In healthcare settings, what is the current epidemiology and latest evidence on transmission pathways and infection prevention and control measures for Norovirus Gastroenteritis?

Technical Report

Prepared for

National Health and Medical Research Council (NHMRC)

Submitted by

University of South Australia

Division of Health Sciences

Submission date

21st April 2017

Table of Contents

In healthcare settings, what is the current epidemiology and latest evidence on transmission pathways and infection prevention and control measures for Norovirus Gastroenteritis?

Review team:
Dr Rasika Jayasekara[1] (Project Leader)
Dr David Evans [1]
Associate Professor Kay Price[1]

Expert Advisors:
Marija Juraja - Clinical Service Coordinator for Central Adelaide Local Health Network, Infection Prevention and Control Unit
Dr Rietie Venter - Microbiologist and Senior Lecturer in Microbiology, School of Pharmacy and Medical Science, Division of Health Sciences, University of South Australia

Literature Search
Carole Gibbs, Academic Librarian, University of South Australia

[1]School of Nursing & Midwifery, Division of Health Sciences, University of South Australia

---

Background

The National Health and Medical Research Council (NHMRC) commissioned this independent literature review to provide assurance that the revision of the *Australian Guidelines for the Prevention and Control of Infection in Healthcare* is grounded in the most up-to-date and relevant scientific evidence.

Norovirus is the most frequently occurring cause of community-acquired acute gastroenteritis in people of all ages. It is also one of the most frequent causes of outbreaks in healthcare settings, affecting both long-term care facilities and acute care hospitals (Kambhampati, Koopmans & Lopman 2015; Lindsay et al. 2015). These outbreaks lead to patient morbidity resulting in extended length of stay and occasionally mortality (Sadique et al. 2016). Norovirus outbreaks also cause additional costs associated with treatment provision and bed-days lost due to temporary closure of wards, as well as productivity losses associated with infected hospital staff (Harris 2016; NHMRC 2010; Sadique et al. 2016; Zheng et al. 2015). It is evident that prevalence of norovirus infection in the community is high and it is difficult to prevent the infection because persons may shed the virus without being ill, and transmission occurs not only through direct and indirect person-to-person contact, but also through food, water, surfaces and aerosols (NHMRC 2010; Petrignani et al. 2015; Rahamat-Langendoen et al. 2013; Xue et al. 2014). Therefore, it is important to explore the current epidemiology and latest evidence on transmission pathways and infection prevention and control measures for Norovirus Gastroenteritis

The purpose of this literature review was to identify the key risk factors that contribute to the risk of norovirus infection and transmission of disease within acute care, aged care, paediatric, neonatal and rehabilitation settings. In addition this literature review examine the available evidence on transmission based precautions methods and infection control measures. The literature review will contribute to identifying key areas that need updating, or further consideration within the *Australian Guidelines for the Prevention and Control of Infection in Healthcare* (2010).

Objectives

The purpose of this literature review was to examine the current epidemiology and latest evidence on transmission pathways and infection prevention and control measures for Norovirus Gastroenteritis.

Specifically, the three review questions of this literature review are:

Q 1: What is the current epidemiology (clinical features, occurrence diagnostics/Screening strategies) for Norovirus Gastroenteritis in acute care, aged care, paediatric, neonatal and rehabilitation settings?

Q 2: What is the latest evidence on transmission pathways for Norovirus Gastroenteritis in acute care, aged care, paediatric, neonatal and rehabilitation settings?

Q 3: What are the infection prevention and control strategies (eg disinfection bleach vs other, frequency of cleaning, hand hygiene alcohol vs soap/water,) for Norovirus Gastroenteritis in acute care, aged care, paediatric, neonatal and rehabilitation settings?

Methods

This literature review will be conducted using a documented search strategy, inclusion and exclusion criteria, critical appraisal methodology and evidence synthesis and practice recommendations. The review method utilises Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green 2011) in particular; the Cochrane Public Health Group: Guide for developing a Cochrane protocol (2011); "How to review the evidence: systematic identification and review of the scientific literature"(NHMRC 1999); "NHMRC additional levels of evidence and grades for recommendations for developers of guidelines (NHMRC 2000) and The Joanna Briggs Institute Reviewers' Manual 2014 -The Systematic Review of Prevalence and Incidence Data (JBI 2014)

Inclusion and exclusion criteria for considering studies for this review

Review questions:

Review question	Condition	Context	Population	Outcomes	Study Designs
Q 1	Norovirus Gastroenteritis	epidemiology (clinical features, occurrence diagnostics/Screening strategies)	all type of patients/participants including children and adults in healthcare settings	incidence, prevalence, frequency of outbreaks	all types of observational studies -prospective and retrospective cohort studies, case-control studies, cross-sectional studies, and case series
Q 2	Norovirus Gastroenteritis	transmission pathways	all type of patients/participants including children and adults in	surfaces, droplet, and oral faecal route	all types of observational studies -prospective and retrospective cohort studies, case-control

			healthcare settings		studies, cross-sectional studies, and case series
Review question	**Population**	**Intervention**	**Comparator**	**Outcomes**	**Study Designs**
Q 3	all type of patients/participants including children and adults in healthcare settings	Disinfection /Bleach hand washing/ soap/water Personal Protective Equipment etc	Other alcohol based	Severity of infection, number of people infected, duration of outbreak	RCTs, cluster RCTs, non-randomised controlled trials (Non-RCTs), controlled before and after studies and interrupted time series studies (ITS), cohort studies, case-control studies, cross-sectional studies

Types of participants/population and settings

This review considered all type of patients/participants including children and adults in healthcare settings. The health care settings of interest for this review included acute care, aged care, paediatric, neonatal and rehabilitation. This literature review considered any study that focused on one or more of these health care settings.

Types of studies

For the review question 1 and 2, this literature review considered all types of observational studies including prospective and retrospective cohort studies, case-control studies, cross-sectional studies, and case series that address one or more of the areas of interest; current epidemiology and transmission pathways. To evaluate the effectiveness of transmission based precautions and control strategies, the gold standard study design is a randomised controlled trial (RCT). However, this literature review considered research designs including RCTs, cluster RCTs, non-randomised controlled trials (Non-RCTs), controlled before and after studies and interrupted time series studies (ITS) (with three time points before and after the intervention). In the absence of above research studies, other quantitative research designs allocated to NHMRC Level of Evidence (Intervention) Level III were considered (NHMRC 2000; The Cochrane Public Health Group 2010). The reviewers will refer to Box 13.1.a- of the Cochrane Handbook to ensure the types of study design descriptors. In this review, case report and qualitative studies are not relevant and were excluded.

Types of interventions

This literature review considered any study that addressed one of the interventions of interest relevant to review question 3. These interventions were: disinfection /bleach/hand washing with soap & water/personal protective equipment etc. The comparators were considered as other environmental cleaning strategies, alcohol based preparation etc. based on individual studies. Type of interventions and comparators are not applicable for review question 1 and 2.

Types of outcome measures

This literature review considered any study that addresses outcome measures related to one or more of the review objectives.

- For current epidemiology for Norovirus Gastroenteritis, the review considered all relevant epidemiology data (incidence, prevalence, frequency of outbreaks, and change in number of outbreaks over time etc) addressing one of the settings of interest.
- For evidence on transmission pathways for Norovirus Gastroenteritis, the review considered all relevant data related to transmission/ contact routes (surfaces, droplet, and oral-faecal route etc) in one of the settings of interest.
- For infection prevention and control measures for Norovirus, the review considered all outcomes related to implementation of the strategies, including such things as; staff compliance with strategies; severity of infection; number of outbreaks and number of people infected or duration of outbreak. In addition, descriptions of the identified infection prevention and control strategies, and limitations were also documented.

Publication Date

The reviewer considered all relevant studies regardless of publication status (published, unpublished, in press, and ongoing) within the last 10 years from 2006 to 2016. There was no search time limit for randomized controlled trials (RCTs). The search was limited to human and English language publications.

Search Strategy

Electronic searches

The following information sources were searched:

- CENTRAL (Cochrane Central Register of Controlled Trials, The Cochrane Library)
- CINAHL (Cumulative Index to Nursing & Allied Health Literature)
- Cochrane Database of Systematic Reviews
- DARE (Database of Abstracts of Reviews of Effects)
- Joanna Briggs Institute EBP Database
- EMBASE-OvidSP
- MEDLINE-OvidSP
- NCCHTA (National Coordinating Centre for Health Technology Assessment)
- Science Citation Index Expanded (Web of Science)
- World Health Organization Library Information System(WHOLIS/IRIS)

The MEDLINE strategy will be translated for other databases using appropriate syntax and vocabulary for those databases

Grey literature

A grey literature search was conducted to identify studies not indexed in the databases listed above.

- AHRQ (Agency for Healthcare Research and Quality)- www.ahrq.gov
- Grey Literature Report (New York Academy of Medicine) http://greylit.org/
- NICE (National Institute for Health and Clinical Excellence) www.nice.org.uk/
- Open Grey http://www.opengrey.eu/)

Key international infection control and health care organisations were also be searched for relevant reports related to one of the review objectives. These international organisations were include:

- USA - Department of Health & Human Services (http://www.hhs.gov/)
- USA - Agency for Healthcare Research and Quality (http://www.ahrq.gov/)
- USA - Infectious Disease Society of America (www.idsociety.org).
- Australia - Department of Health (http://www.health.gov.au/)
- Australia - National Health and Medical Research Council (http://www.nhmrc.gov.au/)
- Australian Institute for Health and Welfare (https://www.aihw.gov.au/)

- Australian Commission on Safety and Quality in Health Care (http://www.safetyandquality.gov.au/)
- Communicable Diseases Network Australia http://www.health.gov.au/cdna
- NZ – Department of Health (http://www.health.govt.nz/)
- World Health Organization (http://www.who.int/en/)
- Centres for Disease Control and Prevention (http://www.cdc.gov/)
- European Centre for Disease Prevention and Control (http://ecdc.europa.eu/en/Pages/home.aspx)
- European Society for Clinical Microbiology and Infectious Diseases (www.escmid.org)
- British Society for Antimicrobial Chemotherapy (www.bsac.org.uk)
- Infectious Diseases Research Network (www.idrn.org).
- Canada - IPAC (http://www.ipac-canada.org/)
- UK Healthcare Infection Society (https://www.his.org.uk/)

Trial Registries

The following registries were searched for ongoing and completed trials:

- ClinicalTrials.gov, US National Institutes of Health (NIH) http://clinicaltrials.gov/
- ICTRP (International Clinical Trials Registry Platform, Word Health Organization (WHO) http://www.who.int/ictrp/en/
- metaRegister of Controlled trials- www.controlled-trials.com

Keywords

Noroviruses/ norovirus gastroenteritis /Norwalk-like Viruses/Norwalk like Viruses/Small Round-Structured Viruses/ human caliciviruses/

Please see Appendix I for Search strategies

Data collection and analysis

Selection of studies

The titles and, where available, abstracts of all search results were reviewed by at least two review authors to identify and select potentially relevant studies. Review authors applied the pre-defined above inclusion and exclusion criteria when selecting studies and obtained the full text of those studies that appear to meet the inclusion criteria. All full text papers were screened by two review authors to determine which studies fully met the inclusion criteria. There were some differences of opinion, and a third reviewer was asked to review the paper in question and a consensus was reached between the three review authors. Please see the Figure 1 and 2 PRISMA Flow Diagrams for the study selection process.

Data extraction

Data were extracted for all those studies that meet the inclusion criteria. Two review authors complete data extraction, tailored to the requirements of this review, for each study. The Appendix (II) shows detailed data extraction for question 1 and 2 and Appendix (III) presents the extracted data for question 3. All copies of studies undergoing data extraction and completed data extraction sheets (included printed versions of electronic forms), were filed and stored for auditing and checking purposes

Data extraction summary table were used to present extracted data from all included studies (Appendix IV). The problems identified were resolved through discussion as required. Excluded studies listed in Appendix V.

Assessment of risk of bias in included studies

This review found 33 observational studies for review questions 1 and 2 and nine studies for the review question 3. Therefore the critical appraisal for observational studies including prospective and retrospective cohort studies, case-control studies, cross-sectional studies, and case series was conducted using JBI Critical Appraisal Tool for Prevalence and Incidence Data (JBI 2014) Identified disagreements between review authors were resolved by discussion. Appendix VI presents the Critical Appraisal findings.

Data analysis & synthesis

Data analysis was presented using summary tables and discussion. Please see the Draft Literature Review Report for the Full Review

Documentation of the declared interest(s) of the author(s)

Please see Appendix VII for documentation of the declared interest(s) of the author(s) of each paper

The study selection process

PRISMA Flow Diagram 1

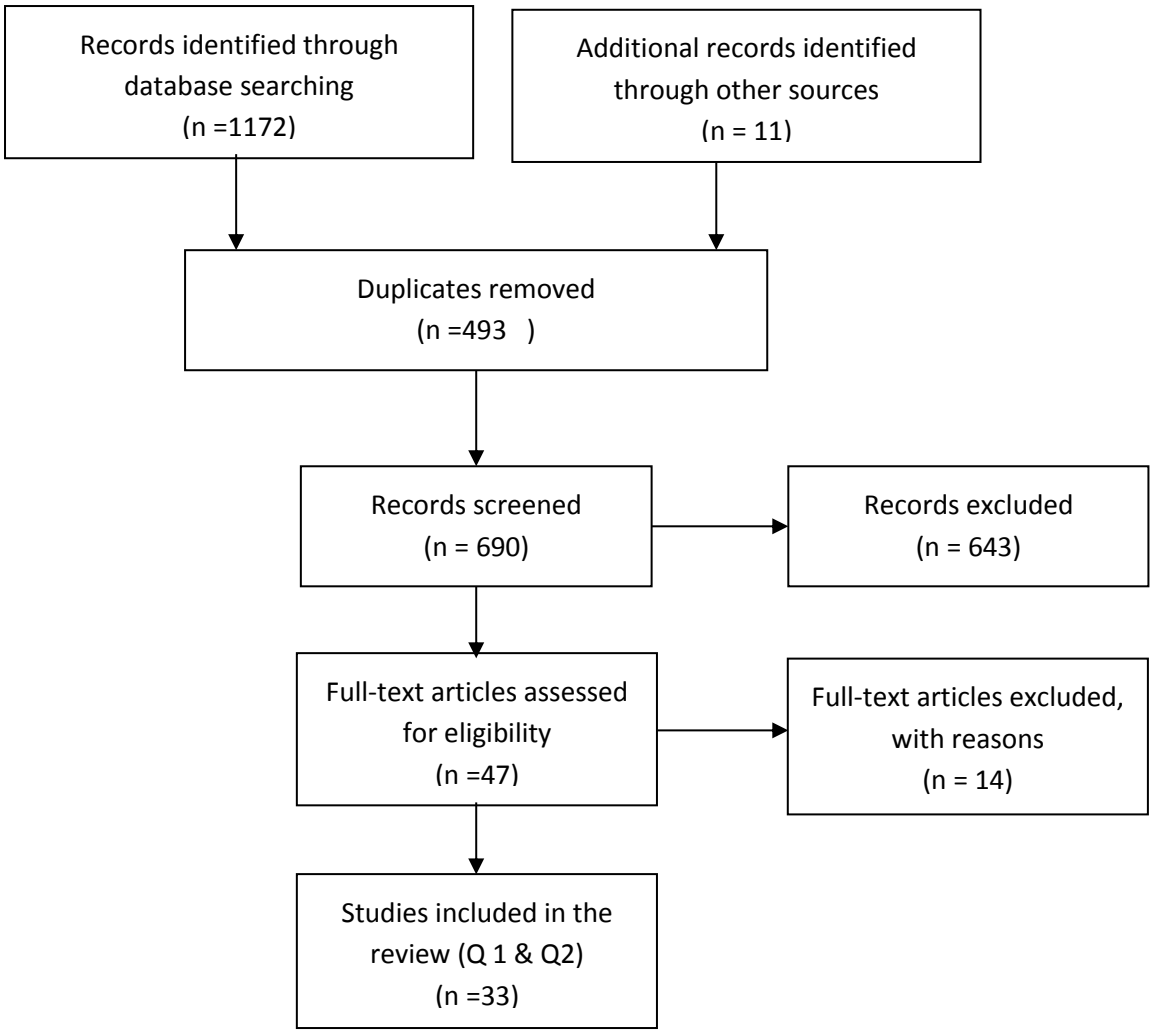


Figure 1. The study selection process

PRISMA Flow Diagram 2

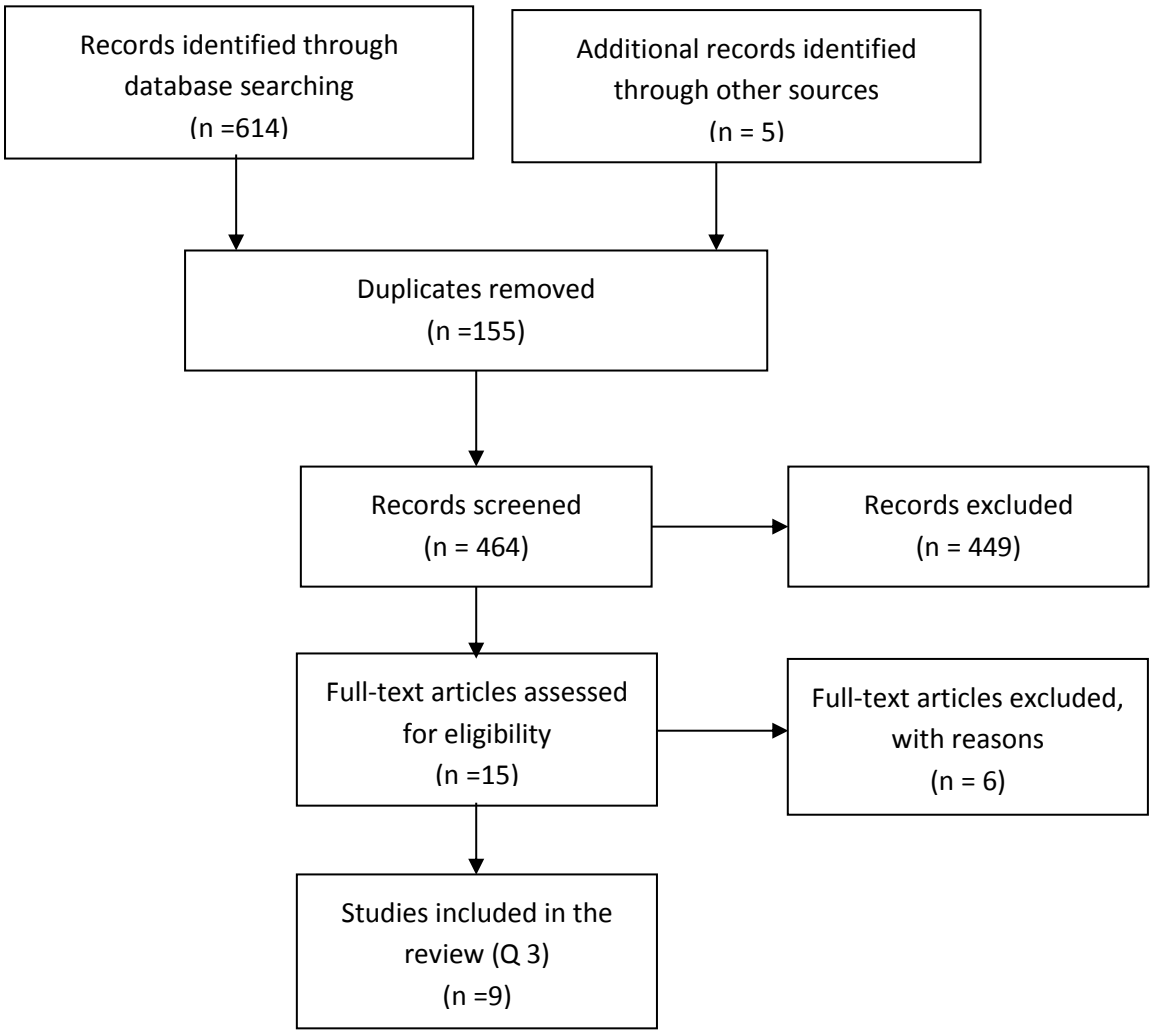


Figure 2. The study selection process

References

Beersma, MF, Schutten, M, Vennema, H, Hartwig, NG, Mes, TH, Osterhaus, AD, van Doornum, GJ & Koopmans, M 2009, 'Norovirus in a Dutch tertiary care hospital (2002-2007): frequent nosocomial transmission and dominance of GIIb strains in young children', *Journal of Hospital Infection,* vol. 71, no. 3, pp. 199-205.

Blaney, DD, Daly, ER, Kirkland, KB, Tongren, JE, Kelso, PT & Talbot, EA 2011, 'Use of alcohol-based hand sanitizers as a risk factor for norovirus outbreaks in long-term care facilities in northern New England: December 2006 to March 2007', *Am J Infect Control,* vol. 39, no. 4, May, pp. 296-301.

Cheng, FWT, Leung, TF, Lai, RWM, Chan, PKS, Hon, EKL & Ng, PC 2006, 'Rapid control of norovirus gastroenteritis outbreak in an acute paediatric ward', *Acta Paediatrica, International Journal of Paediatrics,* vol. 95, no. 5, May, pp. 581-586.

Cheng, VCC, Wong, LMW, Tai, JWM, Chan, JFW, To, KKW, Li, IWS, Hung, IFN, Chan, KH, Ho, PL & Yuen, KY 2011, 'Prevention of nosocomial transmission of norovirus by strategic infection control measures', *Infection Control and Hospital Epidemiology,* vol. 32, no. 3, March, pp. 229-237.

Costantini, VP, Cooper, EM, Hardaker, HL, Lee, LE, Bierhoff, M, Biggs, C, Cieslak, PR, Hall, AJ & Vinje, J 2016, 'Epidemiologic, Virologic, and Host Genetic Factors of Norovirus Outbreaks in Long-term Care Facilities', *Clinical Infectious Diseases,* vol. 62, no. 1, Jan, pp. 1-10.

Cummins, M & Ready, D 2016, 'Role of the Hospital Environment in Norovirus Containment', *Journal of Infectious Diseases,* vol. 213 Suppl 1, pp. S12-14.

Danial, J, Cepeda, JA, Cameron, F, Cloy, K, Wishart, D & Templeton, KE 2011, 'Epidemiology and costs associated with norovirus outbreaks in NHS Lothian, Scotland 2007-2009', *Journal of Hospital Infection,* vol. 79, no. 4, pp. 354-358.

Franck, KT, Fonager, J, Ersboll, AK & Bottiger, B 2014, 'Norovirus epidemiology in community and health care settings and association with patient age, Denmark', *Emerging Infectious Diseases,* vol. 20, no. 7, July, pp. 1123-1131.

Franck, KT, Nielsen, RT, Holzknecht, BJ, Ersboll, AK, Fischer, TK & Bottiger, B 2015, 'Norovirus Genotypes in Hospital Settings: Differences Between Nosocomial and Community-Acquired Infections', *Journal of Infectious Diseases,* vol. 212, no. 6, pp. 881-888.

