NHS National Services Scotland

Safe Disposal of Waste Literature Review

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ARHAI Scotland
Antimicrobial Resistance and Healthcare Associated Infection

Contents

Key Information

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Document information	Description
Description:	This literature review examines the available professional literature on Safe Disposal of Waste.
Purpose:	To inform the recommendations for the safe disposal of waste in the National Infection Prevention and Control Manual in order to facilitate the prevention and control of healthcare associated infections in NHSScotland health and care settings.
Target Audience:	All staff involved in the prevention and control of infection in NHSScotland.
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Version history

This literature review will be updated in real time if any significant changes are found in the professional literature or from national guidance/policy.

Version	Date	Summary of changes
1.0	January 2012	Final for publication
2.0	April 2014	Final for publication
2.1	September 2015	Draft for consultation
3.0	September 2015	Updated after review of current literature
4.0	June 2020	Updated using two-person NIPCM methodology. The question set was reviewed. The following objective has been added: • What is the definition of a sharp in health and care settings?
5.0	March 2025	Three-year update of the Safe Disposal of Waste Literature Review. This literature review was updated using a new methodology, details of which can be found within the **development process** on the NIPCM. The following additional research questions were added: • How should different waste bags/receptacles be filled and sealed in health and care settings? • How should non-hazardous waste be handled in health and care settings? Other research questions were altered, and some research questions were amalgamated to clearly capture the stages of waste disposal. Details of changes can be sought from ARHAI Scotland on request.

Approvals

Version	Date Approved	Name
1.0	January 2012	Steering (Expert Advisory) Group for SICPs and TBPs
2.0	April 2014	
3.0	September 2015	Steering (Expert Advisory) Group for SICPs and TBPs
4.0	July 2020	Steering (Expert Advisory) Group for SICPs and TBPs
5.0	February 2025	ARHAI Scotland National Policy, Guidance and Evidence (NPGE) Working Group

1 Objectives

The aim is to review the extant scientific literature regarding the safe disposal of waste in health and care settings to inform evidence-based recommendations for practice. The specific research questions of the review are provided below:

1. **Are there any legislative requirements for the handling and disposal of waste for infection prevention and control purposes?**
2. **What are the categories of waste in health and care settings?**
3. **How and when should waste be segregated in health and care settings?**
4. **Are there specific standards for different waste receptacles in health and care settings?**
5. **Where should waste receptacles be placed in health and care settings?**
6. **How should different waste receptacles be filled and sealed in health and care settings?**
7. **How should special (hazardous) waste (including sharps, blood and body fluids) be handled in health and care settings?**
8. **How should non-hazardous waste be handled in health and care settings?**
9. **How should waste be labelled or tagged in health and care settings?**
10. **How should waste be transported in health and care settings?**
11. **How should waste be stored prior to uplift for disposal in health and care settings?**
12. **How should waste spillages be managed?**

2 Methodology

This targeted literature review was produced using a defined systematic methodology as described in the **National Infection Prevention and Control Manual: Development Process**. The complete search strategy is provided in **Appendix 1**.

The exclusion criteria outlined in the **NIPCM: Development Process** were used in this review. No additional exclusion criteria were applied.

Definitions for grades of evidence are provided in **Appendix 2**. A PRISMA flowchart is presented in **Appendix 3.** Adapted from Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[1]

3 Discussion

3.1 Implications for practice

3.1.1 Are there any legislative requirements for the handling and disposal of waste for infection prevention and control purposes?

Nine pieces of evidence were included to answer this research question, including four expert opinion guidance documents, graded as SIGN50 Level 4, two of which support compliance with legislation[2, 3] with the remaining two being updates to guidance described in the previous update of this review.[4, 5] Two UK[6, 7] and two Scottish[8, 9] legislations were included to answer this research question, which are also graded as 'Mandatory'. Three Scottish directorate letters (DLs) from the previous update were excluded as they have now been superseded by the one included in this update, which is graded as 'Mandatory' as it contains legislation which NHSScotland bodies are expected to adhere to.[10]

Waste generated or produced in health and care settings is subject to numerous Scottish, UK and international legislation and regulations regarding health and safety, transportation and environmental protection.[4] The prevention and control of infection is considered within some of this legislation, but there is no single specific piece of legislation or regulation which explicitly governs the safe management and disposal of waste in health and care settings with the purpose of preventing or controlling infection.

Health Facilities Scotland (HFS) has interpreted and synthesised relevant legislation within the Scottish Health Technical Note 03-01 (SHTN 03-01), 'NHSScotland waste management guidance' which supports compliance for NHSScotland waste producing health and care services.[4] Legislative requirements for the rest of the UK are described in the Health Technical Memorandum 07-01: 'Safe management of healthcare waste' (HTM 07-01) guidance.[5]

Waste handling in Scottish health and care settings is governed by waste and health and safety legislation.[4] Scottish Government guidance supporting compliance with Duty of Care states that waste producers must "take reasonable measures to ensure

that your waste does not cause […] harm to human health".[3] As such, waste should not be allowed to escape the producer's control, for example from a leaking container.[3] Duty of Care is a legal requirement under the Environmental Protection Act 1990, amended by the Waste (Scotland) Regulations 2012 and the Environmental Protection (Duty of Care) (Scotland) Regulations 2014.[4, 6, 8, 9]

Furthermore, the UK Health and Safety Executive (HSE) guidance states that to comply with Control of Substances Hazardous to Health (COSHH) Regulations, employers should consider safe handling of waste containing hazardous substances.[2] Regulation 7 of COSHH states that "where it is not reasonably practicable to prevent exposure to a substance hazardous to health, the employer shall comply with his duty of control […] by applying protection measures appropriate to the activity and consistent with the risk assessment".[7] Such protection measures must include "arrangements for the safe handling, storage and transport of substances hazardous to health, and of waste containing such substances, at the workplace".[7]

Further specific legislation relating to particular aspects of waste management or disposal are presented throughout this review in the appropriate section(s) and listed in **Appendix 4**. Waste management in NHSScotland health and care settings must also comply with "A Policy for NHS Scotland on the Climate Emergency and Sustainable Development – DL(2021)38".[10] This DL "provides a framework for NHSScotland to maximise its contribution to mitigating and limiting the effects of the global climate emergency" and in terms of waste management specifically, outlines targets for each NHSScotland body to reach by 2025.[10]

3.1.2 What are the categories of waste in health and care settings?

Twenty-eight documents were included to answer this research question, eight of which were included in the previous review update.[6, 8, 9, 11-15] 19 pieces of evidence were added as part of this review update,[4, 5, 16-32] two of which were updates to guidance included in the previous update.[4, 5] In total, 14 documents are legislation which have been graded as 'Mandatory',[6, 8, 9, 11, 15, 17-21, 25-27, 33] one of which was specific to health and care settings. Three guidance documents are included that

were graded AGREE: 'Recommend with Modifications' which carried out systematic reviews to identify evidence but lacked some methodological detail, one published for UK settings[12] and two published by the World Health Organization (WHO) so are applicable internationally.[28, 31] The remaining evidence (n=11) was graded as SIGN50 Level 4, expert opinion, three of which are specific to Scotland,[4, 14, 23] four of which are applicable to the UK, noting divergences in national legislation,[5, 22, 30, 32] one to the US,[13] one to Canada,[24] one to New Zealand,[29] and one guidance document was published by the WHO so is applicable internationally.[16] No primary evidence was included to answer this research question.

Guidance, graded as SIGN50 Level 4, expert opinion, consistently states that the term "healthcare waste" captures all waste produced from healthcare activities.[4, 5, 16] International expert opinion guidance, graded as SIGN50 Level 4, from the WHO states that all those working with waste in health and care settings should be aware of the "main categories" defined in local and national regulations.[16] These categories are listed in the WHO publication 'Safe management of wastes from health-care activities, 2nd ed'.[16] Furthermore, guidance by the WHO published in 2023, graded as AGREE: 'Recommend with Modifications', states that healthcare waste categories are "well-established" and "globally recognised", but did not provide a supporting reference nor specify these categories.[31]

"Main categories" of waste are not explicitly listed in the same way in SHTN 03-01 and HTM 07-01, which were published in 2023 and 2022 respectively,[4, 5] although, much of the terminology aligns.[4, 5, 16] The glossary of SHTN 03-01 defines healthcare wastes consistent with WHO guidance, including cytotoxic, cytostatic, infectious, medicinal and sharps waste.[4] Although the term "sharps" can have a different meaning out-with health and care settings, where the term is used in this review, it is in reference to "medical sharps", consistent with the definition in the Health and Safety (Sharp Instruments in Healthcare) Regulations 2013. Namely, "an object or instrument necessary for the exercise of specific healthcare activities, which is able to cut, prick or cause injury".[33] In addition, SHTN 03-01 defines food waste, organic or biodegradable waste, residual waste, and source-segregated recyclates.[4] However, within this guidance, only infectious and medicinal waste are explicitly described as categories, so it is unclear if the remainder of these are considered

categories or hazardous properties of waste.[4] HTM 07-01 provides a diagram of waste streams, demonstrating relationships between different types of waste, for example, the diagram illustrates that waste which is infectious and medicinally contaminated should be considered both clinical and hazardous.[5] However, it is unclear if clinical and hazardous are regarded as categories within this guidance. It may be that more recently published guidance does not explicitly state the main categories of waste as it is considered established practice.

Meanwhile, Standards New Zealand describe a waste stream as a selection of waste from single or multiple categories which is managed together according to the hazards of whichever categories are included within that stream.[29] Under this definition, healthcare waste may fit into one single waste stream, but this does not mean that it would conform to one single category.[29] Consistent with this definition, under the heading "Segregation of specific waste streams" within SHTN 03-01, radioactive waste, liquid waste, sharps waste, Category A infectious waste, amalgam, fixer and developer, large equipment, implanted devices and hygiene waste are described.[4] Therefore, it is unclear if "main categories" are undetermined in recently published UK guidance documents as a result of waste within one stream potentially conforming to the properties of multiple categories, or because of the legislative requirements for categorising waste, outlined in the following section on waste definitions.[4, 5] The role of waste streams in the segregation of waste are described in **section 3.1.3**.

Waste definitions

Special (hazardous) waste

The legislative definition of "hazardous waste" in the Hazardous Waste (England and Wales) Regulations 2005 and The List of Wastes (England) Regulations 2005 in the rest of the UK captures waste with hazardous characteristics, described in the European Waste Framework Directive as including sharps, chemicals, body parts and medicines.[4, 19, 25, 26] However, this definition is not health or care setting specific.[22] In Scotland, consistent with the Special Waste Regulations 1996, amended by Special Waste (Scotland) Regulations 2004, "special waste" is the term used to describe "hazardous waste" as per SHTN 03-01.[4, 15, 21]

Clinical waste

Under the Controlled Waste Regulations 1992, clinical waste is defined as waste consisting of hazardous materials such as blood and body fluids, pharmaceuticals, swabs or dressings and sharps which may be hazardous to those who encounter them if not rendered safe, and waste from healthcare activities with potential to cause infection.[27] This definition is consistent with definitions in other UK guidance that define clinical waste, graded as AGREE: 'Recommend with Modifications',[12] and expert opinion guidance.[4, 5] SHTN 03-01 describes clinical waste as a category of healthcare waste and specifies that the terms should not be used interchangeably.[4] The healthcare waste definition in SHTN 03-01 includes clinical waste, and clinical waste includes infectious waste and medicinal waste, namely, waste that requires special handling and disposal.[4] SHTN 03-01 states that some clinical waste is classed as special waste.[4] Definition and use of the term "clinical waste" varies across international guidance, but use of the term in UK guidance is consistent with the legislative definition.

