POSITION STATEMENT

Carbapenamase-Producing Enterobacterales (formerly Enterobacteriaceae) (CPE): Follow Up Testing and Drain Management

Background

Carbapenamase-producing Enterobacterales (formerly Enterobacteriaceae) (CPE) have been identified in a growing number of countries since the 1990s[1] and are increasingly seen in Canadian healthcare facilities.[2,3] While other carbapenam resistant organisms (CRO) are also of significant consequence in health care, CPE are of particular concern due to their resistance to carbapenem antibiotics through the production of carbapenemases, with capacity for clonal and plasmid-mediated transmissions,[4] and high mortality in patients infected with these organisms. In addition, only a few last line antibiotics are active against CPE, and these are often highly toxic with unproven efficacy.

Canadian guidance for management of CPE in healthcare facilities focuses on the use of Routine Practices and additional Contact Precautions. However, there is currently no agreed guidance for length of precautions and follow up testing that would facilitate this management.

Although caregiver hands and shared equipment remain the major sources of transmission, drains and plumbing in healthcare settings have been found to be colonized with CPE,[5] serving as an ongoing reservoir.[6,7] Various strategies have been applied to reduce risk of transmission via this route. Non-acute facilities may lack confidence in being able to safely implement these recommendations, resulting in reluctance to accept admissions and transfers when CPE is in the diagnosis.

This Position Statement addresses these discrepancies with the aim of assisting facilities to safely mitigate risks of CPE transmission, with these considerations as part of a multimodal approach to reducing the spread of organisms.[6,7]

Position Statement

Follow-up Testing: Patients/residents/clients with CPE colonization or infection should be safely accommodated in all healthcare settings, based on their care requirements. Routine Practices and Contact Precautions are required until they have been shown to no longer carry the organism in their rectum/stools as evidenced by three negative rectal swabs or stool specimens taken at least one week apart (or as per provincial guidance) in the absence (at least 48 hours after discontinuation) of antimicrobial therapy.[2,3] Ongoing testing should follow to monitor for recolonization at a frequency based on provincial guidance, e.g., for other resistant organisms that may colonize the bowel. Due to long carriage of CPE, which may vary depending on the specific organism,[8-13] resident co-morbidities,[10,14]

and treatment (e.g., hospital admission,[12-15] repeated antimicrobial [15-16] and proton pump inhibitor therapy[16]) testing is not recommended for at least three months after initial positive test, and in most cases, six,[17] or twelve[15] months. Facilities should follow current provincial guidance and consult with their IPAC physician/expert on a case-by-case basis, especially if electing to test within 6 months of last positive culture.

Drain Management: In order to reduce transmission of CPE (and other organisms of concern) from sink or shower drains, staff should be trained to dispose of body fluids, bathing water, leftover tube feeds and IV fluids in the toilet or an approved device (e.g., hopper/dedicated soiled utility room sink) not in the hand hygiene or resident room sink.[18] Appropriate personal protective equipment (PPE) should be worn based on assessment of risk of splashes. Urine and faeces disposal (e.g., via use of washer/disinfector, macerator, or absorbent/solidifier product) should follow organizational policy. When patients/residents/clients with CPE infections or colonizations are discharged, or when transmission is suspected, drains should be swabbed for CPE with follow-up as required and remedial treatment should be initiated to remove CPE, and preferably the biofilm in the drain. Facilities should consider proactive drain treatments to reduce biofilm and the organisms within it, on a regular basis (e.g., weekly or monthly). Treatments should consider the existing plumbing infrastructure and include collaboration with facilities maintenance, plumbing experts, and product manufacturers/suppliers.

Drain treatments should involve effective materials/solutions to remove biofilm and thereby, reduce or eradicate the organisms, considering contact/dwell times. If brushing or scrubbing is involved, care must be taken to ensure any aerosols are contained. Appropriate PPE should be worn based on risk assessment for splashes, chemical exposure, and organizational policy, following manufacturer's instructions for use.