Godoy, P, Ferrrus, G, Torner, N, Camps, N, Sala, MR, Guix, S, Bartolome, R, Martinez, A, De Simon, M, Dominguez, A & Working Group for the Study of Outbreaks of Acute Gastroenteritis in, C 2015, 'High incidence of norovirus GII.4 outbreaks in hospitals and nursing homes in Catalonia (Spain), 2010-2011', *Epidemiology & Infection,* vol. 143, no. 4, pp. 725-733.

Haill, CF, Newell, P, Ford, C, Whitley, M, Cox, J, Wallis, M, Best, R & Jenks, PJ 2012, 'Compartmentalization of wards to cohort symptomatic patients at the beginning and end of norovirus outbreaks', *Journal of Hospital Infection,* vol. 82, no. 1, pp. 30-35.

Harris, JP, Lopman, BA, Cooper, BS & O'Brien, SJ 2013, 'Does spatial proximity drive norovirus transmission during outbreaks in hospitals?', *BMJ Open,* vol. 3 (7) (no pagination), no. e003060.

Harris, JP, Adak, GK & O'Brien, SJ 2014, 'To close or not to close? Analysis of 4 year's data from national surveillance of norovirus outbreaks in hospitals in England', *BMJ Open,* vol. 4, no. 1, p. e003919.

Harris, JP, Adams, NL, Lopman, BA, Allen, DJ & Adak, GK 2014, 'The development of Web-based surveillance provides new insights into the burden of norovirus outbreaks in hospitals in England', *Epidemiology & Infection,* vol. 142, no. 8, pp. 1590-1598.

Harris, JP 2016, 'Norovirus Surveillance: An Epidemiological Perspective', *J Infect Dis,* vol. 213 Suppl 1, Feb 1, pp. S8-s11.

Heijne, JC, Rondy, M, Verhoef, L, Wallinga, J, Kretzschmar, M, Low, N, Koopmans, M & Teunis, PF 2012, 'Quantifying transmission of norovirus during an outbreak', *Epidemiology,* vol. 23, no. 2, pp. 277-284.

Higgins, JPT & Green, S 2011, *Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0*, The Cochrane Collaboration, < http://handbook.cochrane.org.

Hoffmann, D, Mauroy, A, Seebach, J, Simon, V, Wantia, N & Protzer, U 2013, 'New norovirus classified as a recombinant GII.g/GII.1 causes an extended foodborne outbreak at a university hospital in Munich', *Journal of Clinical Virology,* vol. 58, no. 1, pp. 24-30.

Illingworth, E, Taborn, E, Fielding, D, Cheesbrough, J, Diggle, PJ & Orr, D 2011, 'Is closure of entire wards necessary to control norovirus outbreaks in hospital? Comparing the effectiveness of two infection control strategies', *Journal of Hospital Infection,* vol. 79, no. 1, pp. 32-37.

JBI 2014, *The Joanna Briggs Institute Reviewers' Manual 2014 -The Systematic Review of Prevalence and Incidence Data*, The Joanna Briggs Institute, Adelaide.

Johnston, CP, Qiu, H, Ticehurst, JR, Dickson, C, Rosenbaum, P, Lawson, P, Stokes, AB, Lowenstein, CJ, Kaminsky, M, Cosgrove, SE, Green, KY & Perl, TM 2007, 'Outbreak management and implications of a nosocomial norovirus outbreak', *Clinical Infectious Diseases,* vol. 45, no. 5, pp. 534-540.

Kambhampati, A, Koopmans, M & Lopman, BA 2015, 'Burden of norovirus in healthcare facilities and strategies for outbreak control', *J Hosp Infect,* vol. 89, no. 4, Apr, pp. 296-301.

Kanerva, M, Maunula, L, Lappalainen, M, Mannonen, L, von Bonsdorff, CH & Anttila, VJ 2009, 'Prolonged norovirus outbreak in a Finnish tertiary care hospital caused by GII.4-2006b subvariants', *Journal of Hospital Infection,* vol. 71, no. 3, pp. 206-213.

Lindsay, L, Wolter, J, De Coster, I, Van Damme, P & Verstraeten, T 2015, 'A decade of norovirus disease risk among older adults in upper-middle and high income countries: a systematic review', *BMC Infect Dis,* vol. 15, p. 425.

Liu, P, Yuen, Y, Hsiao, HM, Jaykus, LA & Moe, C 2010, 'Effectiveness of liquid soap and hand sanitizer against Norwalk virus on contaminated hands', *Applied & Environmental Microbiology,* vol. 76, no. 2, Jan, pp. 394-399.

Lopman, BA, Gallimore, C, Gray, JJ, Vipond, IB, Andrews, N, Sarangi, J, Reacher, MH & Brown, DW 2006, 'Linking healthcare associated norovirus outbreaks: a molecular epidemiologic method for investigating transmission', *BMC Infect Dis,* vol. 6, p. 108.

Mattner, F, Guyot, A & Henke-Gendo, C 2015, 'Analysis of norovirus outbreaks reveals the need for timely and extended microbiological testing', *Journal of Hospital Infection,* vol. 91, no. 4, pp. 332-337.

Morter, S, Bennet, G, Fish, J, Richards, J, Allen, DJ, Nawaz, S, Iturriza-Gomara, M, Brolly, S & Gray, J 2011, 'Norovirus in the hospital setting: virus introduction and spread within the hospital environment', *Journal of Hospital Infection,* vol. 77, no. 2, pp. 106-112.

Munir, N, Liu, P, Gastanaduy, P, Montes, J, Shane, A & Moe, C 2014, 'Norovirus infection in immunocompromised children and children with hospital-acquired acute gastroenteritis', *Journal of Medical Virology,* vol. 86, no. 7, pp. 1203-1209.

Nenonen, NP, Hannoun, C, Svensson, L, Toren, K, Andersson, LM, Westin, J & Bergstrom, T 2014, 'Norovirus GII.4 detection in environmental samples from patient rooms during nosocomial outbreaks', *Journal of Clinical Microbiology,* vol. 52, no. 7, pp. 2352-2358.

Nguyen, LM & Middaugh, JP 2012, 'Suspected transmission of norovirus in eight long-term care facilities attributed to staff working at multiple institutions', *Epidemiology and Infection,* vol. 140, no. 9, Sep, pp. 1702-1709.

NHMRC 1999, *How to review the evidence: systematic identification and review of the scientific literature*, National Health and Medical Research Council <https://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/cp65.pdf>.

NHMRC 2000, *NHMRC additional levels of evidence and grades for recommendations for developers of guidelines*, National Health and Medical Research Council <https://www.nhmrc.gov.au/_files_nhmrc/file/guidelines/developers/nhmrc_levels_grades_evidence_120423.pdf>.

NHMRC 2010, *Australian Guidelines for the Prevention and Control of Infection in Healthcare*, Commonwealth of Australia, Canberra.

Ohwaki, K, Nagashima, H, Aoki, M, Aoki, H & Yano, E 2009, 'A foodborne norovirus outbreak at a hospital and an attached long-term care facility', *Jpn J Infect Dis,* vol. 62, no. 6, pp. 450-454.

Park, GW, Barclay, L, Macinga, D, Charbonneau, D, Pettigrew, CA & Vinje, J 2010, 'Comparative efficacy of seven hand sanitizers against murine norovirus, feline calicivirus, and GII.4 norovirus', *J Food Prot,* vol. 73, no. 12, Dec, pp. 2232-2238.

Partridge, DG, Evans, CM, Raza, M, Kudesia, G & Parsons, HK 2012, 'Lessons from a large norovirus outbreak: impact of viral load, patient age and ward design on duration of symptoms and shedding and likelihood of transmission', *Journal of Hospital Infection,* vol. 81, no. 1, pp. 25-30.

Petrignani, M, van Beek, J, Borsboom, G, Richardus, JH & Koopmans, M 2015, 'Norovirus introduction routes into nursing homes and risk factors for spread: a systematic review and meta-analysis of observational studies', *J Hosp Infect,* vol. 89, no. 3, Mar, pp. 163-178.

Rahamat-Langendoen, JC, Lokate, M, Scholvinck, EH, Friedrich, AW & Niesters, HG 2013, 'Rapid detection of a norovirus pseudo-outbreak by using real-time sequence based information', *J Clin Virol,* vol. 58, no. 1, Sep, pp. 245-248.

Rao, S, Scattolini de Gier, N, Caram, LB, Frederick, J, Moorefield, M & Woods, CW 2009, 'Adherence to self-quarantine recommendations during an outbreak of norovirus infection', *Infection Control & Hospital Epidemiology,* vol. 30, no. 9, pp. 896-899.

Rosenthal, NA, Lee, LE, Vermeulen, BAJ, Hedberg, K, Keene, WE, Widdowson, MA, Cieslak, PR & Vinje, J 2011, 'Epidemiological and genetic characteristics of norovirus outbreaks in long-term care facilities, 2003-2006', *Epidemiology and Infection,* vol. 139, no. 2, Feb, pp. 286-294.

Sadique, Z, Lopman, B, Cooper, BS & Edmunds, WJ 2016, 'Cost-effectiveness of Ward Closure to Control Outbreaks of Norovirus Infection in United Kingdom National Health Service Hospitals', *J Infect Dis,* vol. 213 Suppl 1, Feb 1, pp. S19-26.

Schmid, D, Kuo, HW, Hell, M, Kasper, S, Lederer, I, Mikula, C, Springer, B & Allerberger, F 2011, 'Foodborne gastroenteritis outbreak in an Austrian healthcare facility caused by asymptomatic, norovirus-excreting kitchen staff', *Journal of Hospital Infection,* vol. 77, no. 3, March, pp. 237-241.

Sheahan, A, Copeland, G, Richardson, L, McKay, S, Chou, A, Babady, NE, Tang, YW, Boulad, F, Eagan, J, Sepkowitz, K & Kamboj, M 2015, 'Control of norovirus outbreak on a pediatric oncology unit', *Am J Infect Control,* vol. 43, no. 10, pp. 1066-1069.

Simon, A, Schildgen, O, Maria Eis-Hubinger, A, Hasan, C, Bode, U, Buderus, S, Engelhart, S & Fleischhack, G 2006, 'Norovirus outbreak in a pediatric oncology unit', *Scandinavian Journal of Gastroenterology,* vol. 41, no. 6, pp. 693-699.

Sukhrie, FHA, Beersma, MFC, Wong, A, Van Der Veer, B, Vennema, H, Bogerman, J & Koopmans, M 2011, 'Using molecular epidemiology to trace transmission of nosocomial norovirus infection', *Journal of Clinical Microbiology,* vol. 49, no. 2, February, pp. 602-606.

Sukhrie, FHA, Teunis, P, Vennema, H, Copra, C, Thijs Beersma, MFC, Bogerman, J & Koopmans, M 2012, 'Nosocomial transmission of norovirus is mainly caused by symptomatic cases', *Clinical Infectious Diseases,* vol. 54, no. 7, 01 Apr, pp. 931-937.

The Cochrane Public Health Group 2010, *Guide for developing a Cochrane protocol V 2.0*, The Cochrane Public Health Group, <http://ph.cochrane.org/sites/ph.cochrane.org/files/uploads/Guide%20for%20PH%20protocol_Nov%202011_final%20for%20website.pdf>.

Tsang, OTY, Wong, ATY, Chow, CB, Yung, RWH, Lim, WWL & Liu, SH 2008, 'Clinical characteristics of nosocomial norovirus outbreaks in Hong Kong', *Journal of Hospital Infection,* vol. 69, no. 2, pp. 135-140.

Tseng, CY, Chen, CH, Su, SC, Wu, FT, Chen, CC, Hsieh, GY, Hung, CH & Fung, CP 2011, 'Characteristics of norovirus gastroenteritis outbreaks in a psychiatric centre', *Epidemiology & Infection,* vol. 139, no. 2, pp. 275-285.

Tu, ETV, Bull, RA, Kim, MJ, McIver, CJ, Heron, L, Rawlinson, WD & White, PA 2008, 'Norovirus excretion in an aged-care setting', *Journal of Clinical Microbiology,* vol. 46, no. 6, June, pp. 2119-2121.

Tung, G, Macinga, D, Arbogast, J & Jaykus, LA 2013, 'Efficacy of commonly used disinfectants for inactivation of human noroviruses and their surrogates', *J Food Prot,* vol. 76, no. 7, Jul, pp. 1210-1217.

Xue, C, Fu, Y, Zhu, W, Fei, Y, Zhu, L, Zhang, H, Pan, L, Xu, H, Wang, Y, Wang, W & Sun, Q 2014, 'An outbreak of acute norovirus gastroenteritis in a boarding school in Shanghai: a retrospective cohort study', *BMC Public Health,* vol. 14, p. 1092.

Zheng, QM, Zeng, HT, Dai, CW, Zhang, SX, Zhang, Z, Mei, SJ, He, YQ & Ma, HW 2015, 'Epidemiological investigation of a norovirus GII.4 Sydney outbreak in a China elder care facility', *Jpn J Infect Dis,* vol. 68, no. 1, pp. 70-74.

Appendix I Search Strategy

Review Question 1 and 2

The following information sources were searched:

- CENTRAL (Cochrane Central Register of Controlled Trials, The Cochrane Library) 12
- CINAHL (Cumulative Index to Nursing & Allied Health Literature)95
- Cochrane Database of Systematic Reviews 12
- DARE (Database of Abstracts of Reviews of Effects) 46
- Joanna Briggs Institute EBP Database 1
- EMBASE-OvidSP 533
- MEDLINE-OvidSP322
- NCCHTA (National Coordinating Centre for Health Technology Assessment) 1
- Science Citation Index Expanded (Web of Science) 120
- World Health Organization Library Information System(WHOLIS/IRIS 42

Total records: 1172

Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) <1946 to
Present>
Search Strategy:

---

1 Norovirus/ (3030)
2 Norwalk virus/ (693)
3 (Norovirus* or norwalk virus* or small round structured virus*).ti,ab. (4656)
4 or/1-3 (5109)
5 Epidemiology/ (11974)
6 (transmission pathway* or epidemiolog*).ti,ab. (304200)
7 (outbreak or out-break or prevalence or epidemic or endemic or incidence or distribution or control).ti,ab.
(3600560)
8 or/5-7 (3777194)
9 exp Hospitals/ (239369)
10 (acute care or hospital$1 or aged care or paediatric or pediatric or neonatal or rehabilitation).ti,ab. (1324107)
11 or/9-10 (1420391)
12 4 and 8 and 11 (560)
13 limit 12 to (english language and humans and yr="2006 -Current") **(322)**
14 Randomized Controlled Trials as Topic/ (110804)
15 randomized controlled trial/ (432794)
16 Random Allocation/ (89204)
17 Double Blind Method/ (139740)
18 Single Blind Method/ (22913)
19 clinical trial/ (506371)
20 controlled clinical trial.pt. (91806)
21 randomized controlled trial.pt. (432794)
22 clinical trial.pt. (506371)
23 exp Clinical Trials as topic/ (303845)
24 (clinical adj trial$).tw. (270943)
25 ((singl$ or doubl$ or treb$ or tripl$) adj (blind$3 or mask$3)).tw. (146857)
26 randomly allocated.tw. (21212)
27 (allocated adj2 random$).tw. (24050)

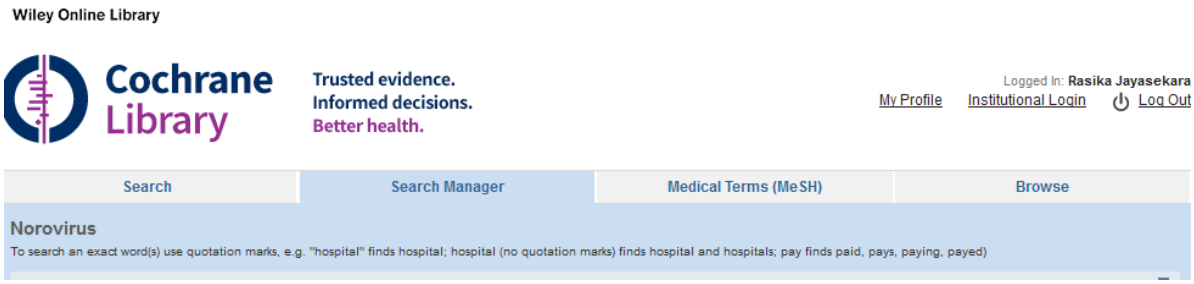
28 or/14-27 (1205617)
29 12 and 28 (4)
30 limit 29 to (english language and humans) (3)

****
1.
Community incidence of norovirus-associated infectious intestinal disease in England: improved estimates using viral load for norovirus diagnosis.
Phillips G; Tam CC; Conti S; Rodrigues LC; Brown D; Iturriza-Gomara M; Gray J; Lopman B.
American Journal of Epidemiology. 171(9):1014-22, 2010 May 1.
[Controlled Clinical Trial. Journal Article]
No Relevant RCT

Ovid Technologies, Inc. Email Service----------Search for: from 30 [limit 29 to (english language and humans)] keep 1Results: 1

Database: Embase Classic+Embase <1947 to 2016 October 10> Search Strategy:
---
1 Norovirus/ (4994)
2 Norwalk virus/ (30)
3 (Norovirus* or norwalk virus* or small round structured virus*).ti,ab. (5261)
4 or/1-3 (5933)
5 Epidemiology/ (293281)
6 (transmission pathway* or epidemiolog*).ti,ab. (395087)
7 (outbreak or out-break or prevalence or epidemic or endemic or incidence or distribution or control).ti,ab.
(4764076)
8 or/5-7 (5098940)
9 exp Hospitals/ (1301851)
10 (acute care or hospital$1 or aged care or paediatric or pediatric or neonatal or rehabilitation).ti,ab. (1937329)
11 or/9-10 (2441587)
12 4 and 8 and 11 (791)
13 limit 12 to (english language and humans and yr="2006 -Current") **(533)**
14 Randomized Controlled Trials as Topic/ (55458)
15 randomized controlled trial/ (454554)
16 Random Allocation/ (79114)
17 Double Blind Method/ (115285)
18 Single Blind Method/ (24689)
19 clinical trial/ (983841)
20 controlled clinical trial.pt. (0)
21 randomized controlled trial.pt. (0)
22 clinical trial.pt. (0)
23 exp Clinical Trials as topic/ (259959)
24 (clinical adj trial$).tw. (374802)
25 ((singl$ or doubl$ or treb$ or tripl$) adj (blind$3 or mask$3)).tw. (197991)
26 randomly allocated.tw. (26405)
27 (allocated adj2 random$).tw. (29817)
28 or/14-27 (1579458)
29 12 and 28 (19)
30 limit 29 to (english language and humans) (18)
31 from 13 keep 1-322 (322)

32 from 30 keep 1 (1)



Search Name: Norovirus

Date Run: 11/10/16 07:58:54.554

Description:

ID	Search	Hits
#1	Norovirus or Norwalk virus:ti,ab,kw (Word variations have been searched)	51
#2	(Norovirus* or norwalk virus* or small round structured virus*) .ti,ab.	12
#3	#1 or #2	63
#4	Epidemiology:ti,ab,kw	8520
#5	(transmission pathway* or epidemiolog*) .ti,ab.	775
#6	(outbreak or out-break or prevalence or epidemic or endemic or incidence or distribution or control) .ti,ab.	3053
#7	#4 or #5 or #6	11569
#8	Hospital:ti,ab,kw	66556
#9	(acute care or hospital$1 or aged care or paediatric or pediatric or neonatal or rehabilitation) .ti,ab.	2382
#10	#8 or #9	68522
#11	#3 and #7 and #10	12

Ovid Technologies, Inc. Email Service

Search for: from 30 [limit 29 to (english language and humans) [Limit not valid; records were retained]] keep 1
Results: 1

Database: Joanna Briggs Institute EBP Database - <Current to October 05, 2016> Search Strategy:
---
1 Norovirus/ (1)
2 Norwalk virus/ (0)
3 (Norovirus* or norwalk virus* or small round structured virus*).ti,ab. (0)
4 or/1-3 (1)
5 Epidemiology/ (2)
6 (transmission pathway* or epidemiolog*).ti,ab. (4)
7 (outbreak or out-break or prevalence or epidemic or endemic or incidence or distribution or control).ti,ab. (143)
8 or/5-7 (147)
9 exp Hospitals/ (4)
10 (acute care or hospital$1 or aged care or paediatric or pediatric or neonatal or rehabilitation).ti,ab. (454)
11 or/9-10 (455)
12 4 and 8 and 11 (1)
13 limit 12 to (english language and humans and yr="2006 -Current") [Limit not valid; records were retained] **(1)**
14 Randomized Controlled Trials as Topic/ (0)
15 randomized controlled trial/ (0)
16 Random Allocation/ (0)
17 Double Blind Method/ (0)
18 Single Blind Method/ (0)
19 clinical trial/ (2)
20 controlled clinical trial.pt. (0)
21 randomized controlled trial.pt. (0)
22 clinical trial.pt. (0)
23 exp Clinical Trials as topic/ (0)
24 (clinical adj trial$).tw. (1232)
25 ((singl$ or doubl$ or treb$ or tripl$) adj (blind$3 or mask$3)).tw. (606)
26 randomly allocated.tw. (57)
27 (allocated adj2 random$).tw. (59)
28 or/14-27 (1578)
29 12 and 28 (1)
30 limit 29 to (english language and humans) [Limit not valid; records were retained] (1)
31 [from 13 keep 1-322] (0)
32 from 30 keep 1 (1)

Searching: CINAHL

Monday, October 31, 2016 1:06:53 AM

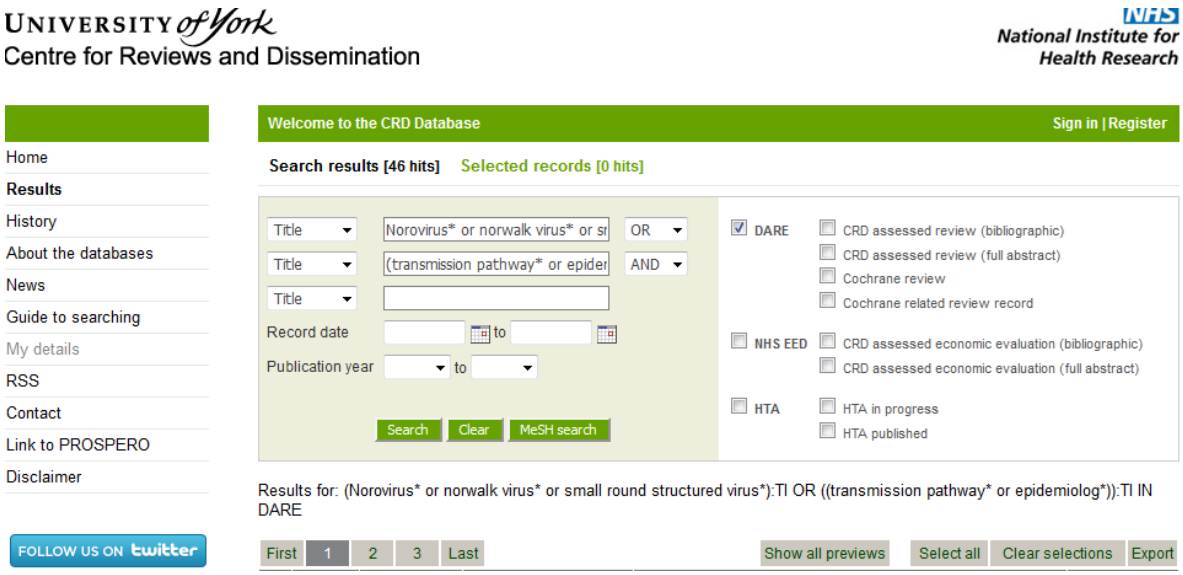
#	Query	Limiters/Expanders	Last Run Via	Results
S24	S11 AND S23	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	10
S23	S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	852,816
S22	TX allocat* random*	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	4,004
S21	(MH "Quantitative Studies")	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	11,941
S20	(MH "Placebos")	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen -	7,694