Infectious clinical waste

In European legislation, "infectious" is the term used to describe "substances and preparations containing viable micro-organisms or their toxins which are known or reliably believed to cause disease in man or other living organisms".[19] This definition is consistent with definitions of infectious waste in other evidence graded SIGN50 Level 4, expert opinion.[4, 16, 29] In SHTN 03-01, it is stated that waste can be clinical and infectious.[4] Guidance by the Health and Safety Executive (HSE) states that in care homes, waste with a suspected or known infection risk is classed as hazardous, but there are no details on how infectivity should be determined.[30] Two UK expert opinion guidance documents, including SHTN 03-01, state that in practice, infectivity of waste should be determined by clinical risk assessment.[4, 5] In Canadian guidance, graded as SIGN50 Level 4, the term "infectious waste" is used interchangeably with "biomedical waste".[24] This definition includes waste produced in healthcare facilities which require "special" handling and disposal due to risk of disease, and contains items contaminated with blood and body fluids which release liquid when compressed.[24] However, what is meant by "special" handling and disposal for biomedical waste is not defined. Meanwhile, guidance by the US Centers for

Disease Control and Prevention (CDC) and Healthcare Infection Control Practices Advisory Committee (HICPAC) use the term “regulated medical waste” to describe a waste category that is determined by legislation, noting that infectivity of waste from healthcare facilities can be difficult to determine in practice.[13] As infectivity of clinical waste is not always known for certain in practice, the term “infectious clinical waste” captures how this type of waste should be managed to prevent and control transmission of infection.

Non-hazardous waste

The WHO define non-hazardous waste as waste that does not have biological, chemical, radioactive or physical hazards.[16] Meanwhile, Standards New Zealand define non-hazardous waste as waste that does not conform to hazardous or controlled waste definitions.[29] SHTN 03-01 does not define non-hazardous waste but provides examples consistent with these definitions including offensive/hygiene waste, residual non-clinical waste, packaging and source-segregated recyclates.[4] Furthermore, in UK expert opinion guidance, graded SIGN50 Level 4, an additional non-hazardous waste category of “offensive” waste, also termed “human hygiene” or “sanpro” waste in SHTN 03-01, is described as a non-infectious waste which has potential to cause offense to someone who encounters it for example, sanitary waste.[4, 5, 14] Offensive or hygiene waste from human healthcare is considered a category within the European Waste Catalogue.[4] Within SHTN 03-01, risk assessment which considers factors such as enteric infection must be applied before disposing of waste in the offensive or hygiene waste stream.[4] As such, offensive or hygiene waste determined as a potential infection risk would be disposed of as infectious clinical waste, and appropriately segregated. Offensive or hygiene waste determined to be non-hazardous is not considered clinical, hazardous or special waste.[4]

Categories of waste in legislation

Waste legislation determines how healthcare waste is categorised in Scottish health and care settings based on its’ characteristics.[4] As per SHTN 03-01, The Waste (Scotland) Regulations 2012 implement the European Union (EU) Waste Framework Directive (2008/98/EC), whereby categories of special (hazardous) waste and

offensive or hygiene waste produced in health and care settings are assigned a code in the European Waste Catalogue, established by European Commission decision 2000/532/EC.[4, 8, 11, 19] Scottish Environment Protection Agency (SEPA) produced Guidance on using the European Waste Catalogue (EWC) to code waste in Scotland.[23] SHTN 03-01 states that European Waste Catalogue codes are required under the following legislation:[4]

- Duty of Care under the Environmental Protection Act 1990[6] and the Environmental Protection Act (Duty of Care) 2014[9]
- Landfill (Scotland) Regulations 2003[20]
- Special Waste Amendment (Scotland) Regulations 2004[21]

Technical Guidance WM3: Waste Classification published by SEPA, the Environment Agency and Natural Resources Wales provides guidance on how healthcare waste should be categorised according to the Waste Framework Directive in the UK.[22] Although not specific to health and care settings, this guidance provides instructions for all waste producers who are required to classify waste based on its' hazardous characteristics.[22] Waste categories are determined by differences between wastes rather than their waste code.[32] Guidance by the WHO states that legislation also determines categories of waste in health and care settings in many countries internationally.[16, 28]

UK transportation legislation determines how hazardous substances are classified. The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009, referred to as "The Carriage Regulations" herein, require classification of hazards into nine United Nations (UN) classifications, implementing the 'Agreement concerning the International Carriage of Dangerous Goods by Road' (ADR).[4, 17, 18] Although not specific to waste nor health and care settings, under The Carriage Regulations, infectious substances, and therefore waste, are classified into two categories.[4, 17] Waste contaminated with an infectious substance posing risk of severe disease would be categorised as Category A, with Category A pathogens listed in the ADR including high consequence infectious diseases such as Ebola virus and cultures of infectious agents.[4, 5, 18] Category B would include all other infectious waste.[4, 5, 18] SHTN 03-01 describes compliance with The Carriage

Regulations in Scotland, and states that infectious waste produced from NHSScotland patient activities will most likely be Category B UN3291 (any Category A infectious waste will be assigned to UN3549).[4]

Summary

In summary, categories of waste and terminology used differed in the included evidence. The WHO describe “main categories” of waste which are not explicitly stated in the same way in UK guidance. Waste within the same waste stream may conform to one or several of these “main categories”. In Scotland, categorisation of waste for health and care settings is described in the EU Waste Framework Directive by which waste is classified by its’ hazardous characteristics. UK transportation legislation also governs how infectious waste that is being transported out-with the health and care setting is categorised.

3.1.3 How and when should waste be segregated in health and care settings?

In total, 16 documents were included to answer this research question, 13 of which were added for this update.[4, 5, 10, 16, 17, 20, 29, 31, 34-38] Three documents were carried over from the previous version of this review,[15, 39, 40] and two documents were updates of guidance included in the previous update.[4, 5] Three UK legislative documents[15, 17, 20] and one European Union council directive[38] were included which were graded as ‘Mandatory’, none of which are specific to health and care settings but are applicable to these settings. One Scottish DL was also included which is directly applicable to Scottish health and care settings.[10] One document published by the WHO was graded AGREE: ‘Recommend with Modifications’ due to systematic methods used to inform recommendations, but not reporting some methodological detail such as search strategies and inclusion or exclusion criteria, and is applicable internationally.[31] The remaining 10 pieces of evidence were graded as SIGN50 Level 4, expert opinion, one of which is specific to Scotland (HFS),[4] five are applicable to the UK, noting divergences in national legislation,[5, 34, 35, 39, 40] one to Canada,[36] one to Australia,[37] one New Zealand standard,[29] and one guidance document published by the WHO so is applicable internationally.[16] No primary evidence was included to answer this research question.

Expert opinion guidance (graded SIGN50 level 4) states that segregation of healthcare waste is key to the safe management of waste[16] and consistently recommends segregation of waste by hazard.[4, 5, 16, 29, 35] However, there is variation across guidance as to how healthcare waste should be segregated according to how that waste will be managed[5, 29, 31] or its disposal route.[4, 16] The WHO guidance recommends a "three-bin" system, at minimum, for the segregation of healthcare waste, segregating non-hazardous and hazardous waste, with further segregation of hazardous waste into sharps and non-sharps.[16] However, other expert opinion guidance, including SHTN 03-01 for Scottish settings and the English HTM 07-01, suggests further segregation of hazardous sharps and non-sharps waste depending on the properties of the waste, such as infectivity, radioactivity and cytotoxic contamination.[4, 5, 29] Where waste has been improperly segregated, expert opinion guidance states that it should not be re-segregated, but rather treated according to the most hazardous waste type in that receptacle.[4, 16]

SHTN 03-01 states that in Scotland, segregation of special (hazardous) waste throughout the waste management process is required under The Special Waste Regulations 1996 (as amended), which does not allow mixing of hazardous and non-hazardous wastes.[4, 15] Furthermore, infectious waste is required to be segregated according to known or suspected infectious substance under transportation legislation,[17] and infectious waste should not be landfilled under The Landfill (Scotland) Regulations 2003, which implement the EU Council Directive (1999/31/EC).[4, 20, 38] Details on how waste should be segregated in NHSScotland for compliance with Scottish legislation are described in **SHTN 03-01**, including legislative requirements requiring the segregation of recyclates and food waste.[4] Furthermore, DL(2021)38 requires NHSScotland bodies to set targets regarding reduced volume of healthcare waste by implementing measures such as improving waste segregation, increasing the use of reusable items and recycling of recyclable materials.[10] Legislative requirements for segregation of waste elsewhere in the UK are described in **HTM 07-01**.

Six expert opinion guidance documents, graded as SIGN50 Level 4, and one guidance document by the WHO, graded as AGREE: 'Recommend with Modifications', were included that emphasise the importance of segregating waste at

source in health and care settings.[4, 16, 29, 31, 34, 36, 37] Two of these guidance documents included were specific to Ebola virus disease (EVD),[36] and EVD and Marburg virus disease (MVD),[31] and one was specific to the segregation of sharps waste.[36] Three expert opinion guidance documents emphasise maintaining segregation of waste throughout the waste management process, including handling, storage and transport.[4, 29, 40] Three of these guidance documents also highlight the importance of providing appropriate signage, as well as the importance of providing education and training to staff to support segregation of waste.[4, 5, 16]

In expert opinion guidance, graded as SIGN50 Level 4, colour coding of waste streams in health and care settings is consistently recommended[4, 5, 16, 34, 35, 39] to facilitate correct segregation.[4, 5] However, the evidence base supporting this recommendation was unclear. In Scotland, SHTN 03-01 describes a colour coding segregation system consisting of eight colours to categorise five waste streams of healthcare waste.[4] This colour coding system is described as mandatory in Scotland to comply with health and safety, transportation and waste legislation which require waste to be handled and disposed of safely.[4] Colour coding described in HTM 07-01 which applies to England and Wales is similar, although there are some minor differences compared with colour categorisation required by SHTN 03-01.[4, 5] Elements of this colour coding system for infectious, sharps, offensive/hygiene and general waste are advocated in the guidance for prevention and control of infection in care homes published by the Department of Health and the Health Protection Agency (HPA), and in adult social care guidance published more recently by the same organisation.[35, 40] The WHO describe a colour coded segregation system which can be used where national legislation is not available.[16]

In summary, there is consistency in the included guidance that special (hazardous) sharps and non-sharps waste should be segregated at source. In Scotland, segregation of special (hazardous) waste and infectious substances is a requirement under waste and transportation legislation. Moreover, colour coded segregation of waste is consistently recommended in expert opinion guidance which, although not required by law, supports compliance with legislative requirements and is mandatory in health and care settings in Scotland.

