorandum HTM 07-01 Safe Management of Healthcare Waste."

Assessment of evidence
Limitations • Unknown methods for producing guideline or consensus recommendations. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Scottish Government. National uniform policy, dress code and laundering policy DL(2018)4 [cited 2024 January 24]	Regulation	Mandatory	N/A	N/A	N/A

Assessment of evidence
This Scottish Government document sets out the policy on uniform laundering for health and social care staff. The document provides the following on linen unfit for reuse: “Where uniform is heavily contaminated, following laundering, the Laundry may condemn it as unfit for re-use. In these circumstances, it should be placed in a healthcare waste sack and disposed of as healthcare (including clinical) waste.”

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
World Health Organization. Infection prevention and control guideline for Ebola and Marburg disease. 2023 [cited 2024 March 13]	Guidance	**AGREE Recommend with modifications**	N/A	N/A	N/A

Assessment of evidence

This WHO guideline aims “to provide clarity on key IPC recommendations as they pertain to settings that pose different risks to the health and care worker, including screening, triage and providing care to patients with Ebola disease or Marburg disease.” It provides the following on linen unfit for reuse:

Conditional recommendation for, Very low certainty evidence "WHO suggests that heavily soiled linens resulting from care of patients with Ebola disease or Marburg disease in health-care facilities, TCs or community settings be safely disposed of (e.g. incinerated rather than disinfected/decontaminated) following existing WHO guidelines on waste management."

Practical implementation considerations: "In health-care settings and TCs, a risk assessment should be conducted to determine if soiled linens can be safely decontaminated (safely handled, washed and disinfected by machine or by hand) or if they should be eliminated.

◦ “Staff should have access to the required PPE for handling soiled linens for patients suspected/confirmed to have Ebolavirus or Marburgvirus.

◦ Training of health and care workers should include how to handle, wash and disinfect linens, how to use PPE appropriately and how to perform hand hygiene.

◦ Linen/laundry should be washed and then disinfected.”

Assessment of evidence
Limitations • The methodology section was unclear particularly with respect to the systematic and rapid reviews.

Question 25: How should linen deemed unfit for reuse be disposed of?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health and Safety Executive. Managing infection risks when handling the deceased. 2018 July [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This British guidance "provides guidance on managing the risks of infection from work activities which involve handling the deceased". On Safe management of linen including uniforms, the document states					

Assessment of evidence
"Store clean linen and clothing appropriately in a designated area and in sufficient supply for the scale of work. Dispose of any linen or work clothing that is unfit for reuse (eg badly torn)" "Dispose of items that are heavily soiled and unlikely to be fit for reuse as clinical waste." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
The Healthcare Laundry Accreditation Council. HLAC Accreditation Standards: Accreditation Standards for Processing Reusable Textiles for Use in Healthcare Facilities.	Standards	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2023 May [cited 2024 January 24]					

Assessment of evidence

These American standards were developed by the Healthcare Laundry Accreditation Council (HLAC) and "are intended to be used to obtain or maintain accreditation in the HLAC Accreditation Program. The standards represent the collective best judgment of HLAC leaders."

The document provides for inspection of clean surgical textiles before they are packed.

"3.2.2. If surgical textile integrity and quality are monitored by the provider, the critical zones of surgical textiles must be visually inspected with the use of light illumination (e.g., table, bar, tube, etc.) for the presence of stains, residue, physical defects, chemical or thermal damage, and foreign debris, and to ensure that appropriate labels are in place and a tracking system is intact."

On stains, the document states:

"3.2.3.1. If, during the inspection process, surgical textiles are determined to be stained, these textiles must be rewashed or retired as appropriate. (ANSI/AAMI ST65:2018; Std. 7.2.2, 7.4.3)

3.2.3.2. Surgical textiles with aesthetic stains that do not adversely affect the functionality of the textile may remain in service unless the end user determines otherwise."

The document recommends retirement for unremovable stains, physical defects, chemical or thermal damage in **surgical textiles**.