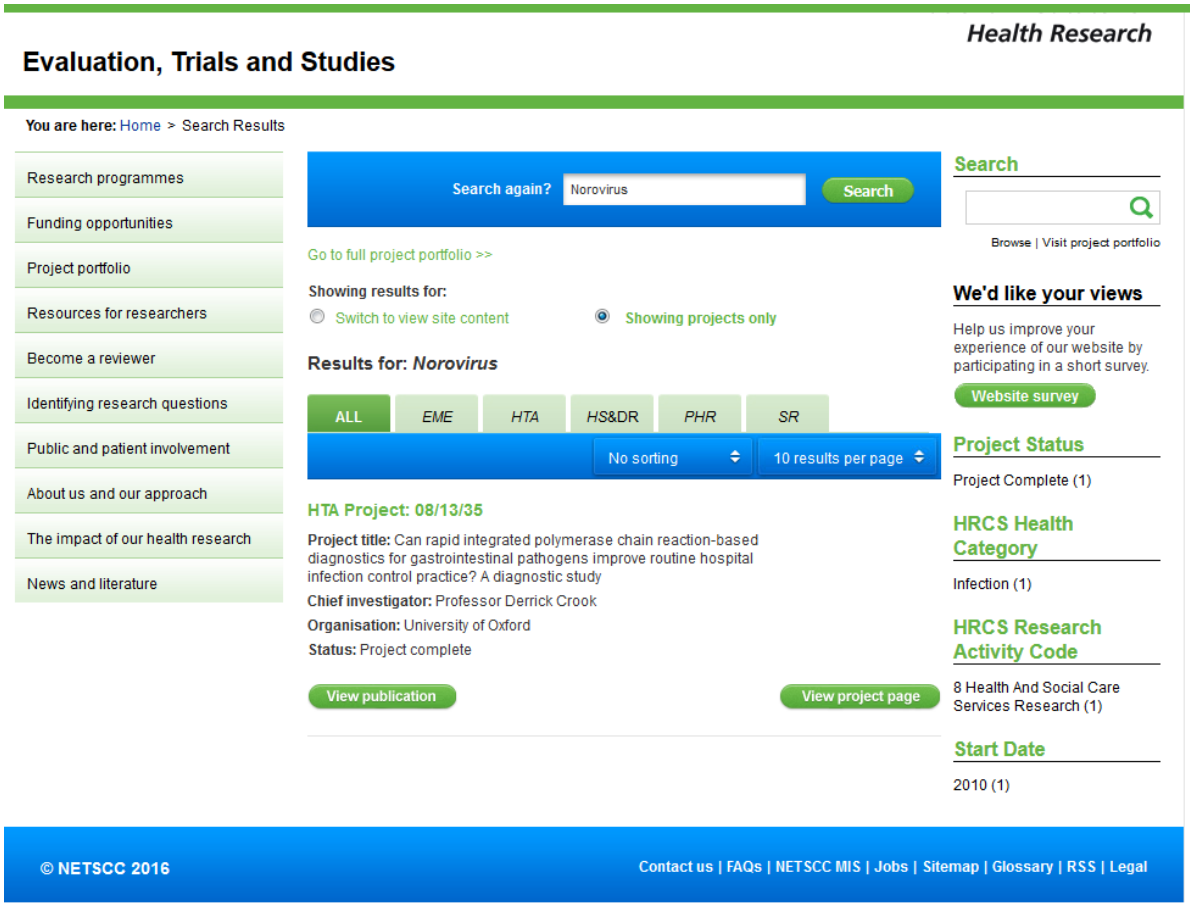
			Advanced Search Database - CINAHL	
S19	TX placebo*	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	29,791
S18	TX random* allocat*	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	4,004
S17	(MH "Random Assignment")	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	33,884
S16	TX randomi* control* trial*	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	69,946
S15	TX ((singl* n1 blind*) or (singl* n1 mask*)) or TX ((doubl* n1 blind*) or (doubl* n1 mask*)) or TX ((tripl* n1 blind*) or (tripl* n1 mask*)) or TX ((trebl* n1 blind*) or (trebl* n1 mask*)	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen -	706,757

	)		Advanced Search Database - CINAHL	
S14	TX clinic* n1 trial*	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	129,934
S13	PT Clinical trial	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	52,806
S12	(MH "Clinical Trials+")	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	137,172
S11	S3 AND S7 AND S10	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	**95**
S10	S8 OR S9	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen -	198,275

			Advanced Search Database - CINAHL	
S9	AB (acute care or hospital$1 or aged care or paediatric or pediatric or neonatal or rehabilitation)	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	90,909
S8	AB hospitals or health care facilities	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	128,216
S7	S4 OR S5 OR S6	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	279,928
S6	AB (outbreak or out-break or prevalence or epidemic or endemic or incidence or distribution or control)	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	266,472
S5	AB (transmission pathway* or epidemiolog*)	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen -	24,156

			Advanced Search Database - CINAHL	
S4	AB Epidemiology	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	9,129
S3	S1 OR S2	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	311
S2	AB (Norovirus* or norwalk virus* or small round structured virus*)	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	311
S1	AB Norovirus OR AB Norwalk virus	Expanders - Apply related words Search modes - Boolean/Phrase	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL	307


UNIVERSITY of York
Centre for Reviews and Dissemination
NHS
National Institute for Health Research
Home
Results
History
About the databases
News
Guide to searching
My details
RSS
Contact
Link to PROSPERO
Disclaimer
FOLLOW US ON twitter
Welcome to the CRD Database
Sign in | Register
Search results [46 hits]
Selected records [0 hits]
Title
Norovirus* or norwalk virus* or sr
OR
Title
(transmission pathway* or epider
AND
Title
Record date
to
Publication year
to
Search
Clear
MeSH search
DARE
CRD assessed review (bibliographic)
CRD assessed review (full abstract)
Cochrane review
Cochrane related review record
NHS EED
CRD assessed economic evaluation (bibliographic)
CRD assessed economic evaluation (full abstract)
HTA
HTA in progress
HTA published
Results for: (Norovirus* or norwalk virus* or small round structured virus*):TI OR ((transmission pathway* or epidemiolog*)):TI IN DARE
First
1
2
3
Last
Show all previews
Select all
Clear selections
Export



Results: 120

(from Web of Science Core Collection)
You searched for: (TS=((Norovirus* or norwalk virus*).) AND TS=((transmission pathway* or epidemiolog*).) AND TS=(Hospital* or acute care or hospital$1 or aged care or paediatric or pediatric or neonatal or rehabilitation)) *AND* **LANGUAGE:** (English)
Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan

Review Question 3

The following information sources were searched:

- CENTRAL (Cochrane Central Register of Controlled Trials, The Cochrane Library) – 0
- CINAHL (Cumulative Index to Nursing & Allied Health Literature) 45
- Cochrane Database of Systematic Reviews - 13
- DARE (Database of Abstracts of Reviews of Effects) 0
- Joanna Briggs Institute EBP Database - 2
- EMBASE-OvidSP 368
- MEDLINE-OvidSP 160
- NCCHTA (National Coordinating Centre for Health Technology Assessment) – 0
- Science Citation Index Expanded (Web of Science) - 29
- World Health Organization Library Information System(WHOLIS/IRIS) - 2

Total records: 614

Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) <1946 to
Present>
Search Strategy:
---

1 norovirus/ (3424)
2 norwalk virus/ (798)
3 (Norovirus* or norwalk virus* or small round structured virus*).mp. [mp=title, abstract, original title, name of
substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (5720)
4 or/1-3 (5720)
5 exp Hospitals/ (253717)
6 (acute care or hospital$1 or rehabilitation or aged care or paediatric or pediatric or neonatal or rehabilitation).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (1735199)
7 or/5-6 (1746956)
8 exp Infection Control/ (59250)
9 exp Hand Disinfection/ (5225)
10 Disinfection/ (12524)
11 Disinfectants/ (11532)
12 exp Personal Protective Equipment/ (20020)
13 exp protective clothing/ (11372)
14 respiratory protective devices/ (1904)
15 (control measure* or infection control or handwashing or hand washing or hand hygiene or glove* or gown* or
apron* or mask* or alcohol based solution*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (137231)
16 (Personal Protective Equipment or protective clothing).mp. [mp=title, abstract, original title, name of substance

word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (7725)
17 respiratory protective devices.mp. (1933)
18 ((barrier* or contact or universal or droplet or isolation or airborne) adj precaution*).mp. [mp=title, abstract,
original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (3601)
19 ((contact or patient or ward* or unit*) adj2 isolation).mp. [mp=title, abstract, original title, name of
substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (4693)
20 (isolated ward* or (ward adj2 clos*) or (clos* adj2 ward*)).mp. [mp=title, abstract, original title, name of
substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier] (328)
21 or/8-20 (195466)
22 4 and 7 and 21 (160)

Database: Embase Classic+Embase <1947 to 2016 November 09>
Search Strategy:
---
1 norovirus/ (5097)
2 norwalk virus/ (33)
3 (Norovirus* or norwalk virus* or small round structured virus*).mp. [mp=title, abstract, heading word, drug trade
name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading] (6184)
4 or/1-3 (6184)
5 exp Hospitals/ (1313865)
6 (acute care or hospital$1 or rehabilitation or aged care or paediatric or pediatric or neonatal or rehabilitation).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug
manufacturer, device trade name, keyword, floating subheading] (2742270)
7 or/5-6 (2951824)
8 exp Infection Control/ (99012)
9 exp Hand Disinfection/ (11382)
10 Disinfection/ (25488)
11 Disinfectants/ (13187)
12 exp Personal Protective Equipment/ (46258)
13 exp protective clothing/ (11189)
14 respiratory protective devices/ (1344)
15 (control measure* or infection control or handwashing or hand washing or hand hygiene or glove* or gown* or
apron* or mask* or alcohol based solution*).mp. [mp=title, abstract, heading word, drug trade name, original title,
device manufacturer, drug manufacturer, device trade name, keyword, floating subheading] (239058)
16 (Personal Protective Equipment or protective clothing).mp. [mp=title, abstract, heading word, drug trade name,

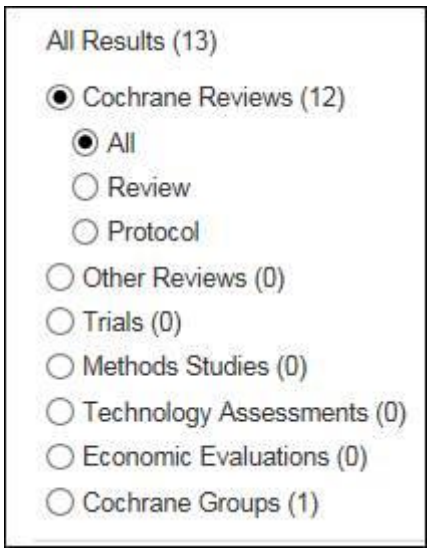
original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading] (13410)
17 respiratory protective devices.mp. (126)
18 ((barrier* or contact or universal or droplet or isolation or airborne) adj precaution*).mp. [mp=title, abstract,
heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword,
floating subheading] (3235)
19 ((contact or patient or ward* or unit*) adj2 isolation).mp. [mp=title, abstract, heading word, drug trade name,
original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading] (2056)
20 (isolated ward* or (ward adj2 clos*) or (clos* adj2 ward*)).mp. [mp=title, abstract, heading word, drug trade
name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading] (465)
21 or/8-20 (322991)
22 4 and 7 and 21 (368)

Database: Joanna Briggs Institute EBP Database - <Current to November 02, 2016> Search Strategy:
---
1 norovirus/ (1)
2 (Norovirus* or norwalk virus* or small round structured virus*).mp. [mp=text, heading word, subject area node, title] (2)
3 or/1-2 (2)
4 exp Hospitals/ (6)
5 (acute care or hospital$1 or rehabilitation or aged care or paediatric or pediatric or neonatal or rehabilitation).mp. [mp=text, heading word, subject area node, title] (4234)
6 or/4-5 (4234)
7 exp Infection Control/ (104)
8 Disinfection/ (6)
9 Disinfectants/ (1)
10 exp Personal Protective Equipment/ (14)
11 exp protective clothing/ (3)
12 (control measure* or infection control or handwashing or hand washing or hand hygiene or glove* or gown* or apron* or mask* or alcohol based solution*).mp. [mp=text, heading word, subject area node, title] (1061)
13 (Personal Protective Equipment or protective clothing).mp. [mp=text, heading word, subject area node, title] (147)
14 respiratory protective devices.mp. (1)
15 ((barrier* or contact or universal or droplet or isolation or airborne) adj precaution*).mp. [mp=text, heading word, subject area node, title] (66)
16 ((contact or patient or ward* or unit*) adj2 isolation).mp. [mp=text, heading word, subject area node, title] (35)
17 (isolated ward* or (ward adj2 clos*) or (clos* adj2 ward*)).mp. [mp=text, heading word, subject area node, title] (9)
18 or/7-17 (1096)
22 and/3,6,18 (2)

Cochrane Library

Search Name: Norovirus Q3 Final
Last Saved: 10/11/2016 20:55:28.897
Description: 11/11/16

ID	Search
#1	MeSH descriptor: [Norovirus] this term only
#2	MeSH descriptor: [Norwalk virus] this term only
#3	Norovirus* or norwalk virus* or small round structured virus*
#4	#1 or #2 or #3
#5	MeSH descriptor: [Hospitals] explode all trees
#6	"acute care" or hospital$1 or rehabilitation or "aged care" or paediatric or pediatric or neonatal
#7	#5 or #6
#8	MeSH descriptor: [Infection Control] explode all trees
#9	MeSH descriptor: [Hand Disinfection] explode all trees
#10	MeSH descriptor: [Disinfection] this term only
#11	MeSH descriptor: [Disinfectants] explode all trees
#12	MeSH descriptor: [Personal Protective Equipment] explode all trees
#13	MeSH descriptor: [Protective Clothing] explode all trees
#14	MeSH descriptor: [Respiratory Protective Devices] this term only
#15	"control measure*" or "infection control" or handwashing or "hand washing" or "hand hygiene" or glove* or gown* or apron* or mask* or "alcohol based solution*" apron* or mask* or alcohol based solution*
#16	"Personal Protective Equipment" or "protective clothing"
#17	"respiratory protective devices"
#18	((barrier* or contact or universal or droplet or isolation or airborne) adj precaution*)
#19	((contact or patient or ward* or unit*) adj2 isolation)
#20	(isolated ward* or (ward adj2 clos*) or (clos* adj2 ward*))
#21	#8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20
#22	#4 and #7 and #21



CINAHL

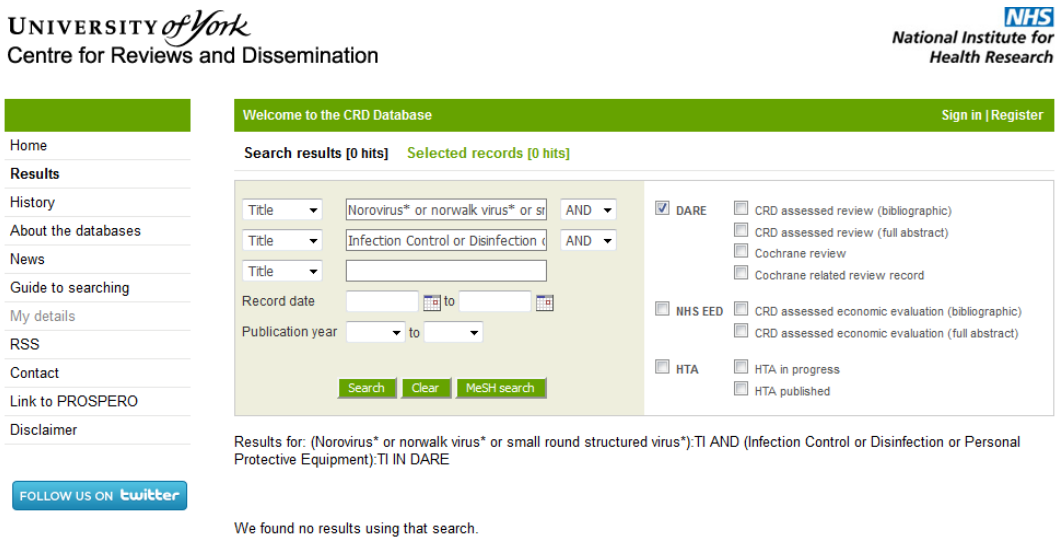
#	Query	Results
S24	S3 AND S6 AND S23	45
S23	(S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22)	52,887
S22	(isolat* ward* or (ward near2 clos*) or (clos* near2 ward*))	99
S21	((contact or patient or ward* or unit*) near2 isolation).	2,895
S20	((contact or patient or ward* or unit*) and isolation)	7,321
S19	((barrier* or contact or universal or droplet or isolation or airborne) and precaution*)	2,348
S18	"respiratory protective device*"	1,026
S17	"Personal Protective Equipment" or "protective clothing"	2,923
S16	"control measure*" or "infection control" or handwashing or "hand washing" or "hand hygiene" or glove* or gown* or apron* or mask* or "alcohol based solution*"	35,508
S15	(MH "Protective Clothing")	2,366
S14	(MH "Head Protective Devices")	1,138
S13	(MH "Respiratory Protective Devices")	1,024
S12	(MH "Protective Devices")	2,658
S11	(MH "Self Defense Agents, Chemical")	27
S10	(MH "Disinfectants")	1,613
S9	(MH "Sterilization and Disinfection")	6,722
S8	(MH "Handwashing")	5,420
S7	(MH "Infection Control")	18,649
S6	S4 OR S5	283,777
S5	"acute care" or hospital$1 or rehabilitation or "aged care" or paediatric or pediatric or neonatal or rehabilitation	226,261

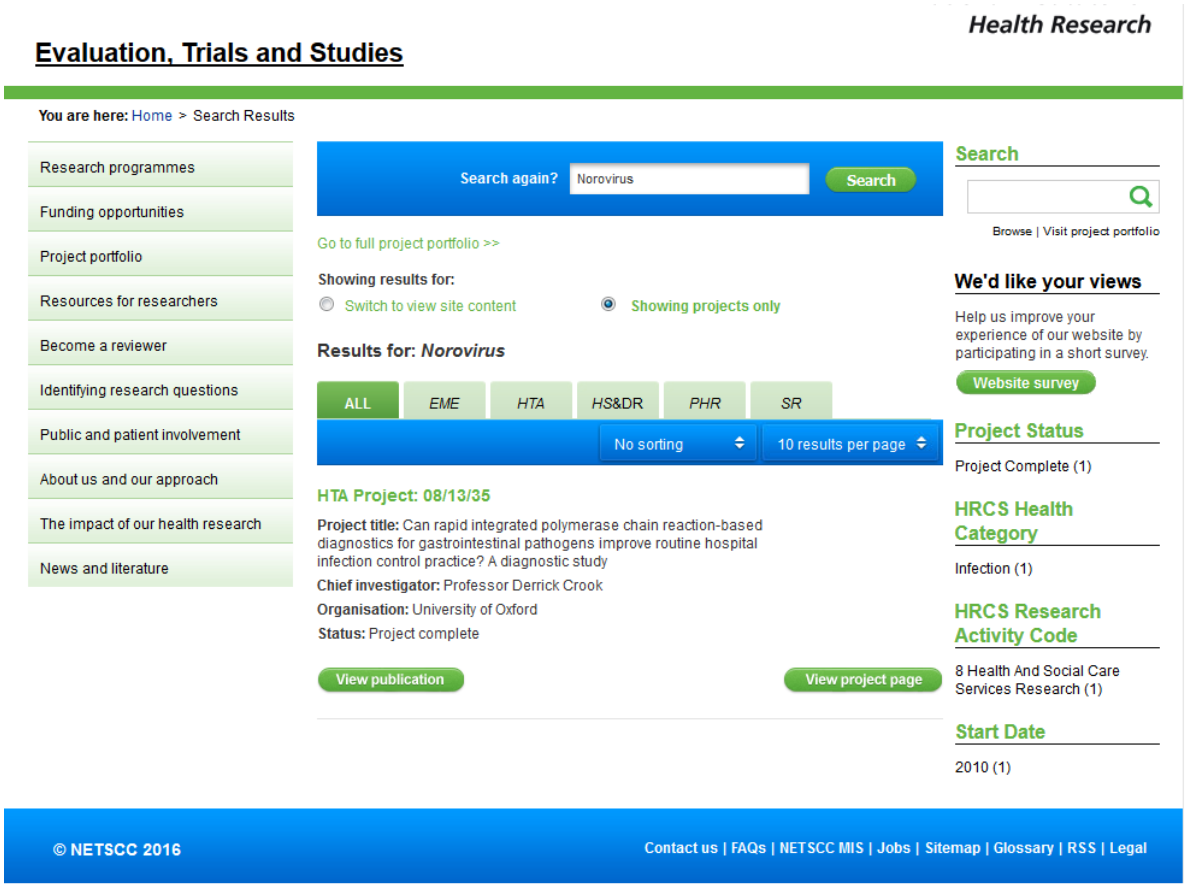
S4	(MH "Hospitals+")	68,403
S3	S1 OR S2	573
S2	Norovirus* or "norwalk virus*" or "small round structured virus*"	466
S1	(MH "Caliciviridae Infections")	369

Web of Science

Search History:

Set	Results	Save History / Create Alert | Open Saved History
# 11	29	#10 AND #2 AND #1 *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years*
# 10	221,841	#9 OR #8 OR #7 OR #6 OR #5 OR #4 OR #3 *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years*
# 9	2,732	**TOPIC:** ((isolat* ward* or (ward near2 clos*) or (clos* near2 ward*))) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years*
# 8	39,574	**TOPIC:** (((contact or patient or ward* or unit*) and isolation)) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years*
# 7	39,574	**TOPIC:** (((contact or patient or ward* or unit*) and isolation)) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years*
# 6	3,381	**TOPIC:** (((barrier* or contact or universal or droplet or isolation or airborne) and precaution*)) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years*
# 5	116	**TOPIC:** ("respiratory protective device*") *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years*
# 4	3,741	**TOPIC:** ("Personal Protective Equipment" or "protective clothing") *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years*
# 3	177,384	**TOPIC:** ("control measure*" or "infection control" or handwashing or "hand washing" or "hand hygiene" or glove* or gown* or apron* or mask* or "alcohol based solution*") *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years*
# 2	565,609	**TOPIC:** ("acute care" or hospital$1 or rehabilitation or "aged care" or paediatric or pediatric or neonatal or rehabilitation) *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years*
# 1	5,107	**TOPIC:** (Norovirus* or "norwalk virus*" or "small round structured virus*") *Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC Timespan=All years*