3.1.4 Are there specific standards for different waste receptacles in health and care settings?

In total, 32 pieces of evidence were included to answer this research question. 25 pieces of evidence were added for this review update,[4, 5, 7, 16, 24, 28, 29, 35, 37, 40-55] two of which were updates to guidance included in the previous review iteration.[4, 5] Seven pieces of evidence were included in the previous review update.[13, 33, 39, 40, 56-58] 23 documents are graded as SIGN50 Level 4, expert opinion,[4, 5, 13, 16, 24, 29, 35, 37, 39, 40, 43-45, 47-55, 57] one graded as AGREE: 'Recommend with Modifications' which used systematic reviews to identify methods but lacked some methodological detail,[28] and one graded as AGREE: 'Recommend' due to rigorous systematic methods and detailed methodology.[58] Of those documents included, 15 guidance documents are applicable to UK settings,[4, 5, 35, 39, 40, 43-45, 50-53, 55, 57, 58] including four British Standards,[43-45, 57] and two guidance documents are specific to Scotland (HFS).[4, 52] The remainder include one New Zealand Standard,[29] four guidance documents applicable to the US,[13, 47, 48, 54] one to Canada,[24] two published by the WHO so are applicable internationally,[16, 28] and one published by the European Centres for Disease Prevention and Control (ECDC) so is applicable to the EU/European Economic Area (EAA).[49] One primary study is included that was graded as SIGN50 Level 3 which was conducted in Germany.[46] Six legislative documents are included which are graded as 'Mandatory', five of which are UK legislation,[7, 33, 41, 42, 56] with the remaining piece of legislation applicable to "competent authorities" under the ADR, including the UK.[18]

The term "waste receptacle" is used interchangeably throughout the identified literature when referring to bags, bins or containers used to contain waste produced in health and care settings.[16] In NHSScotland, colour-coded receptacles compliant with best practice can be obtained from NHS National Services Scotland National Procurement.[4] Although SHTN 03-01 states that suitability of receptacles for waste produced from NHSScotland health and care services should be evaluated at Board level with consideration of local circumstances, specific standards to which these receptacles should comply are not provided.[4]

There is consistency in the included guidance that receptacles in health and care settings should have a hands-free and/or foot pedal operated lid.[16, 24, 28, 35, 53, 55]

However, it is not clear if this recommendation extends to all receptacles for all waste streams in health and care settings, as only two of these pieces of evidence specify setting. WHO guidance graded as AGREE: 'Recommend with Modifications' specifies isolation rooms for those with epidemic- or pandemic-prone acute respiratory illness, but waste stream is not specified.[28] Moreover, expert opinion guidance by NHS England NHS Estates specifies pedal operated bins for facilities for surgical procedures in acute hospitals.[53] Therefore, it is not clear if this recommendation extends to all receptacles for all waste types in health and care settings. An environmental air sampling study set in surgical, internal medicine (diabetic) and intensive care unit (ICU) wards investigated contamination at the openings of waste containers for non-infectious waste including dressings, casts, linen, disposable clothing and nappies from non-infectious patients.[46] Significantly higher fungal contamination at the openings of unlidded non-infectious waste containers and in air samples taken approximately one metre away were reported, when compared with manual lidded and hands-free lidded containers.[46] Fungal counts remained low when compared with bacterial counts, but there were no significant differences between bacterial count in air samples by lid design.[46] This finding suggests that, in these specific settings, fungal air contamination can occur when waste containers are unlidded, even with non-infectious healthcare waste, and bacterial air contamination may occur with non-infectious waste containers of any lid design.

To support colour-coded segregation, expert opinion guidance recommends that receptacles are colour-coded.[5, 16, 29] However, HTM 07-01 guidance stipulates that the colour of the body of a waste bin does not matter so long as the bag, lid and/or label are appropriately colour coded.[5] Whereas the WHO advise against mixing colours of waste containers and bags from the same stream to avoid improper segregation.[16]

Additional characteristics for waste receptacles or bins lined with plastic waste bags were outlined in six expert opinion documents, graded as SIGN50 Level 4. This included that they are sized according to quantity of waste produced in that area,[5, 16, 55] easy to clean[29, 55] (for example having no labels on container lids),[55] and leakproof[16] or leak resistant.[29] Similarly, CDC guidance states that receptacles to

contain waste bags for EVD and MVD waste should be leakproof and rigid.[47, 48] Specifications for receptacles for non-infectious special (hazardous) waste receptacles are outlined in **SHTN 03-01**.[4]

Specific standards for waste bins and containers used in health and care settings did not tend to be signposted in the expert opinion guidance included. However, WHO guidance recommends that plastic waste bags comply with ISO 7765 2004, which has been published in two parts as British Standards.[16, 43, 45] Furthermore, there was consistency among expert opinion guidance that waste bags for health and care settings should be made of plastic,[5, 16, 29, 35, 40] and strong.[13, 16, 29] Expert opinion guidance specifies that waste bags for infectious and pathological waste should also be leakproof[16, 24] or leak resistant.[13] In addition, guidance for high consequence infectious disease (HCID) waste states that plastic waste bags should be large (175 litre capacity), labelled,[48, 49] thick (minimum film thickness of 1.5 mils, corresponding to 0.0015 inch)[48] and “mechanically resistant”.[49]

SHTN 03-01 states that some clinical and other special (hazardous) waste receptacles should comply with UN-type approved packaging requirements, under the ADR.[4, 5, 18] Examples of these for Category A or B infectious waste are provided within HTM 07-01, signposting to packaging instructions within the ADR.[5, 18] Small quantities of medicinal wastes do not require this UN-type approved packaging but infectious clinical waste does.[4] Limited quantities under the ADR are described further in **SHTN 03-01**. SHTN 03-01 states that receptacles should meet the fire safety requirements described in the **Scottish Health Technical Memorandum 83**.[4, 52]

In summary, specific standards for waste receptacles were not indicated in the included evidence, except for plastic waste bags in one expert opinion guidance document by the WHO.[16, 43, 45] At the time of writing, these discussed standards were the most recent versions available. It should be noted, however, that these are subject to amendment and that the standards discussed here may not represent all standards which apply to waste receptacles used in health and care settings. Guidance does describe characteristics to which waste bags, containers and receptacles should adhere, but the evidence base supporting these

recommendations is unclear. Furthermore, in the UK, special (hazardous) waste receptacles may be required to comply with transportation legislation requirements.

Sharps containers

There is consistency in NICE guidance (graded as AGREE: 'Recommend') and expert opinion guidance (graded as SIGN50 Level 4) that sharps containers should comply with British Standards – BS EN ISO 23907-1 for single-use containers, which are "to be filled only once" and BS EN ISO 23907-2 for reusable sharps containers.[37, 39, 44, 50, 57, 58] Compliance with these standards ensures that containers used in health and care settings are puncture- and leak-resistant.[44, 57] This requirement is also consistent with expert opinion guidance from the UK, US, Canada and the WHO.[13, 16, 24, 51, 54] Safe systems of work beyond disposal to prevent sharps injuries are described in the NIPCM literature review on **Management of Occupational Exposure to Blood Borne Viruses**.

Guidance published by NICE (graded as AGREE: 'Recommend') lists UK legislation that requires provision of suitable containers for sharps disposal.[58] This list of legislative requirements was correct as of 2012 and was published before implementation of the Health and Safety (Sharps Instruments in Healthcare) Regulations 2013,[33] which is signposted by SIGN50 level 4 expert opinion guidance from the Royal College of Nursing (RCN) which was published in 2023.[50] These guidance documents consistently state that suitable containers should be provided for compliance with the Health and Safety at Work Act 1974, Management of Health and Safety at Work Regulations 1999, The Personal Protective Equipment at Work Regulations (1992) (as amended) and Control of Substances Hazardous to Health Regulations 2002.[7, 41, 42, 56] The Health and Safety (Sharp Instruments in Healthcare) Regulations 2013 specifies that employers "must ensure that […] in relation to the safe disposal of medical sharps that are not designed for re-use – (i) written instructions for employees, and (ii) clearly marked and secure containers, are located close to areas where medical sharps are used at work".[33]

In summary, guidance consistently recommends that sharps containers comply with British Standards.[37, 39, 44, 50, 57, 58] Provision of suitable containers to support safe disposal of sharps in health and care settings is a requirement under several

legislations in Scotland.[7, 41, 42, 56] At the time of writing, the standards discussed in this research question were the most recent versions available. It should be noted, however, that these are subject to amendment and that the standards discussed may not represent all standards which apply to waste receptacles and sharps containers.

3.1.5 Where should waste receptacles be placed in health and care settings?

In total, 21 pieces of evidence were included to answer this research question. This question was added to this review as part of the current update. 17 guidance documents were graded as SIGN50 Level 4, expert opinion,[4, 13, 16, 24, 35-37, 39, 48-50, 52, 55, 59-62] one guidance document was graded AGREE: 'Recommend' because of rigorous systematic reviews and detailed methodology,[58] and two guidance documents were graded as AGREE: 'Recommend with Modifications' because of systematic reviews used to identify evidence supporting recommendations but some methodological detail was lacking.[28, 31] One piece of UK legislation was graded 'Mandatory'.[33] Of the guidance included, 10 are applicable to the UK,[35, 39, 50, 55, 58-60] including three specific to Scotland (HFS),[4, 52, 61] two to the US,[13, 48] two to Canada,[24, 36] one to Australia,[37] one was published by the ECDC so is applicable to the EU/EAA,[49] and four were published by the WHO so are applicable internationally.[16, 28, 31, 62] No primary evidence was included that addressed placement of waste receptacles in health and care settings.

There was consistency in SHTN 03-01 and expert opinion guidance in stating that waste receptacles should be placed as close to the point of waste production as possible.[4, 16, 24, 55, 61] Two guidance documents cite the reason for this as to reduce handling or transportation of waste.[16, 55] More specifically, the WHO guidance for infection prevention and control in primary care states that waste bins which support proper waste segregation should be placed within five metres of the point of waste production.[62] While the WHO advise that infectious waste containers should not be placed in publicly accessible areas,[16] HFS advise that healthcare waste receptacles are not accessible to the public,[61] although there is no detail provided as to how to achieve this in practice. SHTN 03-01 which was published more recently, in 2023, only specifies that waste storage areas are not publicly accessible.[4] In Scotland,

placement of “loaded” receptacles should comply with the **Scottish Health Technical Memorandum 83 NHSScotland ‘Firecode’**.[52] “Loaded” receptacles in this context may mean full or used, but this is not defined.[52]

To support correct waste segregation, the WHO recommend the following:[16]

- placing hazardous and non-hazardous waste containers close together at point of production
- placing similar sized receptacles next to each other so that staff do not show preference for the larger receptacle when segregating waste items
- infectious waste receptacles are not publicly accessible to avoid improper segregation and to prevent exposure to infectious waste
- attaching infectious waste containers to mobile trolleys so that they can be used for waste produced during bedside interventions and be kept away from patients

Expert opinion guidance consistently state that containers or bins for HCID waste should be placed in patient rooms,[31, 36, 48, 49] concurrently with WHO guidance on epidemic- and pandemic-prone acute respiratory infections.[28]

There is consistency in extant guidance stating that sharps containers should be available at the point of sharps waste production,[13, 16, 24, 28, 35, 37, 39, 50] including two guidance documents published by the RCN.[39, 50] Three guidance documents state that sharps containers should be positioned in a safe place, not accessible to the public and out of reach of children.[37, 39, 58] Alternative recommendations from expert opinion guidance include that sharps containers are placed at eye level, within arm’s reach,[39, 50] above knee height and below shoulder height,[60] not placed on the floor, on windowsills or above shoulder height.[60] The WHO suggest that sharps containers are placed on mobile trolleys.[16]

Placement of sharps containers in Scottish health and care settings are subject to legislative requirement. HSE guidance states that, to comply with the Health and Safety (Sharps Instruments in Healthcare) Regulations 2013, clearly labelled and secure sharps containers should be placed close to where sharps are being used.[33, 59] HSE advise that where this is not possible, a risk assessment should determine

use of portable sharps containers.[59] Legislation and accompanying guidance for waste receptacles in general is less specific, see **section 3.1.1**.