Table 1: Comparison of Some Common Sink Treatment Options, PPE required

Process	Advantages	Disadvantages	Notes
1. Brushing	Helps remove organic matter to enable further cleaning and disinfection.	Potential splashes and sprays to person. performing procedure and environment. Subsequent cleaning and disinfection are also required.[19]	Consider a flange to reduce sprays. Consider reach and cleaning/disinfecting/storage of the brush.
2. Liquid Chemical disinfection[18-21]	Surface organisms may be killed.	Insufficient contact time. Biofilm is not removed and remains a reservoir	Mitigate chemical hazards: See Safety Data Sheet (SDS.
3. Gel Chemical disinfection[22]	Improved contact time. May be sporicidal agent.	Biofilm is not removed and remains a reservoir.	Mitigate chemical hazards: SDS.
4. Foam Chemical disinfection[23,24]	Controlled contact time.	May involve equipment purchase or rental.	Mitigate chemical hazards: SDS.

	Biofilm can be destroyed.		
5. Steam[19,25]	Cost-effective and low toxicity.[22]	Limited effect in some studies.[23,24]	Effective steam parameters may be limited by access.
6. Removal and replacement of drain components[21,26]	Removes source of organisms and biofilm to below P-trap.[6,7]	Biofilm remains in rest of system to recolonize replacement parts.[6,7]	Consider cost of plumbing work and environmental disposal of metal.
7. Other: e.g., Heating and vibration;[25] siphon[26]	Effective in limited studies.		Effective parameters may be limited by access.

Stakeholders

Infection Prevention and Control Professionals and healthcare workers

Participants in Development of Position Statement

This position statement was developed by Standards and Guidelines Committee.

Chair: Madeleine Ashcroft

Principal Authors: Madeleine Ashcroft, Ewelina Dziak, Kathryn Verville-Provencher

Glossary

Clonal transmission: Transmission due to expansion of a single strain of organism.

Plasmid: Small, circular, double-stranded DNA molecule, distinct from a cell's chromosomal DNA, carrying genes such as for antibiotic resistance which may transfer to other strains of organisms.

Plasmid-mediated transmission: Transmission due to plasmids.

Safety Data Sheet (SDS): Document including product information such as chemical properties; physical, health, and environmental health hazards; protective measures; and safety precautions for handling, storing, and transporting the chemical.

References

1. Doi Y, Paterson DL. Carbapenemase-producing enterobacteriaceae. In Seminars in respiratory and critical care medicine 2015 Feb (Vol. 36, No. 01, pp. 074-084). Thieme Medical Publishers. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4470611/
2. Public Health Ontario. Carbapenemase Producing Enterobacteriaceae (CPE) [Internet]. 2019 Aug [cited 2024 Apr 5]. Available from: https://www.publichealthontario.ca/en/Diseases-and-Conditions/Health-Care-Associated-Infections/CPE
3. Ontario Agency for Health Protection and Promotion, Provincial Infectious Diseases Advisory Committee. Annex A – Screening, testing and surveillance for antibiotic-resistant organisms (AROs). Annexed to: Routine Practices and Additional Precautions in All Health Care Settings.

Toronto, ON: Queen's Printer for Ontario; 2013. Available from https://www.publichealthontario.ca/-/media/Documents/A/2013/aros-screening-testing-surveillance.pdf?rev=5b027cecb0034a5e9c3b57635de1dc23&sc_lang=en