Health Research
Evaluation, Trials and Studies
You are here: Home > Search Results
Research programmes
Funding opportunities
Project portfolio
Resources for researchers
Become a reviewer
Identifying research questions
Public and patient involvement
About us and our approach
The impact of our health research
News and literature
Search again? Norovirus
Search
Go to full project portfolio >>
Showing results for:
Switch to view site content
Showing projects only
Results for: Norovirus
ALL
EME
HTA
HS&DR
PHR
SR
No sorting
10 results per page
HTA Project: 08/13/35
Project title: Can rapid integrated polymerase chain reaction-based diagnostics for gastrointestinal pathogens improve routine hospital infection control practice? A diagnostic study
Chief investigator: Professor Derrick Crook
Organisation: University of Oxford
Status: Project complete
View publication
View project page
Search
Browse | Visit project portfolio
We'd like your views
Help us improve your experience of our website by participating in a short survey.
Website survey
Project Status
Project Complete (1)
HRCS Health Category
Infection (1)
HRCS Research Activity Code
8 Health And Social Care Services Research (1)
Start Date
2010 (1)
© NETSCC 2016
Contact us | FAQs | NETSCC MIS | Jobs | Sitemap | Glossary | RSS | Legal

Appendix II: Data Extraction Q 1 & 2

(Beersma et al. 2009)

<table>
<tr><td colspan="8">Ref No: 270</td></tr>
<tr><td colspan="8">Reference: (Beersma et al. 2009)</td></tr>
<tr><td colspan="8">Affiliation / source of funds: Department of Virology, Erasmus Medical Center, Rotterdam, The Netherlands</td></tr>
<tr><td colspan="8">Epidemiology</td></tr>
<tr><td>Study Design:</td><td colspan="3">Retrospective analysis</td><td>Level of Evidence</td><td colspan="3">IV</td></tr>
<tr><td>WHO Region/Country:</td><td colspan="3"></td><td colspan="4"></td></tr>
<tr><td rowspan="2">Location / Setting:</td><td>Acute</td><td>Aged</td><td>Paediatrics</td><td>Neonatal</td><td>Rehab</td><td colspan="2">Other</td></tr>
<tr><td>tertiary care hospital</td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Reported period</td><td>Start:</td><td colspan="2">2002/03</td><td>End:</td><td colspan="3">2006/07</td></tr>
<tr><td>Diagnostic method</td><td colspan="7">polymerase chain reaction (PCR) assays

LightCycler amplification followed by SYBR Green I staining of PCR products was used (LightCycler version 3.5, Roche, Mann-heim, Germany).16 From 2006 onwards, Taqman assays for GI and GII were used</td></tr>
<tr><td>Number of Cases</td><td colspan="2">Stool samples from out-patient clinics (N=7), paediatric wards (N=11) and adult wards (N=20). Most samples (68.2%) were taken from patients aged <18 years</td><td colspan="3">Positive: 221/2458</td><td colspan="2">Negative:</td></tr>
<tr><td>Genotype</td><td colspan="3"></td><td>GII.4 variants</td><td colspan="2">Two genotypes predomi-nated during the study period: GIIb strains occurred mainly in children below the age of two-and-a-half years [odds ratio (OR): 14.7; P<0.0001] whereas GII.4strains affectedallagegr</td></tr>
</table>

									oups
Other pathogen found	Rotavirus			Others					
Age Group/Sample	Neonate/infant			Children		Adults		Older adults	
				X		X			
Population Characteristics									
Clinical features	Vomiting		Abd. pain		Diarrhoea		Other		**Mortality rate**
Transmission pathways									
Person to person transmission	Oral –Faecal route		Direct contact (vomitus)		Aerosols		Other		
							The proportion of NoV infection that was nosocomially acquired was highest in the youngest patients (58%) and in the elderly (78%)		
Primary transmission	Foodborne			Waterborne			Environmental		
Food vehicle categories	Produce			Shellfish			Ready to eat		
Water vehicle categories	Tap water		Ground water		Recreational water		other		
Reported Management strategies / Implication	data demonstrate a diverse and dynamic pattern of NoV infections in a tertiary hospital setting, characterised by frequent nosocomial transmission and the unexplained dominance of GIIb strains in children								

(Cheng, FWT et al. 2006)

Ref No: 864						
Reference: (Cheng, FWT et al. 2006)						
Affiliation / source of funds: The Chinese University of Hong/ Kong, Prince of Wales Hospital, Shatin, Hong Kong						
Epidemiology						
Study Design:	**Case series**		**Level of Evidence**	IV		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
			X			
Reported period	Start:	19 August and No details about Year		End:	28 August No details about Year	
Diagnostic method	reverse transcription polymerase chain reaction (RT-PCR) using the SuperScript III One-Step RT-PCR system with Platinum Taq DNApolymerase (Invitrogen Corporation, Carlsbad CA),with Norovirus-specific primers GLPSG2 and YG-DD1 stool samples /rectal swabs					
Number of Cases	242 subjects (24 HCW, 40 medical students, 54 patients and 124 parents and visitors	Positive: Nine children, one visitor, and one medical student	Negative:			
Genotype		**GII.4 variants**				
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
		X				
Population Characteristics	Median age was five years (range: 4 months to 22 years)					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
	82%	-	63%	Fever 18%	0	

<table>
<tr><th colspan="5">Transmission pathways</th></tr>
<tr><td>Person to person transmission</td><td>Oral –Faecal route</td><td>Direct contact (vomitus)</td><td>Aerosols</td><td>Other</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Primary transmission</td><td colspan="2">Foodborne</td><td colspan="2">Waterborne</td><td>Environmental</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="2"></td><td></td></tr>
<tr><td>Food vehicle categories</td><td colspan="2">Produce</td><td colspan="2">Shellfish</td><td>Ready to eat</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="2"></td><td></td></tr>
<tr><td>Water vehicle categories</td><td>Tap water</td><td>Ground water</td><td>Recreational water</td><td>other</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Reported Management strategies / Implication</td><td colspan="4">Ward A was closed to new admissions once the norovirus outbreak was suspected.
Asymptomatic patients were kept in Ward A, and were closely monitored for any gastroenteritis symptom
All symptomatic patients were immediately isolated in the infectious disease ward (Ward B) with private toilet facility.
Infection control measures - contact precautions
Environmental cleansing - hypochlorite solution 1000 ppm)
Visiting policy
(Table 2)

There is no specific data reporting/ The outbreak was terminated within three days after the implementation of strict infection control measures. No second wave of affected cases was encountered.</td></tr>
</table>

(Cheng, VCC et al. 2011)

Ref No: 711						
Reference: (Cheng, VCC et al. 2011)						
Affiliation / source of funds: Queen Mary Hospital, Hong Kong /Suen Chi Sun Charitable Foundation and Research Fund for the Control of Infectious Diseases (RFCID).						
Epidemiology						
Study Design:	**Cohort study**		**Level of Evidence**	III-2		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X					
Reported period	Start:	November 1, 2009		End:	February 28, 2010	
Diagnostic method	Real-Time RT-PCR					
Number of Cases	988	Positive:242 (25%)		Negative:		
Genotype			**GII.4 variants**	Mostly Forty-three (93%) of 46 norovirus isolates sequenced belonged to the genogroup II.4 variant		
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics						
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		

				Most of the patients (234 [96.7%]) had community acquired infection; 8 (3.3%) had hospital-acquired infection
Primary transmission	Foodborne	Waterborne	Environmental	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Strategic infection control measures with an added test may be useful in controlling nosocomial transmission of norovirus			

(Costantini et al. 2016)

Ref No:						
Reference: (Costantini et al. 2016)						
Affiliation / source of funds: 1Division of Viral Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia/ National Institute of Food and Agriculture at the US Department of Agriculture (grant number 2011-68003-30395) and a grant to the CDC Foundation from Takeda Pharmaceuticals.						
Epidemiology						
Study Design:	**Prospective cohort study**		**Level of Evidence**	**Level III-2**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
		X				
Reported period	Start:	November 2009 to.		End:	January 2013	
Diagnostic method	Polymerase chain reaction testing of stool samples or 4-fold increase in					

	serum antibody titers				
Number of Cases		Positive: 10 Outbreaks /39 (62 cases)		Negative:	
Genotype			**GII.4 variants**	XX	
Other pathogen found	Rotavirus		Others		
Age Group/Sample	Neonate/infant	Children	Adults	Older adults	
Population Characteristics					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**
	76% both vomiting and diarrhoea (62%)		84%	fatigue (81%),	5
Transmission pathways					
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other	
Primary transmission	Foodborne	Waterborne	Environmental		
Food vehicle categories	Produce	Shellfish	Ready to eat		
Water vehicle categories	Tap water	Ground water	Recreational water	other	
Reported Mgt. strategies /Implication	Prolonged shedding (≥21 days) was detected in 16 (47%) of the 35 cases with positive acute stool.				

(Cummins & Ready 2016)

Ref No:						
Reference: (Cummins & Ready 2016)						
Affiliation / source of funds: 1Infection Prevention and Control, Bart's Health NHS Trust and 2Public Health England, London, United Kingdom						
Epidemiology						
Study Design:	**Prospective cohort study**		**Level of Evidence**	**Level III-2**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X					
Reported period	Start:	February to 30 April 2015		End:	Is April 30 the end date	
Diagnostic method	RT-PCR					
Number of Cases		Positive: 57 Patients/7 Staff from 4 Hospitals		Negative:		
Genotype	GII was the dominant genogroup		**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics	No details					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		
Primary transmission	Foodborne	Waterborne	Environmental			

Food vehicle categories	Produce		Shellfish	Ready to eat
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Control measures included isolation, hand hygiene, environmental cleaning, and rapid diagnostic testing But do evaluation data available			

(Danial et al. 2011)

Ref No:						
Reference: (Danial et al. 2011)						
Affiliation / source of funds: Department of Microbiology, Royal Infirmary of Edinburgh, Edinburgh, UK b Department of Microbiology, Basingstoke and North Hampshire Hospital, Basingstoke, UK c Department of Finance, Royal Infirmary of Edinburgh, Edinburgh, UK						
Epidemiology						
Study Design:	**Prospective cohort study**		**Level of Evidence**	**Level III-2**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	Hospitals					
Reported period	Start:	September 2007		End:	June 2009	
Diagnostic method	An optimized in-house RT-PCR					
Number of Cases	192 unit outbreaks	Positive:1732 patients and 599 hospital staff		Negative:		
Genotype			**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
		X	X	X		
Population Characteristics	Not reported					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
	Not reported					
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		
Primary transmission	Foodborne	Waterborne	Environmental			

Food vehicle categories	Produce		Shellfish	Ready to eat
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Outbreaks in which the affected unit was closed to new admissions within the first three days of recognizing the index case(174/192, 91%) were contained in a mean of six days, and outbreaks in units that were closed later persisted for a mean of seven days; this difference was not statistically significant			

(Franck et al. 2014)

Ref No:						
Reference: (Franck et al. 2014)						
Affiliation / source of funds: Statens Serum Institut, Copenhagen, Denmark This study was supported in part by the Helene E.B. Marckwardts Foundation and the European Commission, Project no. 502571 (Enteric Virus Emergence, New Tools).						
Epidemiology						
Study Design:	**Retrospective cohort study**		**Level of Evidence**	**Level III-2**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X	X	X			
Reported period	Start:	2006		End:	2010	
Diagnostic method	Polymerase RT-PCR					
Number of Cases	18796 After exclusion of patients with uncertain hospitalization status, 3,848 patients selected - 230 wards in 60 hospitals in Denmark, 356 general practices or outpatient clinics, and 46 suspected foodborne outbreaks.		Positive: 4056		Negative:	
Genotype			**GII.4 variants**	GII.4 (712/785, 91%		
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant		Children	Adults	Older adults	
			X	X		
Population Characteristics	Hospitals in Denmark/ GP clinics/Community					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	

Transmission pathways					
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other	
				Patients from health care settings (n=1070) catagorised to nosocomially infected patients (n = 539), patients with community-acquired infections (n = 248), patients with an indeterminate source of infection (n = 274), and nursing home residents (n = 9).	
Primary transmission	Foodborne	Waterborne	Environmental		
Food vehicle categories	Produce	Shellfish	Ready to eat		
Water vehicle categories	Tap water	Ground water	Recreational water	other	
Reported Management strategies / Implication	Patients from health care settings (n=1070) catagorised to nosocomially infected patients (n = 539), patients with community-acquired infections (n = 248), patients with an indeterminate source of infection (n = 274), and nursing home residents (n = 9). Most patients from health care settings were infected with GII.4 (712/785, 91%), compared to community settings (421/781, 54%) ($p<0.001$) The proportion of children <3 years of age infected with NoV GII.3 or GII.P21 ranged from 11% to 25% strong association between infection with NoV GII.4 and patient age ≥60 years in community and health care settings				

(Franck et al. 2015)

Ref No:						
Reference: (Franck et al. 2015)						
Affiliation / source of funds: 1Microbiological Diagnostics and Virology, Statens Serum Institut, Copenhagen This work was supported in part by the Helene E.B. Marckwardts Foundation and the European Commission (project 502571; EVENT [Enteric Virus Emergence, New Tools]).						
Epidemiology						
Study Design:	**Retrospective cohort study**		**Level of Evidence**	**Level III-2**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X	X				
Reported period	Start:	2002		End:	2010	
Diagnostic method	Polymerase RT-PCR					
Number of Cases	3656	Positive:2320		Negative:		
Genotype		**GII.4 variants**	X			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics	patients were hospitalized in 297 different wards in 71 hospitals, situated in all 5 administrative regions of Denmark					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		
Primary transmission	Foodborne	Waterborne	Environmental			

Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	2320 (63%) of the NoV positive inpatients had nosocomial NoV infections, and 572 (16%) had community-acquired infections; the NoV acquisition source was classified as indeterminate for 764 (21%) The majority of NoV infections in hospitalized patients were nosocomial. Nosocomial infection was mainly associated with older age but also with the specific genotype GII.4.			

(Godoy et al. 2015)

Ref No:						
Reference: (Godoy et al. 2015)						
Affiliation / source of funds: 1Department of Health, Generalitat of Catalonia, Spain 2CIBER Epidemiología y Salud Pública (CIBERESP), Spai						
Epidemiology						
Study Design:	**Descriptive-epidemiological study**		**Level of Evidence**	**Level III-3**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
Reported period	Start:	1 January 2010 and		End:	31 December 2011	
Diagnostic method						
Number of Cases	27 outbreaks 816/2348	Positive:	Negative:			
Genotype		**GII.4 variants**	GII.4 caused 66·7% of outbreaks			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
		X	X			
Population Characteristics						
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
	55%	34.9%	61.5%	nausea 33·8% and fever 20·2%	2 deaths	
Transmission pathways						

Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other
Primary transmission	Foodborne	Waterborne	Environmental	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	81·5% (22/27) of outbreaks - person to-person transmission. 11·1% (3/27) - foodborne and person-to-person transmission. 7·4% (2/27) – foodborne GII.4 which was detected in 66·7% (10/15) of outbreaks			

(Harris et al. 2014)

Ref No:						
Reference: (Harris et al. 2014)						
Affiliation / source of funds: 1Gastrointestinal, Emerging and Zoonotic Infections Department, Health Protection Services Colindale, Health Protection Agency, Colindale, London, UK						
Epidemiology						
Study Design:	**Retrospective Record Analysis**		**Level of Evidence**	**Level IV**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X					
Reported period	Start:	1992–2008(GSURV) & 2009–2011(HNORS		End:		
Diagnostic method						
Number of Cases	1485 outbreaks (92-08) 2737 NoV outbreaks (HNORS)	Positive:		Negative:		
Genotype			**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics	Norovirus was laboratory confirmed in 69% (2737) of the reported outbreaks (75% in the 2009–2010 season, 62% in 2010–2011). The outbreaks were reported to have affected a total of 40 007 (median 9, range 0–110, IQR 6–14) patients and 10 620 staff (median 2, range 0–55, IQR 0–4).					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person	Oral –Faecal	Direct contact	Aerosols	Other		

transmission	route	(vomitus)		
Primary transmission	Foodborne	Waterborne	Environmental	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Outbreaks lasted a total of 24 129 days (median 6, range 1–59, IQR 4–10) and led to 26 717 days of ward/bay closures (median 8, range 1–86, IQR 6–11) and 46 513 bed-days lost (median 12, range 0–288, IQR 6–32).			

(Harris et al. 2013)

Ref No:						
Reference: (Harris et al. 2013)						
Affiliation / source of funds: 1Gastrointestinal Emerging and Zoonotic Diseases Department, Health Protection Agency, London, England						
Epidemiology						
Study Design:	**Prospective cohort study**		**Level of Evidence**	**Level III-2**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X	X	X			
Reported period	Start:	November 2009 and		End:	November 2011	
Diagnostic method	Polymerase chain reaction (PCR)					
Number of Cases		Positive: 65 outbreaks		Negative:		
Genotype	No data		**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics	The outbreaks affected various ward types, with most occurring in general medical wards (34%) and care of the elderly wards (28%). Other specialties were respiratory medicine (12%), stroke/neurology wards (11%), coronary care wards (9%) and orthopaedic/trauma wards (6%).					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		
Primary transmission	Foodborne	Waterborne	Environmental			

Food vehicle categories	Produce		Shellfish	Ready to eat
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Strong association where patients who are in the same bay as patients who become ill have a higher probability of themselves becoming ill compared with patients in a different bay.			

(Heijne et al. 2012)

Ref No:						
Reference: (Heijne et al. 2012)						
Affiliation / source of funds: Supported by Swiss National Science Foundation (grant numbers 320030_118424 and 320030_135654) (to J.C.M.H.). The authors reported no other financial interests related to this research						
Epidemiology						
Study Design:	**Cross sectional study**		**Level of Evidence**	**Level IV**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X 4 wards of a psychiatric institution, the Netherlands					
Reported period	Start:	2008		End:	No end date provided	
Diagnostic method						
Number of Cases		Positive:46		Negative:		
Genotype			**GII.4 variants**	No data		
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics						
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		

Primary transmission	Foodborne	Waterborne	Environmental	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Transmission route was from patient to patient (64%), followed by patient to healthcare worker (29%).The overall attack rate of norovirus in this outbreak was 42% Patient-to-patient transmission was shown as the main component in this outbreak			

(Hoffmann et al. 2013)

Ref No:						
Reference: (Hoffmann et al. 2013)						
Affiliation / source of funds: Institute of Virology, Technische Universität München and Helmholtz Zentrum München, Trogerstr. 30, 81675 Munich, Germany						
Epidemiology						
Study Design:	**Cross sectional study**		**Level of Evidence**	**Level IV**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X					
Reported period	Start:	2008 June		End:	No end date provided	
Diagnostic method						
Number of Cases		Positive:116 Pts and 28 staff		Negative:		
Genotype	GII.g/GII.1 as the causative agent for an extended outbreak.		**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics						
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		
Primary transmission	Foodborne	Waterborne	Environmental			

	Five of staff worked in the catering facility and were suspected to be the likely source of infection			
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	hygienic measures, including disinfection procedures and closure of wards helped contain the outbreak within 6 days			

(Johnston et al. 2007)

Ref No: #2						
Reference: (Johnston et al. 2007)						
Affiliation / source of funds: Johns Hopkins Hospital, Hospital Epidemiology and Infection Control.						
Epidemiology						
Study Design:	**Case study with economic analysis**		**Level of Evidence**	IV		
WHO Region/Country:	Americas		United states			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	Tertiary care hospital					
Reported period	Start:	Feb 2004		End:	May 2004	
Diagnostic method	For each potential patient (staff are included in this), a standard questionnaire recorded information about type, onset, and duration of symptoms, exposure to ill persons, and, for HCWs, whether they reported to work while sick. … Stool samples from patients were [analysed] to identify the outbreak agent and to determine its nucleotide sequence [using] RNA extraction, reverse transcription, and PCR for noroviruses. … . Nucleotide sequences were determined … from overlapping PCR-amplified cDNA for the complete genome, except the 5'terminus, which was 5'RACE System (Invitrogen) amplified. Nucleotide sequences were compared with those of other noroviruses using BioEdit and ClustalX software. The financial impact associated with the outbreak was calculated by including estimated total lost revenue associated with closure of units to new admissions, attributable sick leave and overtime salary, cost of replacing supplies, and cleaning expenses					
Number of Cases	355	Positive: 265 staff/90	Negative:			

		inpatients			
Genotype	GII.4		**GII.4 variants**	Farmington Hills and MD-2004	
Other pathogen found	Rotavirus		Others		
Age Group/Sample	Neonate/infant	Children	Adults	Older adults	
			Y		
Population Characteristics	Patients and staff from 3 units within the hospital: The cardiac surgery intensive care unit (CICU) is a 16-bed critical-care unit where postoperative cardiac patients are treated. The coronary care unit (CCU) is a 25-bed unit consisting of 10 critical-care and 15 intermediate care beds in private rooms. The psychiatry units are located in a building that is separate from but connected to the CCU. On average, HCWs were younger than patients, with mean ages (±SD) of 36.2±10.4 years and 45.5±23.4 years, respectively (table 1). Of the affected HCWs, 83.8% were female, and 47.8% of the patients were female. By definition, all infected HCWs and patients had diarrhoea or vomiting, but nausea and abdominal cramps were common symptoms among both HCWs and patients.				
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**
	y	y	y	y- chills, myalgia, fever, headache, diaphoresis, bloody stools.	0
Transmission pathways					
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other	
				Not specified beyond "The epidemic curve was consistent with a single-exposure outbreak involving person-to-person transmission"	

Primary transmission	Foodborne	Waterborne	Environmental	
			Believed to be a patient admitted with it.	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Termination of the outbreak in the CCU occurred only after the unit was temporarily closed for extensive environmental decontamination with sodium hypochlorite (i.e., bleach), patients and HCWs were screened for gastroenteritis, ill HCWs were furloughed, and other aggressive infection-control measures were implemented. Bleach is the disinfectant of choice based on its performance against feline caliciviruses (a surrogate used for noroviruses), compared with quaternary ammonium compounds, detergents, or alcohol. No evaluation data reported			

(Kanerva et al. 2009)

Ref No:						
Reference: (Kanerva et al. 2009)						
Affiliation / source of funds: Helsinki University Central Hospital, Department of Medicine, Division of Infectious Diseases, Helsinki, FinlandNone						
Epidemiology						
Study Design:	**Cross sectional study**		**Level of Evidence**	IV		
WHO Region/Country:	European Region		Finland			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	504-bed tertiary care hospital					
Reported period	Start:	Nov 2006		End:	June 2007	
Diagnostic method	reverse transcription-polymerase chain reaction (RT-PCR) to detect norovirus RNA. Norovirus RNA was detected by real-time RT-PCR method using Taqman probe chemistry.12 A Quantitect probe RT-PCR kit (Qiagen, Hilden, Germany) was used for amplification of a nucleotide sequence at the polymerase-capsid junction.					
Number of Cases	445/2447		Positive: 445		Negative: 2002	
Genotype	GII.4 and GII.6.		**GII.4 variants**		2006b	
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
			Y			
Population Characteristics	240 patients (of 1351; attack rate 18%) and 205 HCWs (of 1096; attack rate 19%) fell ill. Most cases were from cardiology wards, and a few internal medicine wards, as well as neurology and pulmonology wards.					

Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**
	y		y	y- possible fever	9 (5%)
Transmission pathways					
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other	
		Y			
Primary transmission	Foodborne	Waterborne	Environmental		
Food vehicle categories	Produce	Shellfish	Ready to eat		
Water vehicle categories	Tap water	Ground water	Recreational water	other	
Reported Management strategies / Implication	Patients with diarrhoea and vomiting were moved into contact isolation in single rooms or cohorts until at least two days had passed since recovery. Their roommates were considered exposed and their rooms were closed to new patients until the 48h incubation period had passed. Patient transfers from out-break wards to other wards were discouraged. If there were patient cases in several rooms, the ward was temporarily closed to non-gastroenteritis patients. All touch surfaces were thoroughly cleaned with chlorine disinfectant in affected rooms and toilets if the patient had vomited and after the patient had been discharged. At the end of January, an extra cleaner was provided to wipe all door knobs and elevator buttons daily in the wards and public areas of the building. The staff was reminded of enhanced hand hygiene and to wash their hands with water and soap before alcohol hand rub. Gloves, aprons and surgical masks were used when nursing diseased patients. [Sick staff] were kept from work for five days, including two asymptomatic days. Staff members who had already had the infection were in the front line in taking care of norovirus patients. Between 2 and 9 January, all elective services of internal medicine were discontinued and on 5 January two affected wards were closed to new admissions; 4 days later, another two wards were closed until no new cases had occurred within 48 h and the wards were thoroughly cleaned. Three epidemic peaks occurred.				

(Lopman et al. 2006)

Ref No:						
Reference: (Lopman et al. 2006)						
Affiliation / source of funds: This study was supported by the Health Protection Agency's Small Scientific Grant						
Epidemiology						
Study Design:	**Prospective cohort**		**Level of Evidence**	III-2		
WHO Region/Country:	European region		England			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	171 inpatient units in 15 hospitals					
Reported period	Start:	April 2002		End:	March 2003	
Diagnostic method	RT-PCR and/or ELISA Two regions of the norovirus genome were amplified and sequenced for each specimen. These regions were segments of the polymerase gene (open reading frame (ORF) 1) and the capsid gene (ORF 2).					
Number of Cases	76 outbreaks	Positive: 76 outbreaks		Negative:		
Genotype	Genogroup II4 viruses	**GII.4 variants**	61 of these viruses (95%) closely clustered with genogroup II4 (≥90% similarity with prototype Lorsdale strain). There were single detection of a genogroup I2, II3 II6.			

Other pathogen found	Rotavirus		Others						
Age Group/Sample	Neonate/infant		Children		Adults		Older adults		
Population Characteristics	Healthcare settings in England. No other details of population given.								
Clinical features	Vomiting		Abd. pain		Diarrhoea		Other		**Mortality rate**
Transmission pathways									
Person to person transmission	Oral –Faecal route		Direct contact (vomitus)		Aerosols		Other		
Primary transmission	Foodborne		Waterborne		Environmental				
Food vehicle categories	Produce		Shellfish		Ready to eat				
Water vehicle categories	Tap water		Ground water		Recreational water		other		
Reported Management strategies / Implication	The evidence suggests that transmission between hospitals units does occur. The combined molecular/epidemiologic approach presented here could be applied to other viral populations and potentially to other pathogens for a more thorough view of transmission								

(Mattner, Guyot & Henke-Gendo 2015)

Ref No: #7						
Reference: (Mattner, Guyot & Henke-Gendo 2015)						
Affiliation / source of funds:						
Epidemiology						
Study Design:	**Retrospective analysis**		**Level of Evidence**	**Level IV**		
WHO Region/Country:	European region		Germany			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	5 University and teaching hospitals		y			
Reported period	Start:	2002		End:	2012	
Diagnostic method	Multiplex microbiologic testing for norovirus and C. difficile toxin and since 2010 also for Campylobacter spp., rotavirus and adenovirus in some of the hospitals allowed analysis of a subset of outbreak data on norovirus and C. difficile infection					
Number of Cases	71 outbreaks. 1432 symptomatic people		Positive: 1084		Negative:	
Genotype			**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant		Children	Adults	Older adults	
Population Characteristics	5 German hospitals in mostly medical wards: medical wards [medicine 42 (59%), surgery 12 (17%), neurology 4 (6%), urology 2 (3%), obstetrics 1 (1%), psychiatry 3 (4%), combined medicine/surgery 3 (4%), paediatrics 1 (1%)					

	and dermatology 1 (1%)]. Just two (3%) outbreaks occurred on medical intensive care units. Staff, visitors and patients were all recorded as being affected.				
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**
	y		y		
Transmission pathways					
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other	
		y			
Primary transmission	Foodborne	Waterborne	Environmental		
Food vehicle categories	Produce	Shellfish	Ready to eat		
Water vehicle categories	Tap water	Ground water	Recreational water	other	
Reported Management strategies / Implication	Isolation strategies, cohorting of patients, not transferring from known NoV sites regardless of patient's apparent symptomology. Faster testing to ensure early diagnosis. Sending ill staff home, restricting visiting during community NoV outbreaks.				

(Munir et al. 2014)

Ref No:						
Reference: (Munir et al. 2014)						
Affiliation / source of funds: Children's Healthcare of Atlanta Friend's Research Fund grant (to A.S.) (2009–2010); Grant sponsor: T32 grant (to P.G.); Grant sponsor: Emory University Research Committee (URC) grant (to Dr. P.L.); Grant sponsor: USDA National Institute of Food and Agriculture (NIFA) Food Virology Collaborative grant (NoroCORE; partial support); Grant number: 1111-2011-0494.						
Epidemiology						
Study Design:	**Prospective cohort**		**Level of Evidence**	**III-2**		
WHO Region/Country:	Americas		United States			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	Y		two pediatric hospitals in Atlanta, Georgia, USA			
Reported period	Start:	Dec 2009		End:	Dec 2010	
Diagnostic method	Viral RNA Extraction and NoV Detection Using TaqMan Real-Time RT-PCR (RT-qPCR), Positive samples identified by RT-qPCR were reamplified using conventional RT-PCR with GII primers, Samples with strong amplification bands from the conventional RT-PCR were submitted for DNA sequencing (GeneWiz, Inc., Research Triangle Park, NC) using the conventional primer set.					
Number of Cases	92 fit the inclusion criteria		Positive: 15/92		Negative:	
Genotype	GII genogroup		**GII.4 variants**		8 GII.4 strains, 3 GII.3 strains, 3 GII.12 strains,	

					and one GII.13 strain detected
Other pathogen found	Rotavirus		Others		
Age Group/Sample	Neonate/infant		Children	Adults	Older adults
			y		
Population Characteristics	Hospitalised children less than 18 years of age, with an immunocompromising condition. Immunocompromising condition was defined as an oncological diagnosis and associated neutropenia (absolute neutrophil count _500 cells/ml) or a history of a solid organ or bone marrow transplant, independent of the transplant date, and current condition. The inclusion criterion for HA diarrheal infection was defined as acute diarrhoea (above criteria) onset in children at least 72 hr after hospital admission.				
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**
	Y		y	fever	
Transmission pathways					
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other	
Primary transmission	Foodborne	Waterborne	Environmental		
Food vehicle categories	Produce	Shellfish	Ready to eat		
Water vehicle categories	Tap water	Ground water	Recreational water	other	
Reported Management strategies / Implication	NoV should be considered as an important etiology of hospitalized acquired acute gastroenteritis and an etiology of gastroenteritis among immunocompromised children.				

(Nenonen et al. 2014)

Ref No:						
Reference: (Nenonen et al. 2014)						
Affiliation / source of funds: This study was supported by grants from Swedish Council for Working Life and Social Research (FAS 82010-0895).						
Epidemiology						
Study Design:	**Case control**		**Level of Evidence**	III-3		
WHO Region/Country:	European region		Sweden			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	University Hospital					
Reported period	Start:	Jan 2012		End:	May 2012	
Diagnostic method	Validated real-time reverse transcription RT-PCR (rRT-PCR) assays were used to detect NoV GI and NoV GII, rotavirus (RoV), human astrovirus (HuAstV) (6, 27), human sapovirus (HuSaV) (28), and human adenovirus (HuAdV) (29) in duplicate TNA extracts (10 _l) of environmental and patient sample					
Number of Cases	125- 108 from outbreak wards and 17 from NoV free wards (control)		Positive: 65/125		Negative: 15/125	
Genotype	NoV GII genome, one GII.6 was found in a newly admitted patient.		**GII.4 variants**		New Orleans 2009 and Berowra 2012	
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant		Children	Adults	Older adults	
				y		

Population Characteristics	symptomatic inpatients and their hospital room environment. Seven outbreak wards and one outbreak-free ward.				
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**
	y				
Transmission pathways					
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other	
			y		
Primary transmission	Foodborne	Waterborne	Environmental		
			y		
Food vehicle categories	Produce	Shellfish	Ready to eat		
Water vehicle categories	Tap water	Ground water	Recreational water	other	
Reported Management strategies / Implication	Air vents, overbed tables, washbasins, dust, and virus traps designed to collect charged particles from the air were swabbed to investigate the possibility of NoV contamination in patient rooms during outbreaks in seven wards and in an outbreak-free ward. Symptomatic inpatients were also sampled. Nucleic acid extracts of the samples were examined for NoV RNA using genogroup I (GI) and GII real-time reverse transcription-PCR (RT-PCR). The NoV strains were characterized by RT-PCR, sequencing, and phylogenetic analysis of the RNA-dependent RNA-polymerase-N/S capsid-coding region It would appear that each outbreak of NoV was different enough in gene sequencing to be called a new outbreak, rather than a reinfection situation. This seems to be concurrent with the other studies extracted so far.				

(Nguyen & Middaugh 2012)

Ref No: #12						
Reference: (Nguyen & Middaugh 2012)						
Affiliation / source of funds: None						
Epidemiology						
Study Design:	**A descriptive epidemiological**		**Level of Evidence**	IV		
WHO Region/Country:	The Americas		United States			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
		long-term care facilities				
Reported period	Start:	Feb 2010		End:	March 2010	
Diagnostic method	Realtime reverse transcriptase–polymerase chain reaction (rRT–PCR) testing for NoV, enzyme-linked immunosorbent assay for rotavirus, and bacterial cultures (Salmonella, Shigella, Campylobacter, strain O157 of Escherichia coli, Yersinia) were performed on these stool samples.					
Number of Cases	1797 Of 954 residents, 299 (31%) were ill, and of 843 staff, 95 (11%) were ill		Positive: 394/1797		Negative:	
Genotype	GII.4		**GII.4 variants**		GII.4 Orange and GII.4 New Orleans	
Other pathogen found	Rotavirus		Others		Clostridium difficile	
Age Group/Sample	Neonate/infant		Children	Adults	Older adults	
Population	8 LTCF: three Skilled Nursing Facilities (which provide 24-h care to residents by a skilled on-site nursing staff), 5 residential care facilities [one Adult					

<table>
<tr><td>Characteristics</td><td colspan="5">Group Care, three AGCs for Alzheimer’s, one mixed] which are not required to provide 24-h nursing care to residents.

Attack rates were higher in residents (range 17–55%) than staff (range 3–35%) in all facilities. Affected staff (n=85, age range 19–78 years, median 43.5 years) were comparatively younger than affected residents (n=225, age range 44–99 years, median 84.5 years). Attack rates did not differ between facility types.</td></tr>
<tr><td rowspan="2">Clinical features</td><td>Vomiting</td><td>Abd. pain</td><td>Diarrhoea</td><td>Other</td><td>Mortality rate</td></tr>
<tr><td>y- 176 (85%, range 68–100%)</td><td></td><td>y- 98 (47%, range 19–64%)</td><td></td><td>none</td></tr>
<tr><td colspan="6">Transmission pathways</td></tr>
<tr><td rowspan="2">Person to person transmission</td><td>Oral –Faecal route</td><td>Direct contact (vomitus)</td><td>Aerosols</td><td colspan="2">Other</td></tr>
<tr><td>y</td><td>y</td><td>y</td><td colspan="2">Believed to have been carried between sites by staff</td></tr>
<tr><td rowspan="2">Primary transmission</td><td colspan="2">Foodborne</td><td colspan="2">Waterborne</td><td>Environmental</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td></td></tr>
<tr><td rowspan="2">Food vehicle categories</td><td colspan="2">Produce</td><td colspan="2">Shellfish</td><td>Ready to eat</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td></td></tr>
<tr><td rowspan="2">Water vehicle categories</td><td>Tap water</td><td>Ground water</td><td>Recreational water</td><td colspan="2">other</td></tr>
<tr><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Reported Management strategies / Implication</td><td colspan="5">Ill residents received varying levels of hydration therapy at all facilities, and SNF residents who tested positive for C. difficile were treated with antibiotics at their respective facilities by their physicians.

Implement NoV infection control measures in healthcare settings based on CDC recommendations, with ill staff excluded from work for 72 h after resolution of symptoms, handwashing with soap and water, and intensive environmental cleaning with bleach or products effective against feline caliciviruses from an environmental protection agency-approved list.</td></tr>
</table>

(Ohwaki et al. 2009)

Ref No:						
Reference: (Ohwaki et al. 2009)						
Affiliation / source of funds: not reported						
Epidemiology						
Study Design:	**Retrospective cohort**		**Level of Evidence**	III-2		
WHO Region/Country:	Western Pacific		Japan			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	hospital	Long term care facility attached to the hospital				
Reported period	Start:	21 Feb (?year)		End:	4 March (?year)	
Diagnostic method	ELSIA. Enzyme linked immunosorbent assay RT-PCR methods for NoV testing. Also tested for Shigella, salmonella, 0157 strain Escherichia Coli, Vibrio, Clostridium perfringens, Yersinis, Campylobacter, Bacillus cereus, aeromnas, Plesiomonas and Staphylococcus aureus.					
Number of Cases	47/285 staff 55/413 patients		Positive: 102		Negative:	
Genotype	NR		**GII.4 variants**			
Other pathogen found	Rotavirus		Others			

Age Group/Sample	Neonate/infant	Children	Adults	Older adults
			y	
Population Characteristics	Staff and patients at tertiary care hospital with an attached long term care facility in Japan, who ate the standard diet			

Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**
	y		y	fever	

Transmission pathways				
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other
			y	

Primary transmission	Foodborne	Waterborne	Environmental
	y		
Food vehicle categories	Produce	Shellfish	Ready to eat

Water vehicle categories	Tap water	Ground water	Recreational water	other

Reported Management strategies / Implication	Education on hand washing and gargling techniques, food sanitation manual was revised, and stricter hygiene measures such as face masks and gowns in the kitchen were implemented. Disinfection of doorknobs and floors with chlorine and monthly collection of stool samples from kitchen workers. Employees instructed to stay home for 1 week if symptomatic.

(Partridge et al. 2012)

Ref No: #14						
Reference: (Partridge et al. 2012)						
Affiliation / source of funds: None						
Epidemiology						
Study Design:	**Case study**		**Level of Evidence**	IV		
WHO Region/Country:	European region		UK			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	Medical and surgical teaching hospital					
Reported period	Start:	1 December 2009		End:	1 April 2010	
Diagnostic method	Real-time PCR. All samples are tested for genogroups 1 and 2 using specific primer and probe sequences					
Number of Cases	623	Positive: 623		Negative:		
Genotype		**GII.4 variants**				
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics						
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
	Y		y			

Transmission pathways				
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other
Primary transmission	Foodborne	Waterborne	Environmental	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Affected patients and their contacts were isolated or cohorted and clinical areas closed until 72 h beyond the last loose stool or vomit of any patient. The bay would then undergo thorough cleaning with hypochlorite and change of curtains. If more than one bay was affected within a clinical area, or if staff were affected, the ward would be closed as above. Cohort wards were created on an ad hoc basis to facilitate cleaning and re-opening of other areas. Twice daily cleaning with 0.1% hypochlorite was instituted during outbreaks.			

(Rao et al. 2009)

Ref No:						
Reference: (Rao et al. 2009)						
Affiliation / source of funds: funded in part by an National Institutes of Health Roadmap Scholarship and by the Duke Clinical Research Training Program.						
Epidemiology						
Study Design:	**Cross sectionals study**		**Level of Evidence**	IV		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	Y				Y	Y
Reported period	Start:	Feb 11th 2007		End:	March 13th 2007	
Diagnostic method	Electron microscopy initial diagnosis confirmed as norovirus by means of a validated polymerase chain reaction–based method.					
Number of Cases	258	Positive: 71 staff, 187 patients		Negative:		
Genotype		**GII.4 variants**				
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
			y	y		
Population Characteristics	154-bed tertiary care facility that includes a 28-bed psychiatry ward, on-site outpatient clinics, an emergency department, a 126-bed acute care facility, and a 120-bed integrated LTCF.					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
	y		y			
Transmission pathways						

Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other
Primary transmission	Foodborne	Waterborne	Environmental	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Active surveillance, which continued through March 13, required daily reports on patients and staff from each ward, including staff absences and reasons for these absences. We also performed a retrospective review of events during the 2 weeks preceding implementation of active surveillance. Infected patients were isolated, group activities were cancelled, hospital closed to new intakes, removed alcohol sanitisers and encouraged soap and water hand washing, chlorine based disinfectant to clean all rooms, sick employees asked to stay home until 48hrs after last symptoms disappeared. staff adhered to self-quarantine protocols.			

(Rosenthal et al. 2011)

Ref No:						
Reference: (Rosenthal et al. 2011)						
Affiliation / source of funds: none						
Epidemiology						
Study Design:	**Retrospective chart review (cohort)**		**Level of Evidence**	IV		
WHO Region/Country:	The Americas		United States			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
		Long term care facilities				
Reported period	Start:	2003		End:	2006	
Diagnostic method	Real-time reverse transcriptase–polymerase chain reaction. NoV strains were genotyped by sequencing. Stool specimens were collected from a convenience sample of at least three ill and symptomatic persons in each outbreak for testing.					
Number of Cases	6274. 541 confirmed and 5733 presumptive		Positive: 6274		Negative:	
Genotype	GI.1, GI.4, GI.6, GII.3, GII.4, GII.5, GII.6, GII.10		**GII.4 variants**		Responsible for 84% of outbreaks: Farmington Hills/2002, Hunter/2004, Minerva/2006b, and Terneuzen/2006 a	

Other pathogen found	Rotavirus		Others		Salmonella (x2)				
Age Group/Sample	Neonate/infant		Children		Adults		Older adults		
					y		y		
Population Characteristics	We categorized LTCFs as 'nursing facilities' if they provided 24-h nursing care or 'non-nursing' facilities otherwise. LTCFs were also categorized as large (≥90 beds) or small (<90 beds). Individual cases were categorized as being related to employees or residents.								
Clinical features	Vomiting		Abd. pain		Diarrhoea		Other		**Mortality rate**
	y				y				5%
Transmission pathways									
Person to person transmission	Oral –Faecal route		Direct contact (vomitus)		Aerosols		Other		
							person-to-person 94% undetermined 3.5%		
Primary transmission	Foodborne			Waterborne			Environmental		
	2.5%								
Food vehicle categories	Produce			Shellfish			Ready to eat		
Water vehicle categories	Tap water		Ground water		Recreational water		other		
Reported Management strategies / Implication	NoV as the most probable cause until proven otherwise. Facilities must have thorough hygienic and infection-control practices in place to deal with NoV outbreaks.								

(Schmid et al. 2011)

Ref No: #18						
Reference: (Schmid et al. 2011)						
Affiliation / source of funds: No external funding outside of public health agency AGES.						
Epidemiology						
Study Design:	**Retrospective cohort**		**Level of Evidence**	III-2		
WHO Region/Country:	European region		Austria			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	y				y	y
Reported period	Start:	15 March (?year)		End:	27 March (?year)	
Diagnostic method	stool samples from six patients examined with symptoms of diarrhoea or vomiting were positive for NV by real-time reverse transcription-polymerase chain reaction (RT-PCR)					
Number of Cases	152/550 patients 52/240 staff		Positive: 204 (17 confirmed)		Negative:	
Genotype	GII.4		**GII.4 variants**		GII.4 2006b	
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics	60-bed hospital (three wards: orthopaedic, internal medicine, surgery), a rehabilitation centre with 125 beds, and a convalescent home with 275 beds					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	

	y	y	y	fever	
Transmission pathways					
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other	
		Secondary infection			
Primary transmission	Foodborne	Waterborne	Environmental		
	y		Secondary infection		
Food vehicle categories	Produce	Shellfish	Ready to eat		
Water vehicle categories	Tap water	Ground water	Recreational water	other	
Reported Management strategies / Implication	The kitchen was closed for disinfection, cleaning and food disposal. Comprehensive disinfection of the facility kitchen, disposal of suspected contaminated food, scrupulous surface disinfection of all affected hospital wards, treatment rooms of the rehabilitation centre and affected resident rooms. Ward closure was not found to be necessary. Essential measures for preventing further person-to-person transmission: • strict hand hygiene applied among the healthcare staff; • use of recommended hand disinfectants by outbreak cases; • isolation of the outbreak cases in a designated isolation ward until 48 h after the end of symptoms, • cohort nursing and restrictions on visiting; • immediate exclusion of symptomatic medical, kitchen and food service staff from work; • continuation of appropriate hand disinfection by the NV-infected personnel for at least three weeks after having returned to work.				