"3.2.3.3. Stained surgical textiles must be retired if rewashing cannot successfully remove unacceptable stains or residues (e.g., medicines, lubricants, adhesives, blood and/or body fluids, hard surfaced or foreign matter of unknown composition, and raised or tactile residues). (ANSI/ AAMI ST65:2018; Std. 7.2.2)"

"3.2.4.1. Physical defects (i.e., loose threads, loose or missing ties/ attachments, damaged/missing snaps, cuts, tears, and holes) must be repaired as appropriate with patching and mending before the textile is reused in accordance with Part III Subpart 3 Section 3.3 of this HLAC Standard. (ANSI/AAMI ST65:2018; Std. 7.2.3)"

Assessment of evidence
"3.2.5.1. Surgical textiles must be inspected for evidence of chemical and/or thermal damages (usually apparent as discoloration, stiffening, or compromised structural integrity holes). (ANSI/ AAMI ST65:2018; Std. 7.2.4)" "3.2.5.2. Surgical textiles with chemical and/or thermal damage that adversely impacts the important functional attributes of the textile must be retired or removed from service. (ANSI/AAMI ST65:2018; Std. 7.2.4)" "3.3.4.1. When reusable surgical textile products fail to meet their minimum functional performance criteria, they must be retired from use, downgraded to a less stringent alternate use category (e.g., cover gowns), or remade into a different product (e.g., a smaller wrapper)." "3.3.4.2. Products placed into alternate use or remade into different products shall continue to be safe and effective for their intended use." "3.3.4.3. Items placed into alternate use must be permanently marked in some obvious fashion to prevent mix-ups or inappropriate use." **Limitations** • Method of producing guidance not stated. • May not be applicable to Scottish health and care settings. • Unclear how recommendations were reached.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Public Health Agency of Canada. Infection prevention and control measures for Ebola disease in acute care settings.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
2021. [cited 2024 June 27]					

Assessment of evidence

This Canadian guidance aims “to provide guidance on the minimum level of IPC measures in healthcare settings in the event that a person under investigation for EBOD or patient with EBOD is identified within a Canadian healthcare facility.”

“EBOD-associated linen storage areas should be clearly marked with a biohazard symbol and kept separate from other storage areas.

If test result for EBOV is negative: No further special handling of the stored reusable linen required. Regular laundry process for stored reusable linen is appropriate and disposal of reusable linen into waste stream is not necessary.

If test result for EBOV is positive: Stored containers of linen should be packaged and transported separately off-site and disposed of in accordance with applicable legislation for regulated biohazardous waste.”

Limitations

- Method of producing guidance is unclear.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Protection Scotland, Health Facilities Scotland and NHS National Services Scotland.	Guidance	**Level 4**	N/A	N/A	N/A

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
National Guidance for Safe Management of Linen in NHSScotland. 2018 [cited 2024 February 02]					

Assessment of evidence

This Scottish document aimed to provide guidance to ensure safe and consistent linen management and reprocessing practice in health and care environments within NHS Scotland.

“Infectious linen from suspected or confirmed category 4 infections (e.g. viral haemorrhagic fevers) should not be returned to the laundry. These items should be disposed of as category A waste and incinerated. The laundry department should be informed if any items of linen are sent for incineration.”

“All processed linen should look visibly clean and should not be damaged or discoloured. Processed linen that does not meet these criteria should be disposed of via the domestic waste stream by the linen services department and the department/ward of origin notified if required.”

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Centers for Disease Control and Prevention Interim Guidance for Environmental Infection Control in Hospitals [updated 2024 March 13; cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This American guidance is for "U.S. hospital personnel caring for a patient who is suspected or confirmed to have one of the selected viral hemorrhagic fevers (VHFs) to help healthcare personnel follow recommended infection prevention and control practices when caring for a patient suspected or confirmed to have VHF." The document provides the following on linen unfit for reuse:

"As part of the care of PUIs or patients with confirmed EVD, hospitals are recommended to:

- To reduce exposure among staff to potentially contaminated textiles (cloth products) while laundering, discard all linens, nonfluid-impermeable pillows or mattresses, and textile privacy curtains into the waste sstream and dispose of appropriately."

On the management of linens and privacy curtains:

"These materials should be placed in leakproof containment and discarded appropriately. To minimize contamination of the exterior of the waste bag, place the bag in a rigid waste receptacle designed for this use. Incineration or autoclaving as a waste treatment process is effective in eliminating viral infectivity and provides waste minimization. If disposal requires transport offsite then this should be done in accordance with the U.S. Department of Transportation's (DOT) Hazardous Materials Regulations (HMR, 49 CFR, Parts 171-180).