In summary, there was consistency in the included guidance that waste receptacles and sharps containers should be placed close to the point of waste production in health and care settings. There was a lack of consensus regarding which waste receptacles should be publicly accessible. However, HCID guidance consistently states that receptacles for HCID-contaminated waste should be placed in patient rooms. Employers are legally required to consider safe waste handling for waste containing hazardous substances. Sharps bins are required by legislation in Scotland to be placed close to the healthcare worker, but there is variation in expert opinion guidance regarding specific placement (for example, height) in relation to the healthcare worker.

3.1.6 How should different waste receptacles be filled and sealed in health and care settings?

In total, 16 documents were included to answer this research question, two of which were included in the previous version(s) of this review,[39, 40] and 14 were added for this update,[4, 5, 16, 18, 29, 34-37, 48, 50, 54, 63, 64] two of which were updates to guidance included in the previous update.[4, 5] 15 documents were graded as SIGN50 Level 4, expert opinion.[4, 5, 16, 29, 34-37, 39, 40, 48, 50, 54, 63, 64] Nine documents are applicable in the UK, [4, 5, 34, 35, 39, 40, 50, 63, 64] one of which is specific to Scotland (HFS),[4] two in the US,[48, 54] one in Canada,[36] one in Australia,[37] and one in New Zealand.[29] One document was published by the WHO so is applicable internationally.[16] One legislative document, which is applicable to “competent authorities” under the ADR including the UK was graded as ‘Mandatory’.[18] No primary evidence was identified that addressed how waste bags and receptacles should be filled or sealed.

Eight expert opinion guidance documents address maximum waste bag capacity before being sealed.[4, 5, 16, 29, 35, 36, 40, 48] The maximum volume described within the included guidance differed, with some stating it should be no more than two-thirds full[5, 29, 36, 48] and others (including SHTN 03-01, Scottish best practice guidance) stating no more than three-quarters full.[4, 16, 35, 40] Two of the guidance documents that specify a maximum volume of two-thirds focused on EVD or EVD and MVD

waste.[36, 48] No evidence base was provided to support these recommendations in this expert opinion guidance.

Six expert opinion guidance documents provide detail on filling sharps containers but they differ in the amount of detail provided.[34, 35, 37, 39, 50, 54] Guidance that specifies a maximum volume differed, with some stating a maximum capacity of two-thirds[39, 48] and one stating three-quarters.[54] One of these guidance documents is specific to EVD and MVD sharps waste.[48] Four guidance documents state that sharps containers should be sealed when filled to the fill line.[34, 35, 37, 39] Whereas, guidance by the RCN differentiates between sealing single-use sharps containers when three-quarters full, and for reusable sharps containers, sealing when the overfill protection mechanism is activated.[50]

Guidance on waste management in health and care settings consistently refers to the 'sealing' of waste bags, but what is meant by this term is unclear. Three expert opinion guidance documents describe knotting waste bags to close them.[5, 40, 48] English guidance describes a swan neck knot, whereby the top part of the waste bag is twisted several times and then folded over on itself.[5, 40] The Department of Health and HPA care home guidance also describes this technique for clinical care home waste,[40] whereas HTM 07-01 describes this technique for primary care and does not specify waste type.[5] A preferred knot type was not specified in SHTN 03-01.[4] The evidence base for these recommendations was not clear. The CDC EVD and MVD waste guidance describes a goose neck knot.[48] It is not clear if these knots are the same, as the methodology for tying a goose neck knot is not provided,[48] but it is understood that these knots are the same with differing terminology. Department of Health and HPA guidance states that an overhand knot should not be used but this method is not described.[40] Four expert opinion guidance documents state that plastic ties should be used, including SHTN 03-01.[4, 5, 16, 40] However, the method of sealing using plastic ties was not described, and only two of these documents mention the use of plastic ties in addition to a swan neck knot.[5, 40] Therefore, it is not clear from the literature if plastic ties should be used alone as a method of sealing waste bags, or if ties are recommended in addition to a knot. The CDC states that a waste bag containing EVD and/or MVD contaminated waste should be sealed using a method where the waste bag will not be punctured or torn and will remain leakproof.[48] Two

guidance documents state that staples should not be used to seal waste bags.[16, 29] The WHO recommend that replacement waste bags or containers are available for replacing sealed receptacles.[16] Only one expert opinion guidance document addressed how sharps containers should be sealed – the US Food and Drug Administration (FDA) state that sharps containers should be closed according to manufacturer's instructions.[54] The Health Building Note (HBN) produced for adult acute mental health units by the UK Government Department of Health states that fixtures and fittings should be anti-ligature in addition to adhering to requirements for infection control.[63] Guidance by the Care Quality Commission advises that individual risk assessment should be undertaken considering items often readily available in hospital wards which are associated with ligature risk.[64]

Two expert opinion UK guidance documents, graded as SIGN50 Level 4, including SHTN 03-01, signpost to packaging requirements for healthcare waste being transported off-site. These are contained within the ADR.[4, 5, 18]

In summary, there was consistency in the evidence base that waste receptacles should not be filled beyond either two-thirds or three-quarters capacity. Guidance on filling sharps containers was dependent on the type of container or its design features. There was a lack of consistency in recommendations made in extant guidance regarding how waste receptacles should be sealed, with unclear evidence underlying recommendations. Waste that is being transported out-with the health or care setting should be packaged in accordance with transportation legislation.

3.1.7 How should special (hazardous) waste (including sharps, blood and body fluids) be handled in health and care settings?

In total, 28 pieces of evidence were included to answer this research question, 10 of which were included in the previous update,[7, 12, 13, 33, 39, 56, 58] with 22 added for this update,[2, 4, 5, 16, 20, 28, 29, 35, 36, 38, 48, 49, 54, 59, 60, 65-69] two of which were updates to guidance included in the previous review update.[4, 5] No primary evidence was identified that addressed how special (hazardous) waste should be handled in health and care settings. The evidence that was included addresses waste with potential infection risk and is discussed in four sections: infectious waste, liquid waste, sharps,

and personal protective equipment (PPE). Labelling, transporting and storing these categories of waste are described in sections 3.1.9, 3.1.10 and 3.1.11 respectively. Guidance on handling other special (hazardous) waste in Scottish health and care settings such as radioactive, chemical and pharmaceutical waste is provided in **SHTN 03-01**.[4] Special (hazardous) waste handling requirements under waste and health and safety legislation are described in section 3.1.1. Additional relevant legislation is listed in **Appendix 4** and signposted throughout this research question.

Infectious clinical waste

Ten pieces of evidence were included to address infectious clinical waste handling in health and care settings. One piece of evidence was included in the previous iteration[13] and nine pieces of evidence were added as part of this update,[4, 5, 16, 20, 29, 36, 48, 49, 65] two of which were updates of guidance included in the previous update.[4, 5] In total, nine documents were graded as SIGN50 Level 4 expert opinion documents, including nine pieces of guidance[4, 5, 13, 16, 36, 48, 49, 65] and one standard.[29] Of these, one is specific to Scotland (HFS),[4] and one applicable to the UK,[5] four to the US,[13, 48, 54, 65] one to Canada,[36] one to New Zealand[29] and one was published by the WHO so is applicable internationally.[16] The one legislative document, graded as 'Mandatory', is applicable in Scotland.[20] No primary evidence was included that addressed handling infectious waste.

Determining infectivity of waste in practice is addressed in section **3.1.2**. Further, guidance by the WHO states that it should always be assumed that infectious clinical waste is contaminated with a variety of infectious agents, given difficulty determining actual infectivity in practice.[16] There was consistency in three guidance documents that infectious waste bags should not be compressed in case they split or burst.[5, 29, 36] Whereas Standards New Zealand differentiates between not compacting hazardous waste in case of release of harmful liquids or aerosols, but that controlled waste, such as sanitary waste and used PPE, may be compacted so long as expelled liquid is disposed of as hazardous liquid.[29] Although it is not clear how this would be carried out in practice. There was consistency in three expert opinion guidance documents that waste containers should not be re-opened after being sealed,[5, 36, 48] two of which are specific to waste from patients with EVD or MVD[36, 48] and one referring to clinical waste.[5]

Guidance on handling containers of waste produced from patients with HCIDs states that the number of personnel handling the waste should be limited.[36, 48] Government of Canada guidance states that EVD waste should be handled in the affected patient surroundings and in the room where PPE is doffed.[36] Guidance by the ECDC states that hand hygiene should be performed after handling HCID waste.[49] Further detail on hand hygiene indications is provided in the NIPCM literature review **Indications and Techniques for Hand Hygiene**. Guidance on environmental infection control in healthcare facilities by the CDC and HICPAC states that waste from viral haemorrhagic fever patients should be disposed of with minimal "agitation".[13] This guidance also advises that additional precautions may be required to minimise aerosol production when handling waste from patients with rare diseases,[13] but does not provide examples. There is lack of consistency in expert opinion guidance on disinfecting the outside of plastic waste bags. This method was recommended for waste bags containing EVD or MVD waste by three expert opinion guidance documents.[36, 48, 65] Whereas this technique was not recommended by any of the UK guidance included.

SHTN 03-01 recommends that infectious waste segregated into the orange, red or yellow waste stream be consigned to a facility for treatment and disposal, as infectious waste should not be disposed directly in landfill under the Landfill (Scotland) Regulations (2003)[4, 20] Some Category A infectious waste may be incinerated on-site, after which point it should still be handled as clinical waste.[4] Expert opinion documents, including SHTN 03-01, suggest that immunisation should be offered to staff handling healthcare waste.[4, 16, 29] Occupational health protection for health and care workers is addressed in the NIPCM literature review **Management of Occupational Exposure to Blood Borne Viruses**.

Hazardous infectious and medicinal healthcare waste is treated so that it is "rendered safe".[4] Definitions of waste that has been "rendered safe" differ depending on the waste category. For infectious waste, the number of infectious organisms is reduced; for anatomical waste it is no longer recognisable; sharps are made unrecognisable and unusable; and chemical "components" of medicinal waste are destroyed.[4, 5] Once hazardous waste is "rendered safe", it can be handled without

additional precautions.[4, 5] However, SHTN 03-01 states that after treatment, Category A infectious waste should be treated as Category B clinical waste.[4]

In summary, the guidance included consistently advises against compressing and re-opening infectious clinical waste bags. However, there was a lack of consistency regarding managing HCID waste, including whether the outside of waste bags should be disinfected. Once hazardous waste has been treated, it is "rendered safe", and is handled either without additional precautions or as Category B clinical waste thereafter. Legislation governs the disposal of infectious waste in Scotland, which should be consigned to a treatment facility.

Liquid waste

Ten documents were included which provide recommendations regarding the disposal of hazardous liquids, nine of which were added as part of this review update,[4, 5, 16, 20, 28, 36, 38, 48, 49] two of which were updates to guidance included in the previous update to this review.[4, 5] One guidance document was included in the previous update of this review.[13] Seven documents were graded as SIGN50 Level 4, expert opinion,[4, 5, 13, 16, 36, 48, 49] one was graded as AGREE: 'Recommend with Modifications' as systematic reviews were used to identify evidence but some methodological detail was lacking,[28] and two legislations were graded as 'Mandatory', one of which for Scotland[20] and the other for EU member countries.[38] Two guidance documents are applicable in the UK,[4, 5] one of which is specific to Scotland (HFS).[4] Two pieces of evidence are applicable to the US,[13, 48] one to Canada,[36] one was published by the ECDC so is applicable to the EU/EAA,[49] and two were published by the WHO so are applicable internationally.[16, 28] No primary evidence was included that addressed handling liquid waste.