(Sheahan et al. 2015)

Ref No:						
Reference: (Sheahan et al. 2015)						
Affiliation / source of funds:						
Epidemiology						
Study Design:	**Case study**		**Level of Evidence**	IV		
WHO Region/Country:	The Americas		United States			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
			y- oncology unit			
Reported period	Start:	30 Jan 2014		End:	22 Feb 2014	
Diagnostic method	Stool specimens were tested for NV using qualitative real-time reverse transcription PCR assay detection and differentiation of NV genogroups I and II.1 Additional testing (surveillance) was performed on a limited number of specimens using the Luminex xTAG Gastrointestinal Pathogen Panel Assay, a multiplexed nucleic acid test.					
Number of Cases	12 patients: 7 hospital acquired, 5 community 25 staff.		Positive: 13 tested positive, the rest (24) showed NV like symptoms and were assumed positive.		Negative:	
Genotype	I and II		**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		

		y			
Population Characteristics	MSKCC is a 470-bed tertiary care hospital in New York City with a 33-bed inpatient pediatric unit. The average length of stay for pediatric patients is 7.4 days				
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**
	y		y		
Transmission pathways					
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other	
Primary transmission	Foodborne	Waterborne	Environmental		
Food vehicle categories	Produce	Shellfish	Ready to eat		
Water vehicle categories	Tap water	Ground water	Recreational water	other	
Reported Management strategies / Implication	All patients on the pediatric floor were placed on special contact precautions: use of gowns, gloves, hand hygiene (alcohol based gel or handwashing with soap and water) before entry into patient room, and handwashing after patient encounter, all HCWs wore masks when caring for patients with active vomiting. All special contact isolation rooms are cleaned daily with bleach. Inpatient playroom was closed, and all toys were cleaned with bleach. Environmental cleaning with bleach was increased to twice daily for the rooms and 3 times daily for high traffic areas, including the pantry and pediatric day hospital. All necessary medical testing, such as radiographs and ultrasound, was performed on the floor for symptomatic patients, and non-urgent testing was postponed. All symptomatic patients were placed in private rooms until testing results were available and negative. Staff with gastrointestinal symptoms were furloughed until no longer symptomatic for 24 hours				

(Simon et al. 2006)

Ref No:						
Reference: (Simon et al. 2006)						
Affiliation / source of funds:						
Epidemiology						
Study Design:	**Case study**		**Level of Evidence**	IV		
WHO Region/Country:	European region		Germany			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
			Oncology unit			
Reported period	Start:	14th Jan 2004		End:	20th Feb 2004	
Diagnostic method	Stool and vomitus samples from 11 patients were tested for NV and other relevant viruses during the outbreak by reverse transcriptase-polymerase chain reaction (RT-PCR) and/or enzyme-linked immunosorbent assay (ELISA) . In all patients with a positive stool sample, the tests were repeated weekly until they became negative.					
Number of Cases	19 patients 2 relatives		Positive: 21/ 246 tested		Negative:	
Genotype			**GII.4 variants**			
Other pathogen found	Rotavirus	3.3%	Others	Adenovirus 0.8% Astrovirus 1.6%		
Age Group/Sample	Neonate/infant		Children	Adults	Older adults	
			y			
Population	The Pediatric Hematology and Oncology Unit is a separate 16-bed inpatient					

Characteristics	unit with 900 admissions and 50 newly diagnosed pediatric cancer patients per year. The unit covers all pediatric cancer diagnoses and treatment modalities, with the exception of allogenic stem-cell transplantation.				
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**
	y		y		
Transmission pathways					
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other	
Primary transmission	Foodborne	Waterborne	Environmental		
Food vehicle categories	Produce	Shellfish	Ready to eat		
Water vehicle categories	Tap water	Ground water	Recreational water	other	
Reported Management strategies / Implication	The agent for hand hygiene was immediately changed to a special product with certified activity against NV, which contains 95% (v/v) ethanol (Sterillium†; Virugard, Bode Chemie, Hamburg, Germany). In addition, the use of masks when in close contact with symptomatic patients was recommended. All patients were tested for NV and were isolated in cohorts if positive. These measures stopped the outbreak.				

(Sukhrie et al. 2011)

Ref No: #						
Reference: (Sukhrie et al. 2011)						
Affiliation / source of funds: Laboratory for Infectious Diseases and Perinatal Screening, National Institute for Public Health and the Environment, Bilthoven,1 and Departments of Virology, Erasmus Medical Center, Rotterdam,2 Netherlands						
Epidemiology						
Study Design:	**Case control study**		**Level of Evidence**	**Level III-2**		
WHO Region/Country:						
Location / Setting:	Acute X	Aged	Paediatrics	Neonatal	Rehab	Other
Reported period	Start:	2002		End:	2007	
Diagnostic method	RT-PCR					
Number of Cases		Positive: 264/2458		Negative:		
Genotype	51% (n= 82) belonged to GII.4, 34% (n 54) belonged to GII.3, and 15% (n=24) belonged to other genotypes (GI.6B, GII.17, GII.7, and GII.2). In children's wards, GII.3 strains were associated with nosocomial spread		**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics						

Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**
				Overall, 48% (n = 128) of Nosocomial	
Transmission pathways					
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other	
Primary transmission	Foodborne	Waterborne	Environmental		
Food vehicle categories	Produce	Shellfish	Ready to eat		
Water vehicle categories	Tap water	Ground water	Recreational water	other	
Reported Management strategies / Implication	Young children may wear diapers, and the handling thereof is associated with higher exposure to stools. Without proper hand-washing hygiene, this may constitute a greater risk of transmission.				

(Sukhrie et al. 2012)

Ref No: #						
Reference: (Sukhrie et al. 2012)						
Affiliation / source of funds: 1Laboratory for Infectious Diseases and Perinatal Screening, Centre for Infectious Disease Control (RIVM), Bilthoven; 2Department of Virology, Erasmus Medical Center, Rotterdam, The Netherlands						
Epidemiology						
Study Design:	**Retrospective cohort study**		**Level of Evidence**	**Level III-2**		
WHO Region/Country:	Europe		The Netherlands			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X					
Reported period	Start:	January 2009		End:	March 2010	
Diagnostic method	polymerase chain reaction (PCR)					
Number of Cases	5 outbreaks /		Positive: 28 patients		Negative:	
Genotype	GII.4, GII.2, and GII.7		**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics						
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		

Primary transmission	Foodborne	Waterborne	Environmental	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Symptomatic patients and HCWs were more often involved in transmission events than asymptomatic shedders. Asymptomatic HCWs rarely contributed to transmission, despite high levels of fecal virus shedding			

(Tsang et al. 2008)

Ref No: #						
Reference: (Tsang et al. 2008)						
Affiliation / source of funds:						
Epidemiology						
Study Design:	**Retrospective cohort study**		**Level of Evidence**	**Level III-2**		
WHO Region/Country:	Asia		Hong Kong			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	Public hospitals under the management of the Hospital Authority (HA) in Hong Kong					
Reported period	Start:	11 May 2006-		End:	27 July 2006	
Diagnostic method	RT-PCR					
Number of Cases		Positive:		Negative:		
Genotype		**GII.4 variants**				
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics	Most patients were elderly with a mean age of 74.5 years (range: 3 months to 97 years)					

Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**
	46.3%		97.2%		
Transmission pathways					
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other	
				38 confirmed norovirus outbreaks involving 218 patients were identified	
Primary transmission	Foodborne	Waterborne	Environmental		
Food vehicle categories	Produce	Shellfish	Ready to eat		
Water vehicle categories	Tap water	Ground water	Recreational water	other	
Reported Management strategies / Implication	The median duration for diarrhoea was 3 days and the longest 24 days. The median duration of vomiting was one day and the longest 15 days. Fever occurred in one-third of all cases				

(Tseng et al. 2011)

Ref No: #						
Reference: (Tseng et al. 2011)						
Affiliation / source of funds: Division of Infectious Diseases, Hsinchu Cathay General Hospital, Hsinchu City, Taiwan 2 Division of Infectious Diseases, Wei-Gong Memorial Hospital (WGMH), Miaoli County, Taiwan						
Epidemiology						
Study Design:	**Retrospective cohort study**		**Level of Evidence**	**Level III-2**		
WHO Region/Country:	Asia		Taiwan.			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X					Psychiatric
Reported period	Start:	2005		End:	2007	
Diagnostic method	ELISA method and RT–PCR.					
Number of Cases	4 norovirus outbreaks occurred within this psychiatric unit	Positive: 172/1351	Negative:			
Genotype		**GII.4 variants**				
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics						
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	

	(47/184, 25.5%	9/184, 4.9%)	161/184, 87.5%	Fever (4/184, 2.2%)	
Transmission pathways					
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other	
Primary transmission	Foodborne	Waterborne	Environmental		
Food vehicle categories	Produce	Shellfish	Ready to eat		
Water vehicle categories	Tap water	Ground water	Recreational water	other	
Reported Management strategies / Implication	Reviewing data for 184 patients between 2005 and 2007 revealed that 17 had experienced recurrent NVG during the four outbreaks				

(Tu et al. 2008)

Ref No: #						
Reference: (Tu et al. 2008)						
Affiliation / source of funds: Prince of Wales Hospital, Sydney 2031, Australia3; and National Centre for Immunisation Research and Surveillance of Vaccine Preventable Diseases, Research Building, The Children's Hospital at Westmead, Westmead 2145, Australia4						
Epidemiology						
Study Design:	**Cross sectionals study**		**Level of Evidence**	**Level IV**		
WHO Region/Country:			Australia			
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
		X				
Reported period	Start:	Date?		End:	Date?	
Diagnostic method	real-time nested reverse transcriptase-PCR					
Number of Cases		Positive: 14		Negative:		
Genotype	NoV GII RNA-		**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
				X		
Population Characteristics	Aged-care facility in New South Wales, Australia					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
	78.6%	(35.7%)	71.4%),	nausea (50.0%),		

Transmission pathways				
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other
Primary transmission	Foodborne	Waterborne	Environmental	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	The duration of viral shedding: average 28.7 days (median, 28.5 days), with a range of 13.5 to 44.5 days			

(Zheng et al. 2015)

Ref No:						
Reference: (Zheng et al. 2015)						
Affiliation / source of funds: Guangming District Center for Disease Control and Prevention, Shenzhen, China This work was supported by grants from the Shenzhen Field Epidemiology Training Program						
Epidemiology						
Study Design:	**Case series**		**Level of Evidence**	**Level III-3**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
		X				staff
Reported period	Start:	December 2012.		End:	No end date?	
Diagnostic method	RT-PCR					
Number of Cases	6/ 13 asymptomatic cases	Positive: 39/105 Patients		Negative:		
Genotype	GII.4 Sydney outbreaks disproportionally affected older persons	**GII.4 variants**	XX			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics						
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
	45.9%	86.5%	67.6%),			
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		
Primary transmission	Foodborne	Waterborne	Environmental			

Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	To control an outbreak of norovirus infection, it is necessary to analyze the stool samples from all staff (symptomatic and asymptomatic) and to pay attention to staff education on hand washing and disinfecting feces and vomitus appropriately.			

Appendix III Data Extraction Q3

(Blaney et al. 2011)

Ref No:						
Reference: (Blaney et al. 2011)						
Affiliation / source of funds: Centers for Disease Control and Prevention						
Epidemiology						
Study Design:	**A cross-sectional survey**		**Level of Evidence**	IV		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
		X				
Reported period	Start:	1/12/2006		End:	31/03/2007	
Diagnostic method	Norovirus confirmation was conducted in public health laboratories					
Number of Cases		Positive: 61 facilities reporting 73 outbreaks; 29 were confirmed norovirus.		Negative:		
Genotype	No data		**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics	Of 160 facilities, 91 (60%) provided survey responses					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		

Primary transmission	Foodborne	Waterborne	Environmental	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Facilities reporting that staff were equally or more likely to use ABHS than soap and water for routine hand hygiene had higher odds of an outbreak than facilities with staff less likely to use ABHS (adjusted odds ratio, 6.06; 95% confidence interval:1.44-33.99).			

(Cheng et al. 2011)

Ref No: 711						
Reference: (Cheng, VCC et al. 2011)						
Affiliation / source of funds: Queen Mary Hospital, Hong Kong /Suen Chi Sun Charitable Foundation and Research Fund for the Control of Infectious Diseases (RFCID).						
Epidemiology						
Study Design:	**Observational comparative study**		**Level of Evidence**	III-2		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X					
Reported period	Start:	November 1, 2009		End:	February 28, 2010	
Diagnostic method	Real-Time RT-PCR					
Number of Cases	988	Positive:242 (25%)		Negative:		
Genotype			**GII.4 variants**	Mostly Forty-three (93%) of 46 norovirus isolates sequenced belonged to the genogroup II.4 variant		
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics						
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person	Oral –Faecal	Direct contact	Aerosols	Other		

transmission	route	(vomitus)		
				Most of the patients (234 [96.7%]) had community acquired infection; 8 (3.3%) had hospital-acquired infection
Primary transmission	Foodborne	Waterborne	Environmental	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Overall rate of hand hygiene compliance of hospital staff -between 60% and 70% after 3 year follow up During 12 months period, the incidence of hospital-acquired norovirus infection decreased from 131 to 16 cases per 1,000 potentially infectious patient-days (P< .001)			

(Haill et al. 2012)

Ref No:						
Reference: (Haill et al. 2012)						
Affiliation / source of funds: Department of Microbiology and Infection Prevention and Control, Derriford Hospital, Plymouth, UK None declared.						
Epidemiology						
Study Design:	**Prospective Intervention study**		**Level of Evidence**	**Level III-2**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X					Lab
Reported period	Start:	1June 2005 and		End:	31 May 2011.	
Diagnostic method						
Number of Cases		Positive:		Negative:		
Genotype	11 and 44 outbreaks per year.		**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics	Derriford Hospital is a 1200-bed teaching hospital in southwest England with 42 wards containing between 14 and 34 beds					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		
Primary transmission	Foodborne	Waterborne	Environmental			

Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Containment of symptomatic patients in single rooms and bays at the beginning and end of norovirus outbreaks reduced the length of bed closure Prior to June 2007, 90% of outbreaks were managed by closure of an entire ward, compared with only 54% from June 2007 onwards. The duration of closure was significantly shorter for bays compared with entire wards, both before (3.5 vs 6, P = 0.0327) and after (3 vs 5, P < 0.0001) June 2007. When considering all outbreaks, there was a significant reduction in duration of closure after the change in strategy (6 vs 5, P = 0.007).			

(Harris, Adak & O'Brien 2014)

Ref No:						
Reference: (Harris, Adak & O'Brien 2014)						
Affiliation / source of funds: 1Gastrointestinal Emerging and Zoonotic Diseases Department, Public Health England, London, UK						
Epidemiology						
Study Design:	**Retrospective Record Analysis**		**Level of Evidence**	Level IV		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X	X				
Reported period	Start:	2009		End:	2012	
Diagnostic method						
Number of Cases		Positive: 3650 laboratory-confirmed norovirus outbreaks		Negative:		
Genotype			**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics	Analysis of summary data from hospitals on outbreaks of norovirus from 2009 to 2012 in England using from the national Hospital Norovirus Outbreak Reporting Scheme (HNORS)					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		
Primary transmission	Foodborne	Waterborne	Environmental			

Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Closing a bay or ward promptly (within 3 days of the first case occurring) in an outbreak of norovirus, the duration of the outbreak is shorter compared with the outbreaks where closure is not prompt. The duration of the outbreaks was longer in the closure group where closure was delayed to seven or more days. However, the interpretation of these results is not straightforward due to several limitations			

(Illingworth et al. 2011)

Ref No:						
Reference: (Illingworth et al. 2011)						
Affiliation / source of funds: School of Medicine, The University of Manchester, Manchester, UK None declared.						
Epidemiology						
Study Design:	**Pre and Post Test Design**		**Level of Evidence**	**Level III-3**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X					Lab
Reported period	Start:	comparing two norovirus seasons (2007-08 and 2009-10) before and after implementation of the new strategy		End:		
Diagnostic method						
Number of Cases	42 confirmed norovirus outbreaks in the 2007-08 season, and 29 possible and 25 confirmed outbreaks in the 2009-10 season		Positive:		Negative:	
Genotype			**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics	NHS Hospitals & Community UK					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	

Transmission pathways				
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other
Primary transmission	Foodborne	Waterborne	Environmental	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Closure of affected ward bays (rather than wards), installation of bay doors, enhanced cleaning, a rapid in-house molecular test and an enlarged infection control team. Significant decrease in the ratio of confirmed hospital outbreaks to community outbreaks(r = 0.317, P =0.025), the number of days of restricted admissions on hospital wards per outbreak (r = 0.742, P= 0.041), and the number of hospital bed-days lost per outbreak (r = 0.344, P< 0.001). However, there was no significant change in the number of patients affected per hospital outbreak (r =1.080, P= 0.517), or the number of hospital staff affected per outbreak (r = 0.651, P =0.105			

(Liu et al. 2010)

Ref No:						
Reference: (Liu et al. 2010)						
Affiliation / source of funds: Center for Global Safe Water, Hubert Department of Global Health, Rollins School of Public Health, Emory University, Atlanta, Georgia This study was supported in part by a grant to L.-A. Jaykus and C. Moe from the International Life Sciences Institute—North America (ILSI-NA).						
Epidemiology						
Study Design:	**Experimental controlled laboratory design**		**Level of Evidence**	**Level III-1**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
						Lab
Reported period	Start:	Not reported		End:	Not reported	
Diagnostic method	real-time reverse transcription-quantitative PCR (RT-qPCR)					
Number of Cases		Positive:		Negative:		
Genotype	Norwalk virus (NV) on human finger pads		**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics	10 volunteers human finger pads					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		

Primary transmission	Foodborne	Waterborne	Environmental	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Reduction in genomic copies of NV cDNA with the antibacterial liquid soap treatment (0.67 to 1.20 log10 reduction) and water rinse only (0.58 to 1.58 log10 reduction). The alcohol-based hand sanitizer was relatively ineffective, reducing the genomic copies of NV cDNA by only 0.14 to 0.34 log10 compared to baseline			

(Morter et al. 2011)

Ref No:						
Reference: (Morter et al. 2011)						
Affiliation / source of funds: Infection Prevention and Control Team, Norfolk and Norwich University Hospital, Norwich, UK						
Epidemiology						
Study Design:	**Interrupted time series without a parallel control group**		**Level of Evidence**	III-3		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
	X (Hospitals)					
Reported period	Start:	2009		End:	2010 (4 months)	
Diagnostic method						
Number of Cases		Positive: NoV was detected in 75 (31.4%) of 239 environmental swabs collected from sites on five wards and one day room		Negative:		
Genotype			**GII.4 variants**	different GII-4 strains		
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics						
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		

Primary transmission	Foodborne	Waterborne	Environmental	
Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Wards environment and clinical equipment were washed using Actichlor NoV contamination was reduced on surfaces sampled from 42.1%to 13.2% and from 48.7% to 19.4% on K2 and H3 wards			

(Park et al. 2010)

Ref No:						
Reference: (Park et al. 2010)						
Affiliation / source of funds: Centers for Disease Control and Prevention, Atlanta, Georgia						
Epidemiology						
Study Design:	**Experimental controlled laboratory design**		**Level of Evidence**	**Level III-1**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
						Lab
Reported period	Start:	Not reported		End:	Not reported	
Diagnostic method						
Number of Cases		Positive:		Negative:		
Genotype	Norwalk virus (NV) on human finger pads		**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics	GII.4 norovirus, feline calicivirus (FCV), murine norovirus (MNV), fecal extract					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		
Primary transmission	Foodborne	Waterborne	Environmental			

Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	For GII.4 NoV, 50 and 70% ethanol and isopropanol resulted in 0.0- to 0.6-log reductions of viral RNA, whereas both 90% ethanol and 90% isopropanol significantly reduced GII.4 RNA (P , 0.001) by 1.2 and 1.8 log PCR units per ml, respectively, after 5 min of exposure			

(Tung et al. 2013)

Ref No:						
Reference: (Tung et al. 2013)						
Affiliation / source of funds:						
Epidemiology						
Study Design:	**Experimental controlled laboratory design**		**Level of Evidence**	**Level III-1**		
WHO Region/Country:						
Location / Setting:	Acute	Aged	Paediatrics	Neonatal	Rehab	Other
						Lab
Reported period	Start:	Not reported		End:	Not reported	
Diagnostic method						
Number of Cases		Positive:		Negative:		
Genotype	norovirus (NoV) genogroup II strains (GII.2 and GII.4) and two surrogates (feline calicivirus [FCV] and murine norovirus [MNV-1]).		**GII.4 variants**			
Other pathogen found	Rotavirus		Others			
Age Group/Sample	Neonate/infant	Children	Adults	Older adults		
Population Characteristics	Lab					
Clinical features	Vomiting	Abd. pain	Diarrhoea	Other	**Mortality rate**	
Transmission pathways						
Person to person transmission	Oral –Faecal route	Direct contact (vomitus)	Aerosols	Other		
Primary transmission	Foodborne	Waterborne	Environmental			

Food vehicle categories	Produce	Shellfish	Ready to eat	
Water vehicle categories	Tap water	Ground water	Recreational water	other
Reported Management strategies / Implication	Compare the efficacy of three commonly used disinfectant active ingredients against representative HuNoV strains and cultivable surrogates- Ethanol (50, 70, and 90%), sodium/hypochlorite (5, 75, 250, 500, and 1,000 ppm)/a quaternary ammonium compound blend (at 0.1x, 1.0x, and 10x concentrations Overall, all 3 products are not effective against HuNoV			

Appendix IV Summary Tables – Included studies Q1 and 2

Reference/ authors	**Type of study** **Level of Evidence** (NHMRC)	**Intervention-** clinical features, occurrence, diagnostics/Screening strategies	**N**	**Population /Study information** Participants, methods, Outcomes, length of follow up **Settings:** acute care, aged care, and rehabilitation	**Results/** Geno type/ Prevalence data/Comparison/ Transmission pathways	**Clinical importance/recommendations**
(Beersma et al. 2009) 270	Retrospective analysis Level IV:	Duration: 2002/03 to 2006/07 polymerase chain reaction (PCR) assays/ LightCycler amplification followed by SYBR Green I staining of PCR products	221/2458	Stool samples from out-patient clinics (N=7), paediatric wards (N=11)and adult wards (N=20). Most samples (68.2%)were taken from patients aged <18 years Tertiary care hospital Erasmus Medical Center, Rotterdam, The Netherlands	NoV infection was more common in patients aged <18 years (4.6 cases per 1000 admissions) than in adults (1.19 cases per 1000 admissions) GIIb strains occurred mainly in children below the age of two-and-a-half years [odds ratio (OR): 14.7; P<0.0001] GII.4 strains affected all age groups Nosocomial infection highest in the youngest patients (58%) and in the elderly (78%) Twelve of 53 patients from whom follow-up samples were available demonstrated long-term virus shedding	data demonstrate a diverse and dynamic pattern of NoV infections in a tertiary hospital setting, characterised by frequent nosocomial transmission and the unexplained dominance of GIIb strains in children