Assessment of evidence
Limitations • Unknown methods for producing guideline or consensus recommendations. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Advisory Committee on Dangerous Pathogens. Management of Hazard Group 4 viral haemorrhagic fevers and similar human infectious diseases of high consequence. 2015 November [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This British document “provides guidance on the risk assessment and management of patients in the United Kingdom in whom infection with a viral haemorrhagic fever (VHF) should be considered or is confirmed”. It provides the following for management of linen used in HCID:					

Assessment of evidence
“The use of disposable linen should always be considered when appropriate, in particular when caring for a patient with a ‘high possibility of’ or ‘confirmed’ VHF infection. Subject to risk assessment, this linen may need to be treated and disposed of as category A waste. "All re-useable linen from patients with a ‘confirmed’ VHF infection should not be returned to a laundry and must therefore be treated and disposed of a category A infectious waste as set out by Health Technical Memorandum HTM 07-01 Safe Management of Healthcare Waste." **Limitations** • Unknown methods for producing guideline or consensus recommendations. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Scottish Government. National uniform policy, dress code and laundering policy. DL (2018) 4 [cited 2024 January 24]	Regulation	Mandatory	N/A	N/A	N/A
Assessment of evidence					
This Scottish Government document sets out the policy on uniform laundering for health and social care staff. The document provides the following on linen unfit for reuse:					

Assessment of evidence
“Where uniform is heavily contaminated, following laundering, the Laundry may condemn it as unfit for re-use. In these circumstances, it should be placed in a healthcare waste sack and disposed of as healthcare (including clinical) waste.”

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
World Health Organization. Infection prevention and control guideline for Ebola and Marburg disease. 2023 [cited 2024 March 13]	Guidance	**AGREE Recommend with modifications**	N/A	N/A	N/A

Assessment of evidence
This WHO guideline aims “to provide clarity on key IPC recommendations as they pertain to settings that pose different risks to the health and care worker, including screening, triage and providing care to patients with Ebola disease or Marburg disease.” It provides the following on linen unfit for reuse: Conditional recommendation for, Very low certainty evidence "WHO suggests that heavily soiled linens resulting from care of patients with Ebola disease or Marburg disease in health-care facilities, TCs or community settings be safely disposed of (e.g. incinerated rather than disinfected/decontaminated) following existing WHO guidelines on waste management." **Limitations** • The methodology section was unclear particularly with respect to the systematic and rapid reviews.

Question 26: How should curtains be put up and taken down to minimise transmission of infection?

Evidence added to current update of Literature Review v4.0:

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
NHS England. Health Building Note 00-10 Part E: Curtains and tracking. 2023 October [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A
Assessment of evidence					
This English "Health Building Note (HBN) provides technical advice on curtains and tracking building components and their fitting and maintenance for both physical and mental healthcare environments. It gives guidance on the installation and maintenance of appropriate curtains and tracking for NHS facilities." On selecting cubicle curtains, the document states: "It should be noted there are no infection protection and control reasons not to use a linen curtain, for instance in clinical areas where the transmission of infection may be an issue, so long as the curtain is changed regularly and is managed as infectious linen as per HTM 01-04 – 'Decontamination of linen for health and social care'. Cleaning frequencies must meet the National Standards of Healthcare Cleanliness 2021 requirements and have a robust audit system in place." On cubicle curtains, the document states the following:					

Assessment of evidence
“Soiled curtains are to be unloaded directly into a container for soiled linen as per local organisational guidelines.” “Routine/planned curtain changes are undertaken at the end of the cubicle furthest from the patient’s head, and the fitting and removal of gliders or runners to the curtains takes place entirely outside the patients’ area.” “If the curtains have been used in a cubicle where a patient had known infection, or the curtains are visibly soiled, it will be necessary to undertake a risk assessment in alignment with local policy regarding the timing and location of curtain changes. Curtains should always be changed prior to cleaning.” **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
NHS National Patient Safety Agency The NHS Cleaning Manual. 2009 June [cited 2024 January 24]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

The NHS Cleaning manual is intended as “as a resource for the Trust Board member or senior manager with responsibility for cleanliness and for all managers and staff with responsibilities for cleaning. The Manual is applicable to all healthcare settings including hospitals, ambulances, and primary care.” It is aimed at providing “guidance on cleaning techniques and best practice advice on defining responsibilities, scheduling work, measuring outcomes, reporting and driving improvements.”