4. Marimuthu K, Venkatachalam I, Koh V, Harbarth S, Perencevich E, Cherng BP, Fong RK, Pada SK, Ooi ST, Smitasin N, Thoon KC. Whole genome sequencing reveals hidden transmission of carbapenemase-producing Enterobacterales. Nature communications. 2022 Jun 1;13(1):3052. Available from https://www.nature.com/articles/s41467-022-30637-5
5. Jamal AJ, Mataseje LF, Brown KA, Katz K, Johnstone J, Muller MP, Allen VG, Borgia S, Boyd DA, Ciccotelli W, Delibasic K. Carbapenemase-producing Enterobacterales in hospital drains in Southern Ontario, Canada. Journal of Hospital Infection. 2020 Dec 1;106(4):820-7. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0195670120304229
6. Tsukada M, Miyazaki T, Aoki K, Yoshizawa S, Kondo Y, Sawa T, Murakami H, Sato E, Tomida M, Otani M, Kumade E. The outbreak of multispecies carbapenemase-producing Enterobacterales associated with pediatric ward sinks: IncM1 plasmids act as vehicles for cross-species transmission. American Journal of Infection Control. 2024 Apr 11. Available from https://www.ajicjournal.org/article/S0196-6553(24)00101-9/fulltext
7. Kizny Gordon AE, Mathers AJ, Cheong EY, Gottlieb T, Kotay S, Walker AS, Peto TE, Crook DW, Stoesser N. The hospital water environment as a reservoir for carbapenem-resistant organisms causing hospital-acquired infections—a systematic review of the literature. Clinical Infectious Diseases. 2017 May 15;64(10):1435-44. Available from: https://academic.oup.com/cid/article/64/10/1435/2990266
8. Haverkate MR, Weiner S, Lolans K, Moore NM, Weinstein RA, Bonten MJ, Hayden MK, Bootsma MC. Duration of colonization with Klebsiella pneumoniae carbapenemase-producing bacteria at long-term acute care hospitals in Chicago, Illinois. InOpen forum infectious diseases 2016 (Vol. 3, No. 4, p. ofw178). Oxford University Press. Available from: https://academic.oup.com/ofid/article/3/4/ofw178/2593310?login=false
9. Loukili NH, Loquet A, Perrin A, Gaillot O, Bruandet A, Sendid B, Zahar JR, Nseir S. Time to intestinal clearance of carbapenemase-producing Enterobacterales in hospital patients: a longitudinal retrospective observational cohort study. Journal of Hospital Infection. 2023 May 1;135:4-10. Available from: https://www.sciencedirect.com/science/article/abs/pii/S019567012300066X
10. Vink JP, Otter JA, Edgeworth JD. Carbapenemase-producing Enterobacteriaceae–once positive always positive?. Current Opinion in Gastroenterology. 2020 Jan 1;36(1):9-16. Available from: https://journals.lww.com/co-gastroenterology/abstract/2020/01000/carbapenemase_producing_enterobacteriaceae___once.4.aspx?context=featuredarticles&collectionid=2
11. Lim YJ, Park HY, Lee JY, Kwak SH, Kim MN, Sung H, Kim SH, Choi SH. Clearance of carbapenemase-producing Enterobacteriaceae (CPE) carriage: a comparative study of NDM-1 and KPC CPE. Clinical Microbiology and Infection. 2018 Oct 1;24(10):1104-e5. Available from: https://www.sciencedirect.com/science/article/pii/S1198743X18304464
12. Kim YK, Chang IB, Kim HS, Song W, Lee SS. Prolonged carriage of carbapenemase-producing Enterobacteriaceae: clinical risk factors and the influence of carbapenemase and organism types. Journal of Clinical Medicine. 2021 Jan 15;10(2):310. Available from: https://www.mdpi.com/2077-0383/10/2/310