Seven guidance documents advise that liquid waste can be disposed of into the toilet,[5, 13, 16, 28, 36, 48, 49] three of which referred to waste produced from patients with a HCID,[49] specifically EVD or MVD,[36, 48] and one referred to waste from patients with epidemic- or pandemic-prone respiratory illness.[28] Additional recommendations made in guidance include that liquid waste is disposed of into the toilet within the patients' room, poured at a low level to avoid splash,[48] the toilet lid is closed to flush, and the toilet is cleaned afterwards.[36, 48] The ECDC state that if the HCID pathogen

did not allow disposal into the sanitary sewer, then the liquid waste could be collected with tissues or nappies and disposed of with other waste.[49] Otherwise, liquid waste not disposed of into the toilet should be solidified.[36, 48] However, many toilets in Scottish health and care settings do not have lids and so the safe disposal of HCID liquid waste into toilets would not be feasible.

Legislation in Scotland governs how liquid waste should be handled in health and care settings. Under the Landfill (Scotland) Regulations (2003), implementing the EU Landfill Directive (1999/31/EC), liquid waste cannot be disposed of in landfill.[20, 38] SHTN 03-01 advises the following regarding liquid waste disposal in Scottish health and care settings. [4]

- A rigid leak-resistant receptacle should be used for disposal of liquid waste and solidified liquid waste.
- Infectious liquid waste like blood should be solidified prior to disposal in an orange stream rigid, leak-resistant bin. Solidifying infectious liquid waste may be required by waste treatment facilities. However, it is acknowledged that it is not always possible to solidify all infectious patient bodily fluids, such as vomit and urine which may be disposed of within the clinical setting. Risk assessment should be undertaken to determine disposal technique.
- Orange stream waste bags are not suitable for liquid waste disposal.
- Disposal of waste which may pose greater risk than domestic sewage requires advice from the sewage undertaker (Scottish Water), and list discharge issues associated with bodily fluids as well as photochemicals, cardboard bedpans, urine bottles and medicinal waste. Bodily fluids may be disposed of in the foul sewer in line with any discharge consent restrictions and local infection control policy.

In summary, the included guidance recommends disposal of infectious liquid waste into the toilet. However, Scottish guidance advises that infectious liquid waste should be solidified and then disposed as clinical waste via the orange waste stream, unless determined otherwise following risk assessment. Disposal of liquid waste in the foul sewer requires advice from the sewage undertaker if it poses greater risk than

domestic sewage and is dependent on discharge consent restrictions and local infection control policy.

Sharps waste

Seventeen pieces of evidence were included that address safe handling of sharps waste in health and care settings. Four pieces of evidence were included in the previous update,[12, 13, 39, 58] and 13 were added as part of the current update,[4, 5, 7, 16, 33, 35, 36, 51, 54, 56, 59, 60, 69] two of which were updates to guidance included in the previous update.[4, 5] 13 guidance documents were included, one of which was graded as AGREE: 'Recommend with Modifications' as systematic reviews were used to identify evidence but some methodological detail was lacking,[12] and another graded as AGREE: 'Recommend' because of rigorous systematic reviews and detailed methodology.[58] The remaining 11 guidance documents were graded SIGN50 Level 4, expert opinion.[4, 5, 13, 16, 35, 36, 39, 51, 54, 59, 60] Of the included guidance, nine are applicable to the UK,[4, 5, 12, 35, 39, 51, 58-60] including one specific to Scotland (HFS),[4] one to the US,[13] and one was published by the WHO so is applicable internationally.[16] The remaining documents were graded 'Mandatory', including three UK legislations,[7, 33, 56] and one for countries in the EU.[69]

The WHO states that sharps pose the greatest risk of infection for those who handle healthcare waste, as they can cause injury as well as pose infection risk.[16] Sharps are required to be disposed of safely under the UK Health and Safety (Sharp Instruments in Healthcare) Regulations (2013), which implements the European Directive 2010/32/EU.[33, 59, 69] According to NICE guidance, this legislation bans re-sheathing of sharps.[58] Consistent with this legislation, six guidance documents on sharps disposal consistently state that sharps should not be re-capped, bent or disassembled for disposal, two of which were graded as AGREE: 'Recommend'[58] and AGREE: 'Recommend with Modifications'[12] respectively and four as SIGN50 Level 4, expert opinion.[13, 16, 35, 39] HSE specifies that sharps should not be compressed when disposed of into sharps containers.[60] However, in some cases recapping or disassembling sharps is required, in which case safety devices should be used.[58] Infection prevention and control guidance by the RCN advises that in the UK, Health and Safety at Work Act 1974 and COSHH 2002 also apply to safe sharps disposal.[7, 39, 56] Additional SIGN50 Level 4 expert opinion guidance on sharps

disposal states that sharps should not be placed in waste bags,[35, 51] only sharps should be disposed of in sharps containers,[4, 58] and that sharps containers should be carried by the handle and not be supported underneath with the other hand.[16] However, this guidance does not specify if this always applies, or only when the sharps container is sealed and ready for disposal. The US FDA guidance states that sharps containers should not be re-opened once sealed.[54] Furthermore, guidance graded AGREE: 'Recommend' and AGREE: 'Recommend with Modifications' states that sharps containers should be temporarily closed while not in use.[12, 58] Expert opinion guidance recommends that sharps waste from patients with EVD should be placed in a second leakproof and puncture-resistant container[36] or a biohazard bag.[48]

Categorisation of sharps is addressed in **section 3.1.2**. SHTN 03-01 advises that sharps must be placed in a designated sharps box to be consigned for treatment and disposal.[4] In Scottish settings, an orange lidded sharps box is for infectious sharps waste,[4] with colour coding for sharps containers in other waste streams addressed in **SHTN 03-01**. Under English legislation, sharps are considered hazardous once they have been used.[5] SHTN 03-01 does not go into detail on determining when sharps are considered infectious but provides the European Waste Catalogue code to which infectious sharps should be assigned which differs from that for non-infectious sharps waste.[4] Safe systems of work beyond disposal to prevent sharps injuries are described in the NIPCM literature review on **Management of Occupational Exposure to Blood Borne Viruses**.

In summary, specific legislation governs how sharps are disposed of in Scottish health and care settings. The legislative requirement that sharps are not re-capped is reflected in extant guidance. Guidance provides additional recommendations to support safe sharps disposal. In Scotland, sharps disposal is determined by legislation and regulatory requirements described in SHTN 03-01.

Personal protective equipment (PPE)

Twelve SIGN50 Level 4 expert opinion guidance documents were included that address PPE required for handling special (hazardous) waste,[2, 4, 5, 7, 16, 29, 36, 48, 49, 66-68] one of which was included in the previous review update.[7] Two of these were

updates to guidance included in the previous update.[4, 5] Three guidance documents are applicable to the UK,[2, 4, 5] including one specific to Scotland (HFS),[4] two to the US,[48, 68] one to Canada,[36] three were published by the ECDC so are applicable to the EU/EAA,[49, 66, 67] one was published by the WHO so is applicable internationally,[16] and one was a New Zealand standard.[29] One UK legislative document was included which is not specific to health and care and is graded as 'Mandatory'.[7]

SHTN 03-01 signposts to the COSHH Regulations, requiring staff who handle waste in health and care settings to be provided with PPE.[4, 7] Although this regulation is not specific to health and care settings, or to handling infectious or special (hazardous) waste, it covers employee exposure to biological agents including measures to support safe handling of waste containing hazardous substances.[2] SHTN 03-01 recommends that the PPE required should be determined by risk assessment,[4] consistent with two other expert opinion guidance documents recommending level of PPE dependent on level of anticipated risk when handling waste.[16, 29]

Detail on recommendations regarding the PPE required for handling special (hazardous) waste varied throughout the evidence. Four expert opinion guidance documents recommend that PPE worn when handling waste in health and care settings should be "appropriate".[5, 36, 48, 67] Clarity on what is considered appropriate was not provided. One of these guidance documents is specific to waste produced by patients with a respiratory virus infection[67] and two were specific to waste produced from patients with suspected or confirmed EVD.[36, 48] Alternatively, two expert opinion guidance documents give examples of PPE that could be provided or worn when handling special (hazardous) waste, but specific recommendations are not made.[4, 16] The WHO guidance specifically recommends gloves for minimum protection against body fluids.[16]

Three expert opinion guidance documents make specific recommendations on PPE ensembles that should be worn by those handling infectious waste.[49, 66, 68] For handling waste from patients with suspected or confirmed COVID-19, guidance published by the ECDC in 2021 states that a face mask, eye protection (visor, goggles, or face shield), gloves and a gown should be worn.[66] There was a lack of consistency in the included guidance for handling waste contaminated with HCIDs. US Occupational Safety and Health Administration (OSHA) guidance recommends

"dedicated clothes" such as uniform, scrubs and shoes, heavy-duty and puncture-resistant nitrile gloves and eye and face protection (shield and goggles) to prevent occupational exposure when handling EVD packaged waste.[68] Where the risk of exposure is considered high, additional PPE is recommended which includes a face mask and fluid resistant gown, coveralls, and boot covers.[68] Additionally, if the waste is to be handled directly or the container lid is to be opened, PPE should be impermeable, and an N95 respirator should be worn instead of a mask, or an elastomeric or powered air purifying respirator if exposure risk is high.[68] ECDC guidance on HCID-contaminated waste was less clear. Inner gloves beneath heavy-duty outer gloves and long sleeves were recommended, but it was also stated that an impermeable apron and rubber boots could be "useful".[49] However, it is clearly stated in this ECDC guidance that PPE should not be adjusted during waste management.[49] Specific standards to which these items of PPE should comply are not described in the extant guidance.

In summary, there is a lack of consistency regarding items of PPE required and the evidence base supporting these recommendations is unclear. There is a legislative requirement which applies in Scotland that those working with hazardous substances be provided with appropriate PPE relative to risk. Expert opinion guidance was vague on the specific PPE required for handling waste, however, some expert opinion guidance on COVID-19 and HCIDs provides specific ensembles that could be worn.

3.1.8 How should non-hazardous waste be handled in health and care settings?

This research question is a new question added as part of the current review update. Six documents were included. One legislative document is applicable in Scotland and is graded 'Mandatory'.[20] The remaining five documents were graded as SIGN50 Level 4 expert opinion, including three guidance documents published in the UK,[3-5] two of which are specific to Scotland,[3, 20] one New Zealand standard,[29] and one guidance document was published by the WHO so is applicable internationally.[16] No primary evidence was included to answer this research question.

The WHO states that most healthcare waste is non-hazardous.[16] Although offensive or hygiene waste is considered non-hazardous, expert opinion guidance describes specific measures for handling this waste category. HTM 07-01 states that offensive or hygiene waste is categorised as non-hazardous waste unless from an infectious patient.[5] Standards New Zealand advise that non-hazardous waste can be compacted to reduce volume,[29] while SHTN 03-01 states that offensive or hygiene waste should not be compacted unless permitted by a facility's waste management licence or permit.[4] Extant guidance is not clear regarding minimum PPE requirements for handling non-hazardous waste such as offensive or hygiene waste. HTM 07-01 states that, after handling offensive or hygiene waste, one should ensure that clothing and PPE is "clean".[5] Although this statement may be alluding to reusable PPE for waste handling, what is meant by "clean" PPE is not clear. Additional recommendations made in HTM 07-01 regarding the handling of offensive or hygiene waste include absorbing liquid offensive waste into a cloth before disposal as an alternative to using solidifier, and that hand hygiene should be carried out after handling offensive or hygiene waste.[5] HTM 07-01 states that under the Landfill Regulations 2003, liquid offensive or hygiene waste must not be disposed of in landfill in Scotland.[5, 20] SHTN 03-01 states that these regulations do not allow disposal of liquid and clinical wastes in landfill but does not explicitly state whether this includes offensive or hygiene waste.[4]

In Scotland, non-hazardous waste is subject to Duty of Care legislative requirements for waste producers,[3] which is described in **section 3.1.1**. This legislation is mandatory in Scotland and SHTN 03-01 provides details on how it may be adhered to when handling non-hazardous waste.[4]

In summary, although non-hazardous waste does not have infectious properties, expert opinion guidance still describes handling requirements for this type of waste, in particular offensive or hygiene waste. While lack of evidence on minimum PPE requirements may be due to non-hazardous waste being considered low infection risk, or because risk assessment should be used to determine level of PPE required, this is not explicitly stated in the evidence base. Non-hazardous waste handling in Scottish health and care settings is subject to Duty of Care and waste legislative requirements.