(Cheng, FWT et al. 2006) 864	Case series Level IV	Duration: 19 and 28 August (Year Not available) Vomiting: 82% Diarrhoea (63%) Fever (18%) Stool samples /rectal swabs-reverse Transcription polymerasechain reaction (RT-PCR)	11/242	9 children , 1 visitor, and 1 medical student affected (Median age 5 years (range: 4 months to 22 years) Norovirus outbreak in acute paediatric wards - 242 subjects (24 HCW,40 medical students, 54 patients and 124 parents and visitors assessed The Prince of Wales Hospital Hong Kong	There is no specific data reporting/ The outbreak was terminated within three days after the implementation of strict infection control measures. No second wave of affected cases was encountered.	Infection control strategies: strict contact precautions, prompt isolation and cohorting of symptomatic patients, vigorous environmental cleansing with concentrated disinfectant (hypochlorite solution 1000 ppm),meticulous handling of waste products, and efficient contact tracing of exposed patients, family members, and medical students
(Cheng, VCC et al. 2011) 711	Observational comparative study Level III-2	Duration: November 1, 2009, and February 28, 2010 Real-Time Reverse transcription polymerase chain reaction (RT-PCR) 47% of 242 patients had norovirus detected by our added test*. * test performed by the microbiology laboratory on all fecal specimens	242/988	The epidemic of norovirus peaked when the incidence density reached 5.25 cases per 1,000 patient-days with 78 potentially infectious patient-days Queen Mary Hospital, Hong Kong	Forty-three (93%) of 46 norovirus isolates sequenced belonged to the genogroup II.4 variant Most of the patients (234 [96.7%]) had community acquired infection; 8 (3.3%) had hospital-acquired infection	Table 2 provides Nosocomial Outbreak of Norovirus Infection in the Public Hospitals in Hong Kong during Winter 2009–2010 Strategic infection control measures with an added test may be useful in controlling nosocomial transmission of norovirus

(Costantini et al. 2016)	Prospective cohort study Level III-2	Duration: November 2009 to January 2013. Diarrhea (84%), fatigue (81%), vomiting (76%), and nausea (74%). Presence of both vomiting and diarrhea (62%) Real-time RT-qPCR) of stool samples or 4-fold increase in serum antibody titers	10 Outbreaks /39 (62 cases)	Ten (26%) of 39 outbreaks (7 LTCFs) resulted in 386 illnesses, 29 hospitalizations, and 5 associated deaths. Long-term care facilities (LTCFs) USA	Illness duration was longer in cases aged ≥70 years (n = 29; median, 4; interquartile range [IQR], 3–4) than aged <70 years (P = .041), with 19 (60%) lasting >3 days and 4 (13%) lasting >5 days Prolonged shedding (≥21 days) was detected in 16 (47%) of the 35 cases with positive acute stool. GII.4 Sydney outbreaks was significantly higher than in outbreaks caused by other genotypes	Infected people can asymptomatically shed virus at high levels for at least 3 weeks
(Cummins & Ready 2016)	Prospective cohort study Level III-2	Duration: February to 30 April 2015 Multiplex real-time reverse-transcription polymerase chain reaction assay (RT-PCR)	57 Patients/7 Staff from 4 Hospitals	Hospitalized patients_ no details GII was the dominant genogroup detected and comprised 94.6% of all the norovirus-positive samples Hospitals (coded A–E). London, United Kingdom	During this 3-month period, 1379 stool samples were tested for the presence of norovirus and other enteric pathogens, with 122 samples (8.8%) positive foGII was the dominant genogroup detected and comprised GII was the dominant genogroup detected and comprised 94.6% of all the norovirus-positive samples	Control measures included isolation, hand hygiene, environmental cleaning, and rapid diagnostic testing But do evaluation data available

(Danial et al. 2011)	Prospective cohort study Level III-2	Duration: September 2007 to June 2009 RT-PCR (including threshold cycle value, if positive).	1732 patients and 599 hospital staff	The hospitals in NHS - approximately 2300 acute inpatient beds and, 150 acute functional care units' were monitored in this study 192 unit outbreaks Hospitals in NHS Lothian, United Kingdom	In the acute sector, 1368 patients (0.99 cases/1000 inpatient bed-days) and 406 healthcare staff (0.29 cases/1000 inpatient bed-days) were affected in 155 unit outbreaks (0.23 unit outbreaks/day). Noroviruses were detected in 142 outbreaks (74%); 50 were not laboratory confirmed but were presumed to be noroviruses on epidemiological grounds	Outbreaks in which the affected unit was closed to new admissions within the first three days of recognizing the index case(174/192, 91%) were contained in a mean of six days, and outbreaks in units that were closed later persisted for a mean of seven days; this difference was not statistically significant
(Franck et al. 2014)	Retrospecti ve cohort study Level III-2	Duration: 2006–2010. Polymerase RT-PCR	4056/ 18796	After exclusion of patients with uncertain hospitalization status, 3,848 patients selected -230 wards in 60 hospitals in Denmark, 356 general practices or outpatient clinics, and 46 suspected foodborne outbreaks. Department of Virology at Statens Serum Institut, Copenhagen, Denmark Hospitals in Denmark	Patients from health care settings (n=1070) catagorised to nosocomially infected patients (n = 539), patients with community-acquired infections (n = 248), patients with an indeterminate source of infection (n = 274), and nursing home residents (n = 9). Most patients from health care settings were infected with GII.4 (712/785, 91%), compared to community settings (421/781, 54%) ($p<0.001$) The proportion of children <3 years of age infected with NoV GII.3 or GII.P21 ranged from 11% to 25% strong association between infection with NoV GII.4 and patient age ≥60 years in community and health care settings	most NoV genotypes circulating in health care settings were GII.4 and that infection with NoV GII.P21 or II.3 was more prevalent in children than adults. The association between older age and infection with NoV GII.4, which could partly explain why most NoV infections in health care settings are caused by this genotype

(Franck et al. 2015)	Retrospective cohort study Level III-2	Duration: 2002-2010 Polymerase RT-PCR	3656	patients were hospitalized in 297 different wards in 71 hospitals, situated in all 5 administrative regions of Denmark	2320 (63%) of the NoV positive inpatients had nosocomial NoV infections, and 572 (16%) had community-acquired infections; the NoV acquisition source was classified as indeterminate for 764 (21%) The highest proportion of nosocomial infections (67%) was seen among inpatients ≥60 years of age, Patients ≥60 years of age were hospitalized for a median of 16 days (IQR, 9–29 days), whereas younger patients <60 years of age were hospitalized for a significantly shorter duration (median, 8 days; IQR, 3–18 days) (P < .001). In multivariate analyses, GII.4 infections were also associated with nosocomial NoV infections.	The majority of NoV infections in hospitalized patients were nosocomial. Nosocomial infection was mainly associated with older age but also with the specific genotype GII.4. Increased susceptibility to NoV of the elderly and chronically ill may also increase transmission in this vulnerable population
(Godoy et al. 2015)	Descriptive Epidemiological study Level IV	Duration: 1 January 2010 and 31 December 2011 Symptoms: diarrhoea 61·5%, vomiting 55·0%, abdominal pain 34·9%, nausea 33·8% and fever 20·2% RT–PCR	27 outbreaks 816/2348	27 outbreaks detected; 13 in hospitals (48·1%) and 14 in nursing homes (51·9%). Hospitals and nursing homes in Catalonia, Spain	81·5% (22/27) of outbreaks - person to-person transmission. 11·1% (3/27) -foodborne and person-to-person transmission. 7·4% (2/27) – foodborne The most frequent genotype was GII.4 which was detected in 66·7% (10/15) of outbreaks.	Primary control measures - environmental decontamination (hypochlorite at 1000–5000 ppm), the prevention of food contamination, the exclusion of sick workers, the cohorting of infectious patients and / hand washing or the use of alcoholic solutions among healthcare workers,

(Harris et al. 2014)	Retrospective Record Analysis Level IV	Duration: 1992–2008(GSURV) & 2009–2011(HNORS) National surveillance (GSURV) The Hospital Norovirus Outbreak Reporting System (HNORS) Polymerase chain reaction (PCR)	1485 outbreaks (92-08) 2737 NoV outbreaks (HNORS)	Norovirus was laboratory confirmed in 69% (2737) of the reported outbreaks (75% in the 2009–2010 season, 62% in 2010–2011). The outbreaks were reported to have affected a total of 40 007 (median 9, range 0–110, IQR 6–14) patients and 10 620 staff (median 2, range 0–55, IQR 0–4). NHS Hospitals UK	Outbreaks lasted a total of 24 129 days (median 6, range 1–59, IQR 4–10) and led to 26 717 days of ward/bay closures (median 8, range 1–86, IQR 6–11) and 46 513 bed-days lost (median 12, range 0–288, IQR 6–32).	On average, reported outbreaks are associated with 13 000 patients and 3400 staff becoming ill, 8900 days of ward closure and the loss of over 15 500 bed-days annually.
(Harris et al. 2013)	Prospective cohort study Level III-2	Duration: November 2009 and November 2011 Polymerase chain reaction (PCR)	65 outbreaks	This study uses statistical modelling methods to assess whether patients in proximity (spatial proximity) are at increased risk of contracting norovirus during outbreaks in hospitals. Five hospitals in two major cities in UK	The outbreaks affected various ward types, with most occurring in general medical wards (34%) and care of the elderly wards (28%). Other specialties were respiratory medicine (12%), stroke/neurology wards (11%), coronary care wards (9%) and orthopaedic/trauma wards (6%). Strong association where patients who are in the same bay as patients who become ill have a higher probability of themselves becoming ill compared with patients in a different bay.	Transmission of norovirus infections is more likely to occur among patients sharing a bay, compared with transmission among patients in different bays. Increasing barriers to movement between bays by closing affected bays promptly would be effective in preventing further spread.
(Heijne et al. 2012)	Cross sectional study Level IV	Duration: 2008 No data for diagnostic	46 patients	The simulated transmission trees were based on serial intervals for time between symptom onsets, weighted for the number of days that healthcare workers were present 4 wards of a psychiatric institution, the Netherlands	Transmission route was from patient to patient (64%), followed by patient to healthcare worker (29%).The overall attack rate of norovirus in this outbreak was 42% The overall estimated reproduction number for healthcare workers was low compared with patients (0.25 vs. 1.20; mean difference 0.95 95% confidence interval (CI) 0.60 to 1.30)	Patient-to-patient transmission was shown as the main component in this outbreak

(Hoffmann et al. 2013)	Cross sectional study Level IV	Duration: June 2011 RT-PCR	116 patients 28 staff	Food-borne outbreak a university hospital, Munich, Germany	Five of staff worked in the catering facility and were suspected to be the likely source of infection. novel strain classified as GII.g/GII.1 as the causative agent for an extended outbreak.	Hygienic measures, including disinfection procedures and closure of wards helped contain the outbreak within 6 days
(Johnston et al. 2007)	Case series with economic analysis Level IV	Duration: 7 January through 1 May2004 RT-PCR Infected HCWs and patients had diarrhea or vomiting, Nearly 50% of HCWs reported fever (42.2%), chills (59.2%), or myalgia (55.7%). Thirteen (4.9%) of the 265 HCWs required emergency department visits (n=9) or hospitalization (n=4) for intravenous hydration	355: 265 staff 90 inpatients	On average, HCWs were younger than patients, with mean ages (±SD) of 36.2±10.4 years and 45.5±23.4 years, respectively (table 1). Of the affected HCWs, 83.8% were female, and 47.8% of the patients were female. 355 cases in the coronary care unit and psychiatry units. Attack rates were 5.3% for patients and 29.9% for health care workers in the coronary care unit and 16.7% for patients and 38.0% for health care workers in the psychiatry units. Thirteen affected health care workers (4.9%) required emergency department visits or hospitalization. Johns Hopkins Hospital (JHH) Baltimore, Maryland USA	Noroviruses have been detected on surfaces, such as carpet (after cleaning), elevator buttons, bed rails, and dining Overall, CCU attack rates were 5.3% (7 of 133) for patients and 29.9% (29 of 97) for HCWs. The epidemic curve was consistent with a single-exposure outbreak involving person-to-person transmission Detected noroviruses had 98%–99% sequence identity with representatives of a new genogroup II.4 variant	Termination of the outbreak in the CCU occurred only after the unit was temporarily closed for extensive environmental decontamination with sodium hypochlorite (i.e., bleach), patients and HCWs were screened for gastroenteritis, ill HCWs were furloughed, and other aggressive infection-control measures were implemented. Bleach is the disinfectant of choice based on its performance against feline caliciviruses (a surrogate used for noroviruses), compared with quaternary ammonium compounds, detergents, or alcohol. No evaluation data reported

(Kanerva et al. 2009)	Cross sectional study Level IV	Duration: mid-December2006 to May 2007 RT-PCR	445 220 patients, 205 health workers	Adult patients and health care workers from cardiology wards, and a few internal medicine wards During the outbreak, 502 patient stool specimens were tested for norovirus RNA, 181 (36%) of which were positive 504-bed tertiary care hospital in Finland.	The outbreak affected 23 wards (77%) on 14 floors of the hospital's main building from mid-December 2006 to May 2007. According to lists from affected wards, 240 patients (of 1351; attack rate 18%) and 205 HCWs (of 1096; attack rate 19%) fell ill (Figure 1a). Most cases were from cardiology wards, and a few internal medicine wards, as well as neurology and pulmonology wards, and are described here in more detail. Three epidemic peaks occurred.	As new variants of GII.4 appear to emerge at rather short intervals and since no vaccine is thus far available, hygiene measures in infection control are of utmost importance
(Lopman et al. 2006)	Prospective cohort III-2	Duration: April 2002- March 2003 RT-PCR and/or ELISA	76 outbreaks	One or more faecal specimens were taken from affected persons in 122 of the 227 (53%) outbreaks. Of these, one or more specimen was positive for norovirus by RT-PCR [26] and/or ELISA [27] in 76 (63%) outbreaks 171 inpatient units in 15 hospitals, UK	61 of these viruses (95%) closely clustered with genogroup II4 (≥90% similarity with prototype Lorsdale strain). The evidence suggests that transmission between hospitals units does occur.	Combining virological and epidemiological evidence may give insight into transmission events.
(Mattner, Guyot & Henke-Gendo 2015)	Retrospecti ve analysis Level IV	Duration:2002-2012 RT-PCR and/or ELISA	71 Outbreaks : 1432 patients	Majority of outbreaks occurring on medical wards [medicine 42 (59%), surgery 12 (17%), neurology 4 (6%), urology 2 (3%), obstetrics 1 (1%), psychiatry 3 (4%), combined medicine/surgery 3 (4%), paediatrics 1 (1%) and dermatology 1 (1%)]. 5 University and teaching hospitals Germany	Identifiable index cases in 68 (96%) of 71 outbreaks. 5 developed due to a visitor. 2 started with a vomiting event on the ward's corridor. In 44 (62%) outbreaks a single patient could be determined as index case, 30 index patients acquired norovirus infection nosocomially.	Constant surveillance for new cases of diarrhoea and vomiting and timely adherence to contact precautions for all exposed persons is crucial in outbreak control, as is the need for extended microbiological testing.

(Munir et al. 2014)	Prospective cohort Level III-2	Duration: 2009-2010 Real-Time RT-PCR	15/92	Hospitalised children less than 18 years of age, with an immunocompromising condition 2 pediatric hospitals in Atlanta, Georgia, USA	NoV was identified in 16.3% (15/92) of all stool specimens; 23.4% (11/47) in immunocompromised only children, and 13.3% (4/30) in children with hospital acquired infections (HAI). All NoV positive cases were genogroup II (GII), and GII.4 was the predominant strain followed by GII.3, GII.12, and GII.13	NoV infections are common among immunocompromised children and children with hospital-acquired gastroenteritis, underscoring the urgent need for rapid NoV detection system
(Nenonen et al. 2014)	Case control Level III-2	Duration: Janu 2012- May 2012 RT-PCR (rRT-PCR)	63/108	Samples from inpatients and their hospital room environment were examined in rRT-PCR assays designed for laboratory diagnosis of enteric virus infections.molecular methods were used to investigate the nature of NoV contamination, including airborne dispersal of NoV in dust from patient rooms, as well as the molecular epidemiology of the outbreaks. University Hospital, Sweden	In the outbreak wards, NoV GII was detected in 48 of 101 (47%) environmental swabs and 63 of 108 patients (58%); NoV genotype II.4 was sequenced from 18 environmental samples, dust (n8), virus traps (n4), surfaces (n6), and 56 patients. In contrast, NoV GII was detected in 2 (GII.4) of 28 (7%) environmental samples and in 2 (GII.6 and GII.4) of 17 patients in the outbreak-free ward. Sequence analyses revealed a high degree of similarity (>99.5%, 1,040 nt) between NoV GII.4 environmental and patient strains from a given ward at a given time.	Avoiding the rapid spread of NoV GII.4 strains that characterized NoV transmission in the other wards may require a more intense cleaning response.
(Nguyen & Middaugh 2012)	A escriptive epidemiological study Level IV	Duration: Feb-March 2010 Of 207 cases, 176 (85%, range 68–100%) experienced diarrhoea and 98 (47%, range 19–64%) vomiting (rRT–PCR)	394/1797 patients	Eight long-term care facilities, staff (n=85, age range 19–78 years, median 43.5 years); residents (n=225, age range 44–99 years, median 84.5 years). Eight long-term care facilities, USA	394 (22%) met the case definition. Of 954 residents, 299 (31%) were ill, and of 843 staff, 95 (11%) were ill. Symptoms were first observed in staff at three facilities, with subsequent spread to other residents and staff. Staff members simultaneously employed at multiple LTCFs can facilitate the spread of NoV between them Only 62 stool samples were submitted. GII.4 New Orleans	Special efforts need to be taken to identify staff members who are employed or have interactions with multiple facilities. ill staff should be excluded from work for up to 72h after the cessation of symptoms and should also not work at other LTCFs within this period

(Ohwaki et al. 2009)	Retrospective cohort study Level III-2	Duration: Feb-March 2007 Staff members (285) Diarrhea (72%), Vomiting (57%) and fever (57%) RT-PCR	102/698	An at-risk group of 698 people was identified, which included staff, hospital patients, LTCF residents, and adult daycare users who shared consumption of food prepared in a central kitchen Hospital patients and attached LTCF, Japan	Consumption of the standard diet was sig. associated with illness (staff: RR=18.13, 95%CI= 5.76-57.03; patients: RR=2.12, 95%CI= 1.05-4.31) Believed to be caused by aerosols from the bathroom directly across from the kitchen. Kitchen door was kept open due to poor ventilation	Suggest infection control measures be consistently updated and possible restructuring of building area to prevent further contaminations.
(Partridge et al. 2012)	Retrospective cohort study Level III-2	Duration: 2009-2010 Real-Time RT-PCR	623	Retrospective study but data on symptom onset, duration and locations were gathered prospectively using an outbreak proforma as part of the standard infection control practice. A teaching hospital in UK	The mean duration of symptoms for patients aged >80 years was 5.7 days compared with 3.7 days for those aged <80 years. For patients with an initial CT value of <30, 83% remained positive at two weeks and 57% at three weeks. Transfer of patients into isolation rooms or cohorted area within two days of symptom onset did not significantly influence probability of onward transmission (52% vs 47%; P = 0.67).	Moving to isolation facilities is unnecessary, but ward should be closed to new admissions. Need to allow for a longer closure when older adults are involved as viral shedding is extended in this group.

(Rao et al. 2009)	Cross sectionals study Level IV	Duration: 2007 survey to affected staff to evaluate adherence to social distancing recommendations	74 staff	Of the 102 staff (55%) who responded to the survey, 93 (91%) experienced at least 2 episodes of vomiting, and 71 (70%) had at least 3 episodes of diarrhea). The median number of days ill was 3 (range, 0.25–14 days; mean, 3.5 days), and the median number of work days missed was 2 (range, 0–6 days; mean, 2.4 days). Sixty-five people (64%) had direct contact with patients who had NLI, 15 (15%) were exposed to children, and 16 (16%) had exposure to another healthcare facility tertiary care facility & LTCF USA,	. Adherence to self-quarantine recommendations was acknowledged by 74 affected staff (73%). Adherence was similar across job responsibility (50 clinical staff [76%] vs 24 non-clinical staff [67%]; and sex (16 men [73%] vs 53 women [66%].	Increased rates of adherence to self-quarantine recommendations could potentially decrease the length of time and number of patients and staff who become ill.

(Rosenthal et al. 2011)	Retrospective chart review Level IV	Duration:2003-2006 RT-PCR	163/234 (70%) Outbreaks	case-hospitalization rate (3.1%), and case-fatality rate (0.5%) stool specimens were first tested for NoV by reverse transcriptase–polymerase chain re- action (RT–PCR). Long-term care facilities (LTCFs), USA	The annual attack rate of outbreak-associated NoV infection in LTCF residents was 4%, with acase-hospitalization rate of 3.1% and a case-fatality rate of 0.5%. GII.4 strains accounted for 84% of NoV outbreaks. Median duration of illness was longer for GII.4 infections than non-GII.4 infections (33 vs. 24 h, P<0.001). Emerging GII.4 strains (Hunter/2004, Minerva/2006b, Terneuzen/2006a) gradually replaced the previously dominant strain (Farmington Hills/2002) during 2004–2006. Overall, strains belonging to eight NoVgenotypes (GI.1, GI.4, GI.6, GII.3, GII.4, GII.5,GII.6, GII.10) were detected in LTCFs during the study period. GII.4 strains accounted for 108 (84%) All confirmed NoV outbreaks, primary transmission mode was -s person-to-person (94%), foodborne (2.5%) and undetermined for 3.5%.	NoV is highly contagious, and after the virus is introduced into a LTCF, especially a large facility, an outbreak is almost unavoidable if the facility does not have thorough hygienic and infection-control practices. Outbreaks attributable to GII.4 strains, unlike those resulting from non-GII.4 strains, appear to have a distinct seasonal pattern, peaking in winter or spring. the emergence of novel GII.4 strains underscore the need for more effective infection-control strategies in LTCFs.