13. Herrera S, Torralbo B, Herranz S, Bernal-Maurandi J, Rubio E, Pitart C, Fortes I, Valls S, Rodríguez L, Santana G, Bodro M. Carriage of multidrug-resistant Gram-negative bacilli: duration and risk factors. European Journal of Clinical Microbiology & Infectious Diseases. 2023 May;42(5):631-8. Available from: https://link.springer.com/article/10.1007/s10096-023-04581-1
14. Asai N, Sakanashi D, Suematsu H, Kato H, Hagihara M, Nishiyama N, Koizumi Y, Yamagishi Y, Mikamo H. The epidemiology and risk factor of carbapenem-resistant enterobacteriaceae colonization and infections: Case control study in a single institute in Japan. Journal of infection and chemotherapy. 2018 Jul 1;24(7):505-9. Available from: https://www.sciencedirect.com/science/article/abs/pii/S1341321X18300606
15. Mo Y, Hernandez-Koutoucheva A, Musicha P, Bertrand D, Lye D, Ng OT, Fenlon SN, Chen SL, Ling ML, Tang WY, Barkham T. Duration of carbapenemase-producing Enterobacteriaceae carriage in hospital patients. Emerging Infectious Diseases. 2020 Sep;26(9):2182. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7454053/
16. Cheng VC, Chen JH, So SY, Wong SC, Chau PH, Wong LM, Ching RH, Ng MM, Lee WM, Hung IF, Ho PL. A novel risk factor associated with colonization by carbapenemase-producing Enterobacteriaceae: use of proton pump inhibitors in addition to antimicrobial treatment. infection control & hospital epidemiology. 2016 Dec;37(12):1418-25. Available from: https://pubmed.ncbi.nlm.nih.gov/27619653/
17. Institut Nationale de Santé Publique du Québec. Interim measures to prevent and control transmission of carbapenemase-producing Enterobacteriaceae and other multidrug-resistant gram-negative bacilli in long-term care settings. 2018. Available from: https://www.inspq.qc.ca/en/publications/2426
18. Glowicz JB, Landon E, Sickbert-Bennett EE, Aiello AE, Dekay K, Hoffmann KK, Maragakis L, Olmsted RN, Polgreen PM, Trexler PA, VanAmringe MA. SHEA/IDSA/APIC practice recommendation: strategies to prevent healthcare-associated infections through hand hygiene: 2022 Update. Infection Control & Hospital Epidemiology. 2023 Mar;44(3):355-76. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10015275/
19. Kotsanas D, Wijesooriya WR, Korman TM, Gillespie EE, Wright L, Snook K, Williams N, Bell JM, Li HY, Stuart RL. "Down the drain": carbapenem-resistant bacteria in intensive care unit patients and handwashing sinks. Medical Journal of Australia. 2013 Mar;198(5):267-9. Available from: https://onlinelibrary.wiley.com/doi/abs/10.5694/mja12.11757
20. Smolders D, Hendriks B, Rogiers P, Mul M, Gordts B. Acetic acid as a decontamination method for ICU sink drains colonized by carbapenemase-producing Enterobacteriaceae and its effect on CPE infections. Journal of Hospital Infection. 2019 May 1;102(1):82-8. Available from https://www.sciencedirect.com/science/article/abs/pii/S0195670118307138
21. Kearney A, Boyle MA, Curley GF, Humphreys H. Preventing infections caused by carbapenemase-producing bacteria in the intensive care unit-Think about the sink. Journal of Critical Care. 2021 Dec 1;66:52-9. Available from https://www.sciencedirect.com/science/article/abs/pii/S0883944121001738
22. Tang L, Tadros M, Matukas L, Taggart L, Muller M. Sink and drain monitoring and decontamination protocol for carbapenemase-producing Enterobacteriaceae (CPE). American Journal of Infection Control. 2020 Aug 1;48(8):S17. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0196655320304934
23. Varghese MM, Torres-Teran MM, Greentree DH, Cadnum JL, Donskey CJ. What is the optimal frequency of sink drain decontamination with a foam disinfectant? Available from: https://www.cambridge.org/core/journals/infection-control-and-hospital-

epidemiology/article/abs/what-is-the-optimal-frequency-of-sink-drain-decontamination-with-a-foam-disinfectant/71334817D85F204A25C5331A25E4E500
24. Wood-Wyant. Report on the BIOASSURE field study for drain treatment: McGill University Health Centre. 2020 Apr 28. Available from: https://api.sanimarc.com/wp-content/uploads/2022/11/Bioassure-McGill-Study.pdf
25. Infection Control & Hospital Epidemiology. 2024 Apr 25:1-3.Umemura T, Mutoh Y, Sukawa M, Hioki T, Sakanashi D, Kato H, Hagihara M, Yamada T, Ikeda Y, Mikamo H, Ichihara T. Diminishment of carbapenemase-producing enterobacterales from sink outlets using a steam cleaner. Hygiene. 2023 Jan 27;3(1):13-7. Available from: https://www.mdpi.com/2673-947X/3/1/3
26. De Geyter D, Blommaert L, Verbraeken N, Sevenois M, Huyghens L, Martini H, Covens L, Piérard D, Wybo I. The sink as a potential source of transmission of carbapenemase-producing Enterobacteriaceae in the intensive care unit. Antimicrobial Resistance & Infection Control. 2017 Dec;6:1-6. Available from: https://link.springer.com/article/10.1186/s13756-017-0182-3
27. De Jonge E, De Boer MG, Van Essen EH, Dogterom-Ballering HC, Veldkamp KE. Effects of a disinfection device on colonization of sink drains and patients during a prolonged outbreak of multidrug-resistant Pseudomonas aeruginosa in an intensive care unit. Journal of Hospital Infection. 2019 May 1;102(1):70-4. Available from https://www.sciencedirect.com/science/article/abs/pii/S0195670119300052

Publication Date

Original: 2024 July