3.1.9 How should waste be labelled or tagged in health and care settings?

In total, 15 documents were included to answer this research question, four of which were included in the previous version of this review.[9, 39, 40, 57] 11 pieces of evidence were added for this review update,[3-5, 16, 17, 29, 36, 40, 49, 61, 70] two of which were updates of guidance included in the previous update.[4, 5] Of the 10 guidance documents included, all were graded as SIGN50 Level 4 expert opinion.[3-5, 16, 36, 39, 40, 49, 55, 61] One British Standard and one New Zealand Standard were included which were graded as SIGN50 Level 4, expert opinion.[29, 57] Eight documents are applicable to the UK, noting divergences in national legislation,[3-5, 39, 40, 55, 57, 61] including three specific to Scotland.[3, 4, 61] Guidance was also included that is applicable to Canada,[36] one to New Zealand,[29] one was published by the ECDC so is applicable to the EU/EAA,[49] and one was published by the WHO so is applicable internationally.[16] Two documents were published by HFS,[4, 61] and two were published by the Department of Health.[40, 55] Three legislative documents were included which are graded as 'Mandatory', one UK legislation,[17] and two Scottish legislations.[9, 70] No primary evidence was included to answer this research question.

SHTN 03-01 states that labelled packaging supports good waste management.[4] Expert opinion guidance consistently recommends the labelling of healthcare waste[4, 16, 29, 36, 49, 61] including sharps containers.[39, 49, 57] UK guidance on the prevention and control of infection in care homes specifies that clinical or hazardous waste should be labelled.[40] The guidance provides alternatives to written labels including permanent marker, numbered tags, tape[4] or pre-printed labels.[4, 5, 16] In addition, UK expert opinion guidance states that placing temporary labels on receptacle lids could inhibit effective cleaning of clinical waste receptacles.[55] and healthcare waste receptacles.[61] However, the role of temporary labels is not clear in this guidance and alternative measures are not provided.

There was consistency in expert opinion guidance that waste labels should record the waste source for example the ward or department,[4, 5, 16, 29] and the type of waste.[4, 16, 29] Guidance from the WHO states that labels should also include detail on the date and time the container was sealed to facilitate location of waste throughout the waste management process.[16] The authors also suggest detailing the quantity of

waste and the name of the person filling out the label,[16] but rationale for including this detail was not provided. In addition, there was a lack of consistency regarding when waste receptacles should be labelled within the identified literature. The WHO states that labelling should be after the receptacle is sealed,[16] and guidance from the RCN states that sharps containers should be labelled and dated when assembled and when being disposed of.[39] SHTN 03-01 states that staff should be provided with labelled receptacles.[4]

Some expert opinion guidance describes additional labelling requirements for special (hazardous) or infectious clinical waste. HTM 07-01 states that hazardous waste excluding medicinal waste should be clearly labelled with a detailed description for compliance with English legislation.[5] Whereas guidance from the WHO states that an internationally recognised hazard symbol may be used.[16] ECDC provide specific examples of wording that should be used on labels such as “highly infectious waste” to ensure safe management.[36, 49]

Labelling of waste in Scotland is a legislative requirement. SHTN 03-01 states that labelling is required under health and safety regulations.[4] A Code of Practice by the Scottish Government providing guidance on compliance with Duty of Care for those producing waste under the Environmental Protection Act 2014 states that waste should be described accurately with information to support safe handling by others.[3, 9] This guidance is not specific to health and care settings. SHTN 03-01 states that in Scotland “traceability” of waste is required by waste contractors under the Pollution Prevention and Control (PPC) Permit.[4, 70] Marking and labelling requirements of receptacles for compliance with The Carriage Regulations are described in SHTN 03-01 and HTM 07-01.[4, 5, 17]

In summary, the method of labelling and the level of detail required differs across the included literature, but there was consistency that type of waste and its origin should be stated. Some expert opinion guidance recommends additional labelling for infectious waste. In Scotland, waste is required to be labelled to support safe handling for compliance with legislation within the health or care setting and beyond.

3.1.10 How should waste be transported in health and care settings?

In total, 17 documents were included that address transportation of healthcare waste, five of which were included in the previous update of this review.[6, 7, 9, 13, 15] Twelve documents were added for this update,[2-5, 16, 29, 31, 36, 48, 52, 61, 71] including two pieces of evidence superseding guidance included in the previous update.[4, 5] Of these, 12 were graded as SIGN50 Level 4, expert opinion,[2-5, 13, 16, 29, 36, 48, 52, 61, 71] and one was graded as AGREE: 'Recommend with Modifications' due to systematic methods being used to identify evidence but some methodological detail was lacking.[31] Two guidance documents support compliance with legislation so are not specific to health and care settings.[2, 3] Of the remaining guidance, three expert opinion guidance documents are specific to Scottish health and care settings,[4, 52, 61] one is applicable to the UK, noting divergences in national legislation,[5] three to the US,[13, 48, 71] one to Canada,[36] one to New Zealand,[29] and two guidance documents were published by the WHO so are applicable internationally.[16, 31] Three pieces of UK legislation[6, 7, 15] and one piece of Scottish legislation were also included.[9] This review update did not identify any peer-reviewed evidence that examines the transportation of waste within health and care settings from point of use to bulk or intermediate storage.

Expert opinion guidance that addresses transportation of waste in health and care settings states that hazardous and non-hazardous waste should not be collected within healthcare facilities at the same time nor using the same trolley.[16, 29] Furthermore, the WHO recommend that different categories of hazardous waste should also be transported separately.[16] Expert opinion guidance states that transportation containers should remain shut or securely closed during waste transportation.[16, 29]

Recommendations in the included guidance on the transportation of special (hazardous) waste in health and care settings differed in level of detail and scope. Standards New Zealand state that hazardous and controlled waste should not be left unattended in publicly accessible areas.[29] HTM 07-01 states that damaged clinical waste bags should not be moved until placed into a new, intact receptacle.[5] The WHO advise against transporting waste by hand, especially that which is hazardous,

as injury could occur through contact with infectious material or improperly segregated sharps that may protrude.[16] This recommendation is supported by Government of Canada expert opinion guidance advising against direct handling when moving EVD waste.[36] The WHO advise against waste chutes for transportation of waste in healthcare facilities due to increased risk of airborne transmission[16] but no references are provided to support this recommendation. Waste chutes are mentioned in NHSScotland Firecode regulations,[52] but their role in transporting special (hazardous) waste in NHSScotland is not addressed in this guidance.

Extant guidance makes additional recommendations for the transportation of waste contaminated with HCIDs. WHO guidance, graded as AGREE: 'Recommend with Modifications', discourages transportation of EVD and MVD waste where possible.[31] The authors state that infection prevention and control precautions should be followed if transportation of this waste is required, but do not provide examples.[31] The CDC recommends that rigid transportation carts for EVD- and MVD-contaminated waste should contain absorbent material.[48] For EVD-contaminated waste, Government of Canada guidance recommends that non-sharps waste should only be handled by the outer container, and transportation carts with guard rails or raised edges used for large and heavy containers.[36]

Collection of waste in health and care settings is described by Standards New Zealand as the movement of waste either from the primary source to intermediate storage, or from a waste holding area to pre-disposal storage.[29] There was consistency in two expert opinion guidance documents that waste collections should be scheduled, including SHTN 03-01.[4, 16] The WHO recommend frequency of collection in the healthcare facility according to the quantity of waste produced,[16] as expert opinion guidance advises against overflowing waste containers.[16, 61] SHTN 03-01 states that "appropriate" frequency of waste collection promotes successful segregation and that time between waste collections should be "as short as reasonably practicable".[4] There was variation regarding how often infectious waste should be collected, as SHTN 03-01 recommends collection weekly but this can be longer if the waste is refrigerated.[4] However, it is not clear if SHTN 03-01 is referring to collection from intermediate or bulk storage. Meanwhile, the WHO recommend

that infectious waste is collected daily.[16] Expert opinion guidance suggests that non-hazardous waste can be collected less frequently.[16]

There was inconsistency in expert opinion guidance on optimal waste transportation routes for infection prevention and control purposes. Expert opinion guidance by the WHO advises that routes are determined by the volume of waste, number of bags or containers, type of waste, storage and trolley capacity, distance and journey time.[16] However, details on how these factors should influence determining a route were not provided. The WHO also advise that waste should be collected from the "most hygienically sensitive medical areas" such as the ICU first.[16] Included guidance differs regarding transportation of waste in clinical areas. Some expert opinion documents advise that waste should not be transported through clinical areas.[4, 29] However, the WHO advise that planned transportation routes should limit movement through clinical areas, using separate routes if possible to minimise staff and patient exposure.[16] Further recommendations made include that routes are reliable,[16] well-lit[29] and easy to use.[29] Expert opinion guidance on HCID waste requires that EVD and MVD waste is "properly contained" when being transported through PPE storage and donning areas.[36, 71] While CDC guidance signposts to packaging requirements,[48] Government of Canada guidance does not.[36]

The following recommendations are made by the WHO for containers used to transport waste in health and care settings[16] supported by extant expert opinion guidance:

- leakproof[13, 29]
- easy to load and unload
- no sharp edges
- easy to move
- sized relative to volume of waste being transported
- labelled[29]
- enclosed with drainage and plug
- assigned to a waste stream to prevent contamination[5]
- lockable if used for hazardous waste

Two expert opinion documents suggest that, following transportation, waste bag seals should be checked to confirm no damage[16] and that trolleys or carts should be checked for damage after use.[29] Expert opinion guidance consistently states that the receptacle for transportation is clean.[4, 5, 16]

SHTN 03-01 states that health and safety, transportation and waste regulations require that healthcare waste is transported safely.[4] For compliance with COSHH Regulations, safe systems should be in place for transporting waste containing substances hazardous to health[2] and staff transporting waste should be provided with appropriate PPE, subject to risk assessment.[4, 7] WHO guidance recommends that this PPE consists of gloves, strong shoes, overalls and a mask.[16] However, specific standards to which this PPE should adhere to were not provided. Furthermore, A Code of Practice by the Scottish Government providing guidance on compliance with Duty of Care for those producing waste, states that waste should be described accurately with information to support safe handling by others during transportation.[3, 6, 9] Under the Special Waste Regulations 1996 (as amended), waste producers are required to provide consignment notes detailing the waste and hazardous properties[4, 15] Waste being transported by road within private premises is not required to meet Carriage Regulations.[5] However, healthcare waste being transported out-with health and care settings may be required to comply with transportation legislation which is described in **SHTN 03-01** and **HTM 07-01**.[4, 5]

In summary, there was a variation in the included guidance regarding how waste should be transported in health and care settings and on the frequency of collection. None of the guidance documents included addressed transportation of waste in care settings specifically. Transportation of healthcare waste in health and care settings and beyond is governed by legislation in Scotland, whereby accurate descriptions of the waste are required so that it can be handled safely.