The document provides the following statement on changing curtains:

- “Equipment and materials required:
  - colour-coded bucket;
  - colour-coded cloth;
  - colour-coded domestic gloves;
  - laundry bags;
  - curtain hooks and container;
  - stepladder;
  - cleaning trolley;
  - general purpose detergent or general surface cleaner;
  - warning signs.
- Method

1. Wash hands and put on gloves.

Assessment of evidence
2. Display warning signs. 3. Prepare the cleaning solution in the bucket in strict accordance with the manufacturer's instructions and with your training. Do not mix chemicals and only use a cleaning product provided by your employer. 4. Place the bucket on a cleaning trolley. 5. Using the stepladder (refer to health and safety notes), take down the curtains. Remove the curtain hooks and place in the container. Place the curtains in the laundry bag. 6. Dampen or rinse a cloth in the cleaning solution. 7. Damp-dust the curtain rails and surrounding areas. 8. Wash the used curtain hooks and allow to dry. 9. On completion, dispose of the cloth, clean and dry all equipment and store safely and tidily in a secure storage area, segregated according to colour-coding where appropriate. 10. Remove gloves and wash hands. 11. Fit the curtain hooks to a clean curtain at appropriate, evenly spaced intervals. 12. Carefully drape the curtain over your shoulder and climb the stepladder (refer to health and safety notes). 13. Hang the curtain, starting at one end. 14. Wash hands." **Limitations** • Method of producing guidance not stated. • Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Facilities Scotland. SHTM 66 SHTM Building Component Series Cubicle curtain track 2006 [cited 2024 March 19]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Scottish document "offers guidance on the technical design and output specifications of curtain cubicle track in health buildings".

The document provides the following on changing curtains:

Curtain changing "Domestic services staff are usually responsible for changing curtains. Speed and efficiency of the procedure are of great importance to the smooth running of the department, which should minimise:

- […] risk of cross-infection due to movement of soiled curtains."
- Soiled curtains are usually unloaded straight into a container on the floor, the gliders or runners being run off the track when an end-stop is removed to fit the loading device.
- Curtains are changed at the end of the cubicle furthest from the patient's head, and the fitting and removal of gliders or runners to the curtains takes place entirely outside the patients' area.

Limitations

- Method of producing guidance not stated.
- Update process or schedule not provided.

Study	Study Type	Evidence Level	Intervention	Comparison	Outcome measure
Health Facilities Scotland. The NHSScotland National Cleaning Services Specification. 2016 cited 2024 March 21]	Guidance	**Level 4**	N/A	N/A	N/A

Assessment of evidence

This Scottish document provides specifications for cleaning processes.

The document provides a step-by-step process under the title ‘changing/hanging curtains and bed screens’:

Materials required: The document lists the following as required materials

- “wet floor sign
- colour coded equipment (buckets, microfibre, cloths), disposable cloth or paper
- cleaning solution
- PPE (i.e. apron, gloves, safety goggles etc) as per local policy laundry bags
- curtain hooks and container
- suitable safety ladder/platform
- clean curtains”

Assessment of evidence
Method • wear appropriate PPE • Correctly position wet floor sign to identify cleaning task taking place • If using the safety ladder/platform, and in line with outcome of risk assessment, take down the bed screen/curtain • Wear safety goggles and half fill bucket with warm water and add the cleaning agent in line with manufacturers' instructions; change cleaning solution as appropriate • Remove the curtain hooks and place in the container • Bag curtains and label bags, for transfer to laundry as per local policy • Dampen cloth/paper and wipe curtain rail and associated fixtures. Wipe the surface with the damp cloth using one swipe, fold a section of the cloth over to reveal a clean unused surface and wipe again. Ensure to always work clean to dirty • wash curtain hooks in cleaning solution and dry • Fit the curtain hooks to a clean curtain at appropriate, evenly spaced intervals • Carry and hang curtain as per recommendations from risk assessment • Remove stepladders and wet floor signs • Remove PPE and dispose of in appropriate waste stream • Return equipment to DSR • Ensure to clean and store all used equipment away appropriately

Assessment of evidence
Limitations • Method of producing guidance not stated. • Update process or schedule not provided.