3.1.11 How should waste be stored prior to uplift for disposal in health and care settings?

Twenty pieces of evidence were included that address storage of waste in health and care settings, four of which were included in the previous update.[6, 9, 13, 40] 16 pieces of evidence were added as part of this review update.[3-5, 16, 29-31, 35, 48, 53, 55, 61,

[72-75] Two of these guidance documents were updates of guidance included in the previous update.[4, 5] There were 17 guidance documents graded SIGN50 Level 4, expert opinion,[3-5, 13, 16, 29, 30, 35, 40, 48, 53, 55, 61, 72-75] and one guidance document graded AGREE: 'Recommend with Modifications' due to systematic reviews being used to identify evidence but some methodological detail was lacking.[31] In total, 13 guidance documents are applicable to the UK, noting divergences in national legislation,[3-5, 30, 35, 40, 53, 55, 61, 72-75] including four specific to Scotland,[3, 4, 61, 72] two to the US,[13, 48] one to New Zealand,[29] and two guidance documents were published by the WHO so are applicable internationally.[16, 31] Two pieces of legislation were also included which are graded as 'Mandatory', one in Scotland[9] and one in the UK.[6] There is a lack of primary evidence in the scientific literature examining the central storage of waste prior to uplift for disposal.

In Scotland, The Environmental Protection Act 1990 and The Environmental Protection (Duty of Care) (Scotland) Regulations 2014 require that waste producers securely store healthcare waste under Duty of Care to prevent waste escape and therefore harm to environmental and human health.[4, 6, 9] Scottish Government Duty of Care Code of Practice states that waste holders should ensure that waste is kept safe from spillages because of defective containers, weather damage, waste escape, scavenging animals and thieves.[3] SHTN 03-01 guidance states that, under these regulations, waste should not accumulate in corridors, within wards or other areas that are accessible to the public.[4] This is consistent with guidance from HSE on infection prevention and control in care homes.[30]

Expert opinion documents consistently recommend that waste storage capacity is based on the frequency of waste collection[4, 16, 55, 61] and/or the amount of and type of waste produced.[16, 55, 61] Standards New Zealand state that waste storage should be large enough so that it is convenient for those who require access and enables them to enter and move around.[29] Furthermore, expert opinion guidance recommends contingency planning arrangements are made to account for unpredicted increases in volume of waste such as that associated with outbreak or contingency events with increased outputs of waste,[16, 35] or when waste collection is not carried out.[61] Contingency planning may involve storing waste in vehicles, but this is not

recommended otherwise.[5] Expert opinion guidance recommends that designated storage should be easy to clean.[16, 29, 55, 61]

Other recommendations were not consistent across the evidence base. HTM 07-01 states that to prevent spills, waste containers should be stored upright, should not be overloaded and waste bags should not be compressed to avoid splitting.[5] Only guidance by the WHO advises use of PPE when entering waste storage areas for those collecting or handling waste for example industrial boots and heavy-duty gloves.[16]

Expert opinion guidance differentiates between temporary intermediate storage and bulk storage,[4, 16, 29] both of which must ensure secure storage of waste under the Duty of Care.[4, 6, 9] Expert opinion guidance consistently states that intermediate storage should be secure, inaccessible to the public and large enough to allow segregation of waste.[4, 55, 61]

Along with the recommendations made within SHTN 03-01,[4] there is some consistency on requirements for bulk storage in health and care settings. They should be:

- well-lit and ventilated[4, 13, 16, 29]
- located away from food preparation, general storage areas, and publicly accessible routes[4, 16, 29]
- fully enclosed and secure[4, 30]
- structured to enable separate storage of waste streams[4, 16, 35, 55, 61]
- large enough to enable separate and secure storage of sharps containers and medicinal waste[4]
- on a well-drained, impervious hard-standing [3, 4, 16, 29, 40]
- readily accessible, but only to authorised people[4, 16, 29, 35]
- kept locked when not being used[4]
- inaccessible to animals and free from insects or rodents[3, 4, 13, 16, 29, 35]
- provided with wash-down facilities [4, 40] but a definition of this is not provided

- provided with washing facilities for employees,[4] such as a hand wash basin with running water and tap[16]
- clearly marked with warning signs[4, 16]
- contain separate labelled areas for wastes according to disposal route[4, 29]
- provided with access to first-aid facilities[4]
- drained to a sewer[4, 16]

While guidance by the WHO recommends that waste is stored with dirty linen and cleaning supplies,[16] HBNs produced by the UK Department of Health, applicable to England, differed in recommendations on waste storage in dirty utility rooms. Infection prevention and control guidance states that waste should not be stored in dirty utility rooms,[55] consistent with the HBN on surgical procedures.[53] However, for adult in-patient facilities, the UK Department of Health state that waste may be temporarily stored in a dirty utility room before it is taken to the disposal hold.[73] For a renal unit, it was stated that a dirty utility room can be used for the disposal of liquid and solid waste or storing waste when there is not a disposal room.[74] In the HBN for clinical and clinical support spaces, the purpose of dirty utility rooms was described as waste storage before waste is taken to the disposal hold.[75] Three of these HBNs were republished by HFS as best practice guidance, to be read alongside Scottish Government policy and NHSScotland guidance for use in Scottish settings.[53, 74, 75] Although HFS published independent guidance on adult in-patient settings, guidance is consistent with that of the Department of Health with the additional recommendation that the room should be locked if clinical waste is being stored.[72, 73] These differences across settings may reflect variances in types and/or volumes of waste produced in different clinical settings, but this is not explicitly stated. Therefore, recommendations by the UK Department of Health regarding storage of waste in dirty utility rooms are unclear.

Additional storage requirements for infectious waste are described in expert opinion guidance. Three guidance documents, including SHTN 03-01, state that infectious waste may be refrigerated to extend the period of time it can be stored before collection,[4, 16, 29] to more than a week.[16] Two expert opinion guidance documents state that anatomical waste should be stored under similar conditions to infectious

waste.[5, 16] SHTN 03-01 and guidance by the WHO, graded AGREE: 'Recommend with Modifications', state that Category A infectious waste including EVD- and MVD-contaminated waste should not be stored for more than 24 hours before being incinerated.[4, 31] Further recommendations made regarding special (hazardous) waste storage were less consistent in expert opinion guidance:

- hazardous waste storage should be labelled with a biohazard sign, have special waste drainage if possible, and have surfaces that can be disinfected easily[16]
- infectious waste should not be stored outside unless no alternative is available, environmental risk assessments have been carried out, container lids remain on and locked and containers are on impermeable surfaces with sealed drains[5]
- Category A infectious waste should be stored securely with limited access[4]
- EVD and MVD waste should only be accessible to waste contractors[48]

In summary, Scottish legislation requires that waste produced from health and care settings is kept safe. There was consensus that waste storage areas should be large enough and account for contingency events which may result in an increased output of waste. There were differences in recommendations made for intermediate storage when compared with bulk storage. There was a lack of consistency in the included guidance regarding storage of waste in dirty utility rooms and requirements for storage of infectious waste.

3.1.12 How should waste spillages be managed?

Ten documents were included to answer this research question. There were seven guidance documents graded SIGN50 Level 4 expert opinion, one of which was included in the previous iteration,[40] two were updates to guidance included in the previous iteration, [4, 5] and the remaining four were included for this update.[16, 29, 30, 36] One guidance document is specific to Scotland (HFS),[4] three are applicable to the UK,[5, 30, 40] one to Canada,[36] one to New Zealand,[29] and one guidance document was published by the WHO so is applicable internationally.[16] Three legislative documents were graded as SIGN50 'Mandatory' including two UK legislations[7, 76] and one Scottish Chief Executive letter as it contains legislation which NHSScotland bodies

are expected to adhere to.[77] This research question addresses waste spillages specifically. Evidence on managing spillages of blood and body fluids is described in the NIPCM literature review **Management of blood and body fluid spillage in health and care settings**. No evidence on management of waste spillages was identified in the peer-reviewed scientific literature.

The guidance included varies in the level of detail provided on managing waste spills. SHTN 03-01 recommends that workplace-specific procedures should address incidents like spillages, including reporting, investigative processes, and decontamination.[4] Expert opinion guidance states that procedures should address safe handling of waste and PPE required.[4, 16] Government of Canada guidance states that those cleaning up EVD waste spills should wear “appropriate”, “enhanced” PPE based on risk assessment.[36] Expert opinion guidance by the WHO provides an example of a waste spill procedure, although it is based on a reference which has since been updated, so it not clear if it is representative of current best practice.[16] The WHO did however specify that the infectious agent involved in the spill should be determined in case evacuation of the area is required.[16] Government of Canada guidance on EVD waste spills specifically, states that the area where the spill has occurred should be made inaccessible to others until disinfection has been carried out.[36] Additional recommendations in expert opinion guidance included disposing of spilled waste and any absorbent materials used to soak up this waste as infectious waste[4] and not picking sharps up by hand.[4, 16] Department of Health and HPA guidance on the prevention and control of infections in care homes recommends that accidental spillages of waste in bulk storage areas should be cleaned up immediately.[40] However, HTM 07-01 did not differentiate between protocols for managing waste spills and generic spills in health and care settings.[5]

There was consistency in four expert opinion guidance documents, graded as SIGN50 Level 4, stating that those handling waste spills should be appropriately trained.[4, 16, 30, 36] Prompts may also be used to facilitate understanding of spillage procedures.[4]

There is consensus in the guidance that spill kits should be available.[4, 16, 29, 30, 36] SHTN 03-01 also recommends that spill kits are available in storage areas, vehicles used for transportation and waste disposal sites to manage waste spills.[4] Guidance

consistently states that employers should provide appropriate equipment for handling waste spillages specifically.[4, 16, 29, 30, 36] Items for waste spill kits include the following, however, the expert opinion documents cited do not provide evidence supporting the inclusion of these items:

- disinfectant for example bleaching powder or sodium hypochlorite[4, 16, 29, 30, 36]
- waste receptacles for example clinical waste bag and tags, sharps containers, disposable containers and plastic bags[4, 16, 29, 30]
- (disposable or single-use) gloves and overalls or an apron[4, 29, 30]
- facemask or shield[29]
- items to contain the spill for example disposable cloths,[4] absorbent material[16, 29]
- "protective equipment" to secure the area (type not specified)[16]
- equipment for picking up spilled waste or "means of collecting sharps"[4] for example bucket and shovel[29]

SHTN 03-01 signposts to The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013 (RIDDOR) and Scottish Government Chief Executive Letter 43 (2009), which require work-related accidents to be reported.[4, 76, 77] The Chief Executive Letter specifies that procedures should be in place to report adverse events relating to estates and facilities equipment, including waste management, transport and disposal equipment.[77] Furthermore, under COSSH Regulations, risk assessments carried out by employers should consider what PPE is required to protect employees from potential exposure to hazardous substances.[4, 7]

In summary, guidance differed in the level of detail provided. Much of the expert opinion guidance described was vague regarding the management of waste spills including recommendations on decontamination, disposal of spilled waste, how to pick up sharps and evacuation of the affected area. There was consistency in expert opinion guidance that spill kits should be available to manage waste spills in health and care settings. In Scotland, legislation requires employees to be provided with sufficient PPE and that incidents such as waste spills are reported.

3.2 Implications for research

There is limited scientific research on this topic. Therefore, it is not clear whether current practice is effective at reducing infection risk, or if it is representative of established practice based on expert opinion due to a lack of research in the field. Guidance by the CDC and HICPAC does reference an outbreak study linked to the mishandling of infectious *Mycobacterium tuberculosis* waste at a medical waste treatment facility in the US.[13, 78] However, this study was excluded because it was published before 2000 and was not in a health or care setting,[78] so does not conform to NIPCM inclusion criteria.

The WHO cite methodological difficulties as a reason for lack of research in the field.[16] For example, there may be difficulty obtaining samples from sealed infectious waste containers and linking contaminated waste to an outbreak when receptacles will likely contain numerous infectious agents from various sources. As such, guidance graded AGREE: 'Recommend' or AGREE: 'Recommend with Modifications' (which has systematic and clear methodology underlying its recommendations), has limited references made to scientific literature to support the recommendations made. For example, many of the recommendations made in NICE guidance were based on legislative requirements.[58]

Primary evidence was considered for this review but most identified was deemed low quality so was excluded. For example, an environmental sampling study investigated contamination of bulk storage and waste transportation carts from nine acute hospitals in London. Of the 23 sampled, "low numbers" of *Staphylococcus aureus* and *enterococci* were found on samples taken from lids (n=7) and wheels (n=10), among other infectious agents.[79] However, infectivity of the samples was not considered, and consistent lack of compliance with waste management procedure was reported such as visibly dirty and over-filled carts.[79] In contrast, a larger environmental sampling study sampled waste carts, service lift buttons and door handles used when transporting waste in three NHS England hospitals and did not find contamination of target organisms associated with healthcare associated infection, but did find contamination of moulds, *Staphylococci sp.*, *enterococci*, and fungi.[80] The findings of this study are limited – it is difficult to extrapolate that no

detection of the targeted organisms indicated correct protocol was followed and its' role in limiting bacterial contamination risk from waste management procedures as stated by authors. Adherence to waste management protocol was not reported and there was no control, so it was not clear if the sampling technique used was effective.[80] Moreover, snowball searching identified studies considered for inclusion which investigated contamination of and risk of sharps injury from disposable single-use versus reusable sharps containers using the same experimental framework. However, amongst other limitations, these were deemed high risk of bias given lead author's affiliations with the sharps container company.[81-84] A full list of studies excluded following critical appraisal is provided in **Appendix 5**. Further research to improve the safe management of waste would be beneficial to protect patients, staff, the public and the environment.

Therefore, most of the evidence included in this review update was expert opinion guidance which does not have a clear evidence to decision framework, nor consistent references to scientific literature made throughout. Expert opinion guidance documents can reference one another, so original sources of recommendations become unclear over time. For example, Government of Canada infection prevention and control guidance for Ebola in acute care settings references WHO and CDC guidance.[16, 36, 47, 48] In-text citations are not provided, so much of the recommendations made in these guidance documents align, but it is not clear how they have informed one another. Furthermore, expert opinion guidance that references other expert opinion guidance risks becoming inaccurate if not updated appropriately. For example, multiple guidance documents were excluded from this review as they referenced UK waste management guidance that has since been superseded, and guidance by the Secretariat of the Basel Convention was also excluded because it referenced a superseded version of the WHO guidance 'Safe management of wastes from health-care activities'.[16, 85]

Furthermore, one guidance document on safe use of sharps by the Association of periOperative Registered Nurses (AORN) was graded AGREE: 'Not Recommend' and so was excluded from this review.[86] This AORN guidance was graded as such as it was not clear how recommendations were formed considering the limited evidence base and expert opinion formation, and due to a lack of methodological

detail. Although much of the recommendations for sharps disposal aligned with those described in the evidence included in this review,[86] applicability to Scottish settings may be limited due to differences in US legislation determining sharps disposal.

Lack of research in waste management could also be due to legislative requirements underpinning much of current practice. Most legislation regarding the safe disposal of waste is not specific to health and care settings nor to infection prevention and control. Therefore, much of expert opinion guidance is likely based on these experts' interpretations of otherwise vague legislative requirements, which may explain differences in scope and amount of detail provided, especially between different countries. SHTN 03-01 provides best practice guidance for compliance with legislation in Scotland but provides a disclaimer that the legislation provided may not be exhaustive.

Although there is less guidance for waste management in care homes, much of the recommendations made are consistent with guidance for acute care with alternative suggestions made for where facilities may differ. However, no such recommendations were made for transporting waste within care settings. This discrepancy in volume of guidance may be representative of the type of waste that tends to be produced in this setting. In Scotland, SHTN 03-01 represents best practice guidance for waste management for all NHSScotland waste-producing services.

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Appendix 1: Search strategy

Medline/Embase

1. exp Medical Waste/ or medical waste.ti,ab,kw.
2. exp Hazardous Waste/ or hazardous waste.ti,ab,kw.
3. Refuse Disposal/
4. ((refuse or waste) adj2 dispos*).ti,ab,kw.
5. Waste Disposal, Fluid/
6. Waste Management/
7. (waste adj2 manag*).ti,ab,kw.
8. clinical waste.mp.
9. health* waste.mp.
10. (sharp* adj2 dispos*).mp.
11. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10
12. exp Health Services/
13. exp Health Facilities/
14. exp Infections/
15. exp Infection Control/
16. exp Disease Transmission, Infectious/
17. IHCD or "high consequence infectious disease*" or "infectious disease* of high consequence").mp.
18. Transportation/
19. 12 or 13 or 14 or 15 or 16 or 17 or 18
20. 11 and 19

21. limit 20 to english language

22. limit 21 to yr="2019 -Current"

CINAHL

Search 2019 to current

S21. S13 AND S20

S20. S14 OR S15 OR S16 OR S17 OR S18 OR S19

S19. (MH "Transportation")

S18. IHCD or "high consequence infectious disease*" or "infectious disease* of high consequence”

S17. (MH "Infection Control+")

S16. (MH "Infection+")

S15. (MH "Health Facilities+")

S14. (MH "Health Services+")

S13. S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12

S12. sharp* N2 dispos*

S11. health* waste

S10. clinical waste

S9. waste N2 manag*

S8. (refuse or waste) N2 dispos*

S7. hazardous waste

S6. medical waste

S5. (MH "Refuse Disposal")

S4. (MH "Sharps Disposal")

S3. (MH "Hazardous Materials")

S2. (MH "Medical Waste Disposal")

S1. (MH "Medical Waste+")

Appendix 2: Evidence levels

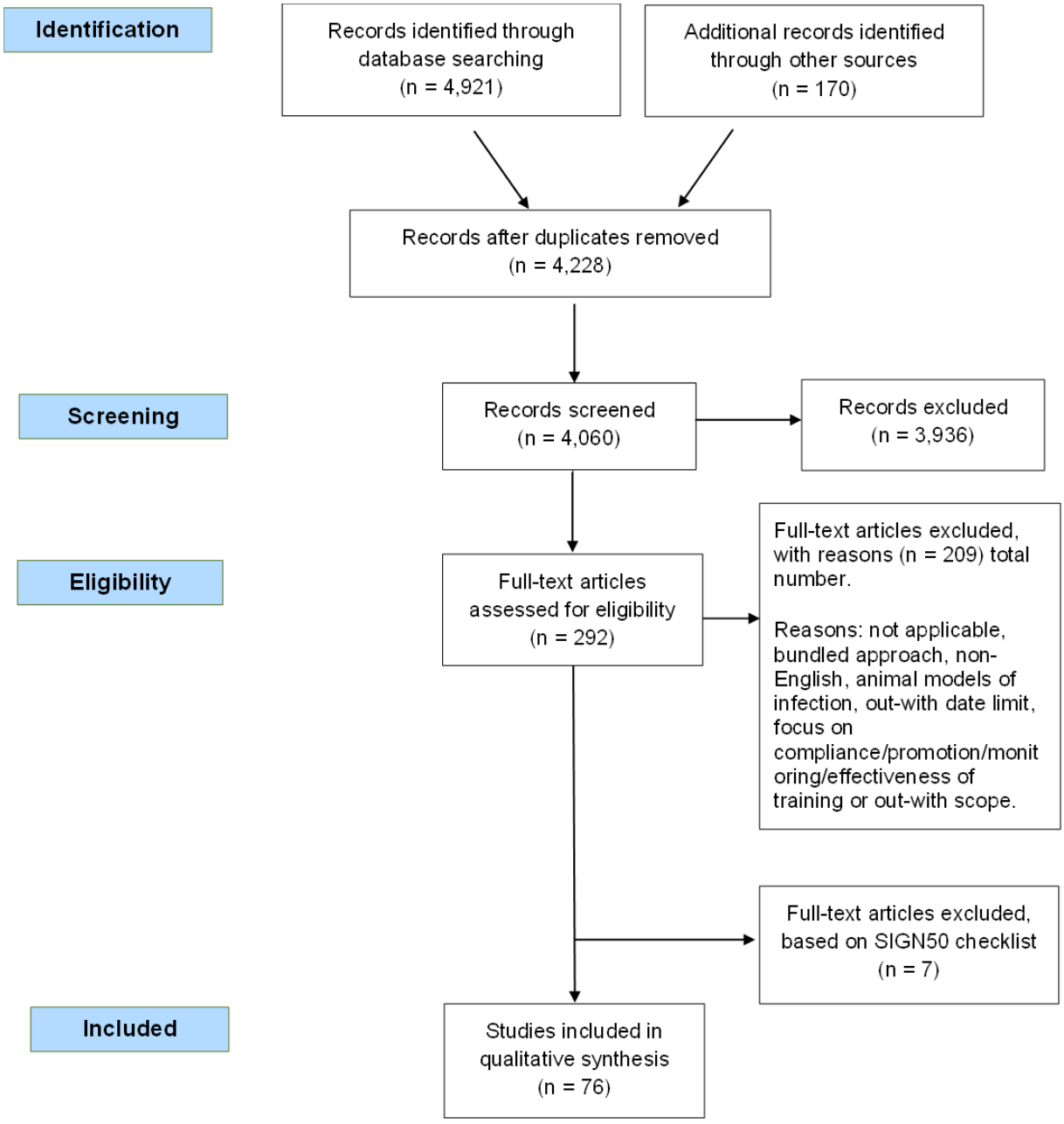
SIGN50 Evidence levels

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

AGREE II Evidence Levels

Grade	Description
AGREE 'Recommend'	This indicates that the guideline 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.

Appendix 3: PRISMA flow diagram[1]



Appendix 4: Legislation pertaining to waste disposal in health and care settings

This appendix provides a non-exhaustive list of legislations pertaining to waste disposal. This list represents relevant legislation at the time of publication. Please note, however, that legislation is subject to amendments and the most recent versions should always be sourced and used in practice.

- Special Waste Regulations 1996, amended by Special Waste (Scotland) Regulations 2004
- Controlled Waste Regulations 1992
- The Waste (Scotland) Regulations 2012 implement the European Union (EU) Waste Framework Directive (2008/98/EC**)**
- European Waste Catalogue, established by European Commission decision 2000/532/EC
- Duty of Care under the Environmental Protection Act 1990 and the Environmental Protection Act (Duty of Care) 2014
- Landfill (Scotland) Regulations 2003 implementing the EU Council Directive (1999/31/EC)
- The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009
- Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)
- Health and Safety (Sharps Instruments in Healthcare) Regulations 2013
- Health and Safety at Work Act 1974 which implements the European Directive 2010/32/EU
- Management of Health and Safety at Work Regulations 1999
- The Personal Protective Equipment at Work Regulations (1992) (as amended)
- Control of Substances Hazardous to Health Regulations (COSHH) 2002

- Pollution Prevention and Control (Scotland) Regulations 2012
- Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013

Appendix 5: Studies excluded following critical appraisal

The following primary studies were excluded during critical appraisal based on their limitations:

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