(Schmid et al. 2011)	Retrospective cohort (Aetiology) III-2	Duration:15-27 March 2009 RT-PCR	17/204	Of the 204 cases, 152 were patients and residents, yielding an overall attack rate of 27.6% among the 550 patients and residents present at the facility from 13 March until 27 March. The department-specific attack rates were as follows: 12.3% (8/65 patients; orthopaedic ward only) in the hospital, 24.8% (41/ 165 patients) in the rehabilitation centre and 32.2% (103/320 residents) in the convalescent home. Of the 240 staff members, 52 reported symptoms of diarrhoea or vomiting (attack rate: 21.7%). 600-bed Hospital, Austria	Consumption of sliced cold sausage offered on 15 March [odds ratio (OR):3.98; 95% confidence interval (CI): 1.18e14.1], a meat dish with salad (adjusted OR: 2.2; 95% CI:1.19e4.08) and a rolled spinach pancake (adjusted OR: 2.17; 95% CI: 1.27e3.71) on 16 March were independent risk factors.	kitchen hygiene practices revealed that the hazard analysis critical control point system was not in place. Infected food handlers who continue to work despite diarrhoea or vomiting are commonly the source of foodborne NV outbreaks in institutional settings
(Sheahan et al. 2015)	Case series Level III-3	Duration: January 31, 2014, and February 22, 2014. RT-PCR	14	Twelve occurred in pediatric patients, and 2 occurred among adult patients admitted on separate floors 25 HCWs reported NV compatible illness between February 1 and February 15; only 1 among these was tested and was positive. 33-bed inpatient pediatric unit of a 470-bed tertiary care hospital in New York City USA	At least 2 of the affected children have become long-term shedders and may represent a risk for future outbreaks. The impact of NV infection on immunocompromised patients, especially HSCT recipients, can be profound and long lasting. NV can lead to chronic debilitatingwasting syndrome, often requiring nutritional support and prolonged hospitalization for management	All patients on the pediatric floor were placed on special contact precautions: use of gowns, gloves, hand hygiene (alcohol based gel or handwashing with soap and water) before entry into patient room, and handwashing after patient encounter, all HCWs wore masks when caring for patients with active vomiting. All special contact isolation rooms are cleaned daily with bleach –No reportable data available

(Simon et al. 2006)	Case series Level III-3	Duration: 14 January to 20 February 2004, RT-PCR) and/or ELISA	21/ 246	The index patient and the chain of infection were identified. Pediatric oncology unit, Germany	Follow-up investigation demonstrated viral shedding for a maximum of 140 days (median 23 days). Three patients experienced severe or lifethreatening symptoms, probably related to NV infection No data available for the effectiveness of infection control strategies	Pediatric oncology patients must be closely monitored during follow-up investigations as they may shed the virus for months. There is some evidence from the outbreak described here that those patients face a greater risk of severe NV-related complications..
(Sukhrie et al. 2011)	Case control study Level III-2	Duration:2002-2007 RT-PCR	264/2458	264 patients (of 2,458 tested) were diagnosed with NoV infection during the 5-year period, and 61% of the patient strains genotyped. Hospital Netherlands	51% (n= 82) belonged to GII.4, 34% (n 54) belonged to GII.3, and 15% (n=24) belonged to other genotypes (GI.6B, GII.17, GII.7, and GII.2). In children's wards, GII.3 strains were associated with nosocomial spread more often than other viruses were, whereas in adults this was the case for GII.4 strains. Overall, 48% (n = 128) of NoV-positive patients most likely had hospital-acquired infection, according to the cutoff. Patients with newly diagnosed cases (17%; n= 44) had an onset of illness within 2 to 4 days after admission, but the exact source of infection could not be established	The generally higher rate of nosocomial infection in the young is easily explained by hygienic conditions: young children may wear diapers, and the handling thereof is associated with higher exposure to stools. Without proper hand-washing hygiene, this may constitute a greater risk of transmission.
(Sukhrie et al. 2012)	Retrospecti ve cohort study Level III-2	Duration: January 2009 and March 2010 polymerase chain reaction (PCR)	5 outbreaks / 28 patients	Five outbreaks were investigated, involving 28 patients withrecognized symptomatic NoV infection. a tertiary care hospital and 2 nursing homes in the region of Rotterdam Netherlands	NoV genotypes (ie, GII.4, GII.2, and GII.7). Enhanced sampling, however, yielded 65 additional cases, of whom 14% (n 5 9) were asymptomatic patients, 57% (n 5 37) were symptomatic HCWs, and 17% (n 5 11) were asymptomatic HCWs	symptomatic patients and HCWs were more often involved in transmission events than asymptomatic shedders. Asymptomatic HCWs rarely contributed to transmission, despite high levels of fecal virus shedding.

(Tsang et al. 2008)	Retrospective cohort study Level III-2	Duration: 11 May 2006-27 July 2006 Diarrhoea 97.2% Vomiting - 46.3% RT-PCR	38 outbreaks 218 patients	Most patients were elderly with a mean age of 74.5 years (range: 3 months to 97 years) A total of 208 patients had their stool specimen tested for norovirus by RTePCR and 151 (72.6%) were positive. Nineteen out of 41 public hospitals under management of the HA were involved. Public hospitals Hong Kong	The median duration for diarrhoea was 3 days and the longest 24 days. The median duration of vomiting was one day and the longest 15 days. Fever occurred in one-third of all cases	The median age of our patients was 74.5 years. Clinical symptoms tend to be more prolonged in the elderly, hospitalised or immunosuppressed individuals.
(Tseng et al. 2011)	Retrospective cohort study Level III-2	Duration: January 2005 to April 2007 Diarrhoea (161/184, 87.5%), followed by vomiting (47/184, 25.5%), abdominal pain (9/184, 4.9%) and fever (4/184, 2.2%) ELISA method and RT–PCR.	172/1351	4 norovirus outbreaks occurred within this psychiatric unit. Psychiatric Unit/The Wei-Gong Memorial Hospital (WGMH) -979-bed regional teaching hospital in Miaoli County, Taiwan.	Reviewing data for 184 patients between 2005 and 2007 revealed that 17 had experienced recurrent NVG during the four outbreaks	Psychiatric care centres are long-term-care facilities in which efforts to control outbreaks are usually hindered by the inability to detect them sufficiently early enough to confine the index patient due to behavior associated with psychiatric disorders
(Tu et al. 2008)	Cross sectionals study Level IV	Duration: June 2003 Vomiting -(78.6% diarrhea (71.4%), nausea (50.0%),abdominal cramps (35.7%) real-time nested reverse transcriptase-PCR	14 patients	an outbreak of vomiting and diarrhea affecting 28 (56%) of 50 patients and 43(57%) of 75 staff members occurred in two out of three wards Aged-care facility in New South Wales, Australia	NoV GII RNA-positive volunteers were closely documented until symptoms ceased. The duration of viral shedding: average 28.7 days (median, 28.5 days), with a range of 13.5 to 44.5 days	the duration and quantity of NoV GII RNA excretion in human stools to provide a clearer insight into the period of NoV infectivity in an aged-care setting

(Zheng et al. 2015)	Case series Level III-3	Duration: December 2012. Abd pain (86.5%), Diarrhea (67.6%), and Vomiting (45.9%). RT-PCR	39/105 Patients 6/ 13 asymptomatic cases	Elderly and staff showing symptoms of vomiting and diarrhea as well as from the asymptomatic staff. The facility housed 195 elderly whose nursing requirements were classified into self-caring, semi-nursing, full nursing, and special nursing. Eighty-two staff included doctors, nurses, attendants, food handlers, and logistics personnel. Aged care facility, China	GII.4 Sydney outbreaks disproportionally affected older persons	To control an outbreak of norovirus infection, it is necessary to analyze the stool samples from all staff (symptomatic and asymptomatic) and to pay attention to staff education on hand washing and disinfecting feces and vomitus appropriately.

Summary Table Q3 – Included studies

Reference authors	**Type of study** **Level of Evidence** (NHMRC)	**Intervention-precautions and control strategies** disinfection bleach vs other, frequency of cleaning, hand hygiene alcohol vs soap/water, contact +/- aerosol etc	**N**	**Population /Study information** Participants, methods, Outcomes, length of follow up	**Quality** Description-is study quality good enough to inspire confidence in results?	**Results/**	**Clinical importance/recommendations**
(Blaney et al. 2011)	A cross-sectional survey Level IV	Alcohol-based hand sanitizer (ABHS) versus soap and water long-term care facilities in northern New England December 2006 to March 2007	29 Aged care facilities 1,184 residents and 757 staff affected	91 long-term care facilities (60%) provided survey responses 61 facilities reporting 73 outbreaks; 29 were confirmed norovirus. long-term care facilities in northern New England USA		In long-term care facilities with laboratory-confirmed norovirus outbreak, Staff were equally or more likely to use ABHS than soap and water for routine hand hygiene had higher odds of an outbreak than facilities with staff less likely to use ABHS (adjusted odds ratio, 6.06; 95% confidence interval:1.44-33.99 p = .02).	preferential use of ABHS over soap and water for routine hand hygiene might be associated with increased risk of norovirus outbreaks in long-term care facilities

(Cheng, VCC et al. 2011)	Observational comparative study Level III-2	Staff education (3594 -18 months) and promotion of directly observed hand hygiene using alcohol based hand rub (ethanol (80% vol/vol), Queen Mary Hospital, Hong Kong ,400-bed tertiary referral university-affiliated hospital with 3 adult isolation wards and 1 pediatric isolation ward and incidence in the other 6 hospital networks in Hong Kong was chosen as the concurrent control November 1, 2009, and February 28, 2010	242/988	242 patients were positive for norovirus 142 females and 100 males, with a median age of 57 years (range, 1 month to 101 years). Aged 3 years or younger- 74 (31%) Aged 70 years or older 106 (44%). 52 (21%) patients were long-term-care home residents		Overall rate of hand hygiene compliance of hospital staff -between 60% and 70% after 3 year follow up During12 months period, the incidence of hospital-acquired norovirus infection decreased from 131 to 16 cases per 1,000 potentially infectious patient-days (P< .001)	Strategic infection control measures including staff education and observed hand hygiene using alcohol based hand rub with an added test to detect the Norovirus* may be useful in controlling nosocomial transmission of norovirus *47% of 242 patients had norovirus detected by our added test*.

(Haill et al. 2012)	Prospective Intervention study Level III-2	Containment of symptomatic patients in single rooms and bays at the beginning and end of norovirus outbreaks reduced the length of bed closure Derriford Hospital is a 1200-bed teaching hospital in southwest England with 42 wards containing between 14 and 34 beds. 1June 2005 and 31 May 2011.	11 and 44 outbreaks per year.	There were between 11 and 44 outbreaks per year. First, soon after an outbreak had been identified, symptomatic patients were cohorted in single rooms or bays in an attempt to contain the outbreak without closing the entire ward.		Prior to June 2007, 90% of outbreaks were managed by closure of an entire ward, compared with only 54% from June 2007 onwards. The duration of closure was significantly shorter for bays compared with entire wards, both before (3.5 vs 6, P = 0.0327) and after (3 vs 5, P < 0.0001) June 2007. When considering all outbreaks, there was a significant reduction in duration of closure after the change in strategy (6 vs 5, P = 0.007).	Many norovirus outbreaks can be controlled by containment in bays rather than by entire ward closures, particularly when this is combined with adequate infection control support this approach needs to be implemented promptly and early in an outbreak before extensive transmission has occurred within a clinical area
(Harris, Adak & O'Brien 2014)	Retrospective Record Analysis Level IV	Ward or bay closures, specifically, whether prompt closure of an affected ward Vs not to close Analysis of summary data from hospitals on outbreaks of norovirus from 2009 to 2012 in England using from the national Hospital Norovirus Outbreak Reporting Scheme (HNORS) 2009 to 2012	3650 outbreaks	3650 laboratory-confirmed norovirus outbreaks		Closing a bay or ward promptly (within 3 days of the first case occurring) in an outbreak of norovirus, the duration of the outbreak is shorter compared with the outbreaks where closure is not prompt. The duration of the outbreaks was longer in the closure group where closure was delayed to seven or more days. However there are several limitations and assumptions of this study	There is no compelling evidence that closing the ward is an effective way of curtailing an outbreak of norovirus.

(Illingworth et al. 2011)	Pre and Post Test Design Level III-3	Closure of affected ward bays (rather than wards), installation of bay doors, enhanced cleaning, a rapid in-house molecular test and an enlarged infection control team comparing two norovirus seasons (2007-08 and 2009-10) before and after implementation of the new strategy NHS Hospitals & Community UK	67 NoV Outbarks	42 confirmed norovirus outbreaks in the 2007-08 season, and 29 possible and 25 confirmed outbreaks in the 2009-10 season.		significant decrease in the ratio of confirmed hospital outbreaks to community outbreaks(r = 0.317, P =0.025), the number of days of restricted admissions on hospital wards per outbreak (r = 0.742, P= 0.041), and the number of hospital bed-days lost per outbreak (r = 0.344, P< 0.001). However, there was no significant change in the number of patients affected per hospital outbreak (r =1.080, P= 0.517), or the number of hospital staff affected per outbreak (r = 0.651, P =0.105).	Closure of entire wards during norovirus outbreaks is not always necessary. The changes implemented at the study hospital resulted in a significant reduction in the number of bed-days lost per outbreak, and this, together with a reduction in outbreak frequency, resulted in considerable cost savings
(Liu et al. 2010)	Experimental controlled laboratory design Level III-1	Efficacy of (1) sodium hypochlorite Vs ethanol (2) antibacterial liquid soap (Fisher Scientific International-Hampton, NH) and alcohol-based hand sanitizer (2% ethyl alcohol) for the inactivation of Norwalk virus (NV) on human finger pads real-time reverse transcription-quantitative PCR (RT-qPCR)	10	10 volunteers human finger pads		Reduction in genomic copies of NV cDNA with the antibacterial liquid soap treatment (0.67 to 1.20 log10 reduction) and water rinse only (0.58 to 1.58 log10 reduction). The alcohol-based hand sanitizer was relatively ineffective, reducing the genomic copies of NV cDNA by only 0.14 to 0.34 log10 compared to baseline	Ethanol-based hand sanitizers are less effective controlling the transmission of HuNoV group

(Morter et al. 2011)	Pre and Post test design Level III-3	Time 1: Wards environment and clinical equipment were washed using Actichlor.. If soiled with blood or body fluids, equipment was cleaned first with water and detergent, followed by 10 000 ppm Actichlor plus Environmental monitoring was performed after cleaning using Cotton-tipped swabs Time 2: Re-cleaned and re-tested four-month period during 2009-2010	75/239 swabs	NoV was detected in 75 (31.4%) of 239 environmental swabs collected from sites on five wards and one day room 963-bedded teaching hospital.UK		NoV contamination was reduced on surfaces sampled from 42.1%to 13.2% and from 48.7% to 19.4% on K2 and H3 wards 45% swabs from soap and alcohol dispensers, 45.9% from equipment, 29.4% within the nurses' station, 42.9% at the bedside and 23.6% from furniture, fixtures and fittings were positive for NoV	It is difficult to determine the effectiveness of cleaning agents however ward environment and equipment can be considered as NoV reservoirs.
(Park et al. 2010)	Experimental controlled laboratory design Level III-1	Virucidal efficacy of seven hand sanitizers containing various active ingredients ethanol, triclosan, and chlorhexidine	N/A	GII.4 norovirus, feline calicivirus (FCV), murine norovirus (MNV), fecal extract		For GII.4 NoV, 50 and 70% ethanol and isopropanol resulted in 0.0- to 0.6-log reductions of viral RNA, whereas both 90% ethanol and 90% isopropanol significantly reduced GII.4 RNA (P , 0.001) by 1.2 and 1.8 log PCR units per ml, respectively, after 5 min of exposure	Significant reduction in RNAtiters of GII.4 NoV after exposure to 90% ethanol or 90% isopropanol indicates that both alcohols could be effective against HuNoV. However, it is not clear whether lower concentrations (50 to 70%) of alcohols, which are widely used in commercial sanitizers, are effective against HuNoV.

(Tung et al. 2013)	Experimental controlled laboratory design Level III-1	Compare the efficacy of three commonly used disinfectant active ingredients against representative HuNoV strains and cultivable surrogates- Ethanol (50, 70, and 90%), sodium/hypochlorite (5, 75, 250, 500, and 1,000 ppm)/a quaternary ammonium compound blend (at 0.1x, 1.0x, and 10x concentrations	N/A	Two norovirus (NoV) genogroup II strains (GII.2 and GII.4) and two surrogates (feline calicivirus [FCV] and murine norovirus [MNV-1]).		Both HuNoV strains were more resistant to hypochlorite than were either of the animal surrogates, with the human strains requiring >_500 ppm of hypochlorite to achieve statistically significant reduction (>_3.0 log) in virus concentration. All four viruses were resistant to inactivation (,0.5-log reduction) using the quaternary ammonium compound formulation at all concentrations tested.	Overall, all 3 products are not effective against HuNoV

Appendix V Excluded Studies

Excluded studies Q 1 & 2

1. Bentley, K, Dove, BK, Parks, SR, Walker, JT & Bennett, AM 2012, 'Hydrogen peroxide vapour decontamination of surfaces artificially contaminated with norovirus surrogate feline calicivirus', *Journal of Hospital Infection,* vol. 80, no. 2, pp. 116-121. [Lab study- not human]
2. Cooper, T, Atta, M, Mackay, A, Roberts, H & Clement, A 2011, 'A major outbreak of Norovirus in an acute NHS hospital in 2010: a practical management approach', *Journal of Infection Prevention,* vol. 12, no. 3, pp. 111-118. [Report only no evaluation data]
3. Fretz, R, Schmid, D, Jelovcan, S, Tschertou, R, Krassnitzer, E, Schirmer, M, Hell, M & Allerberger, F 2009, 'An outbreak of norovirus gastroenteritis in an Austrian hospital, winter 2006-2007', *Wiener Klinische Wochenschrift,* vol. 121, no. 3-4, pp. 137-143.[No data on Norovirus confirmed cases]
4. Georgiadou, SP, Loukeris, D, Smilakou, S, Daikos, GL & Sipsas, NV 2011, 'Effective control of an acute gastroenteritis outbreak due to norovirus infection in a hospital ward in Athens, Greece, April 2011', *Euro Surveillance: Bulletin Europeen sur les Maladies Transmissibles = European Communicable Disease Bulletin,* vol. 16, no. 28. [No relaible method was used to detect Norovirus]
5. Gilbride, SJ, Lee, BE, Taylor, GD & Forgie, SE 2009, 'Successful containment of a norovirus outreak in an acute adult psychiatric area', *Infection Control & Hospital Epidemiology,* vol. 30, no. 3, pp. 289-291. [small sample size/ limited data/ No reliable method was used to detect Norovirus]
6. Harris, JP 2016, 'Norovirus Surveillance: An Epidemiological Perspective', *J Infect Dis,* vol. 213 Suppl 1, Feb 1, pp. S8-s11. [Incomplete study]
7. Jayasekara, L, Leone, CM, Sharp, J & Fraser, A 2016, 'Preventing and controlling human noroviruses in South Carolina long-term care facilities: An analysis of institutional policies and procedures', *Am J Infect Control,* vol. 44, no. 1, 01 Jan, pp. 24-29.[An analysis of institutional policies and procedures- not outbreaks]
8. Koo, HL, Ajami, NJ, Jiang, ZD, Dupont, HL, Atmar, RL, Lewis, D, Byers, P, Abraham, P, Quijano, RA, Musher, DM & Young, EJ 2009, 'A nosocomial outbreak of norovirus infection masquerading as clostridium difficile infection', *Clinical Infectious Diseases,* vol. 48, no. 7, pp. e75-77. [Breif report only]
9. Kundu, S, Lockwood, J, Depledge, DP, Chaudhry, Y, Aston, A, Rao, K, Hartley, JC, Goodfellow, I & Breuer, J 2013, 'Next-generation whole genome sequencing identifies the direction of norovirus transmission in linked patients', *Clinical Infectious Diseases,* vol. 57, no. 3, pp. 407-414. [small study not a outbrake /no data reported]
10. Leone, CM, Jayasekara, L, Sharp, J & Fraser, A 2015, 'Prevention and control practices for human noroviruses in long-term care facilities in South Carolina', *Am J Infect Control,* vol. 43, no. 12, pp. 1276-1280. [Interviews with facility directors or their designees]
11. Malik, YS, Allwood, PB, Hedberg, CW & Goyal, SM 2006, 'Disinfection of fabrics and carpets artificially contaminated with calicivirus: relevance in institutional and healthcare centres', *Journal of Hospital Infection,* vol. 63, no. 2, June, pp. 205-210.[Lab study – artificially contaminated with calicivirus]
12. O'Dea, EB, Pepin, KM, Lopman, BA & Wilke, CO 2014, 'Fitting outbreak models to data from many small norovirus outbreaks', *Epidemics,* vol. 6, pp. 18-29. [outbreak model only – no data reported]
13. Teunis, P, Heijne, JC, Sukhrie, F, van Eijkeren, J, Koopmans, M & Kretzschmar, M 2013, 'Infectious disease transmission as a forensic problem: who infected whom?', *Journal of the Royal Society Interface,* vol. 10, no. 81, p. 20120955.[transmission probability matrix- not relevant]

14. Vardy, J, Love, AJ & Dignon, N 2007, 'Outbreak of acute gastroenteritis among emergency department staff', *Emergency Medicine Journal,* vol. 24, no. 10, pp. 699-702.[No method was used to detect Norovirus]

Excluded studies Q 3

1. Bentley, K, Dove, BK, Parks, SR, Walker, JT & Bennett, AM 2012, 'Hydrogen peroxide vapour decontamination of surfaces artificially contaminated with norovirus surrogate feline calicivirus', *Journal of Hospital Infection*, vol. 80, no. 2, pp. 116-121. [Lab study- not human]
2. Cheng, FWT, Leung, TF, Lai, RWM, Chan, PKS, Hon, EKL & Ng, PC 2006, 'Rapid control of norovirus gastroenteritis outbreak in an acute paediatric ward', *Acta Paediatrica, International Journal of Paediatrics*, vol. 95, no. 5, May, pp. 581-586. [No data on prevention strategies]
3. Cooper, T, Atta, M, Mackay, A, Roberts, H & Clement, A 2011, 'A major outbreak of Norovirus in an acute NHS hospital in 2010: a practical management approach', *Journal of Infection Prevention*, vol. 12, no. 3, pp. 111-118. [Report only no evaluation data]
4. Leone, CM, Jayasekara, L, Sharp, J & Fraser, A 2015, 'Prevention and control practices for human noroviruses in long-term care facilities in South Carolina', *Am J Infect Control*, vol. 43, no. 12, pp. 1276-1280.[Interviews with facility directors or their designees]
5. Malik, YS, Allwood, PB, Hedberg, CW & Goyal, SM 2006, 'Disinfection of fabrics and carpets artificially contaminated with calicivirus: relevance in institutional and healthcare centres', *Journal of Hospital Infection*, vol. 63, no. 2, June, pp. 205-210.[Lab study – artificially contaminated with calicivirus]
6. Rao, S, Scattolini de Gier, N, Caram, LB, Frederick, J, Moorefield, M & Woods, CW 2009, 'Adherence to self-quarantine recommendations during an outbreak of norovirus infection', *Infection Control & Hospital Epidemiology*, vol. 30, no. 9, pp. 896-899. [self-quarantine-incomplete study]

Appendix VI Critical appraisal of included studies

Review Question 1 and 2

Keys: Yes/No/Unclear/Not applicable (NA)

Reference	1. Was the sample frame appropriate to address the target population ?	2. Were study participants sampled in an appropriate way?	3. Was the sample size adequate?	4. Were the study subjects and the setting described in detail?	5. Was the data analysis conducted with sufficient coverage of the identified sample?	6. Were valid methods used for the identification of the condition?	7. Was the condition measured in a standard, reliable way for all participants ?	8. Was there appropriate statistical analysis?	9. Was the response rate adequate, and if not, was the low response rate managed appropriately?
1. (Beersma et al. 2009)	Yes	Yes	Yes	Yes	Yes	Yes	Not clear	Yes	No
2. (Cheng, FWT et al. 2006)	No	No	No	Yes	Yes	Yes	Yes	No	No
3. (Cheng, VCC et al. 2011)	Yes	Yes	Yes	Not Clear	Yes	Yes	Yes	Yes	Yes
4. (Costantini et al. 2016)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
5. (Cummins & Ready 2016)	Yes	Yes	Yes	No	No	Yes	No	No	No
6. (Danial et al. 2011)	Yes	Yes	Yes	No	Yes	Yes	Yes	Not clear	Yes
7. (Franck et al. 2014)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
8. (Franck et al. 2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

9. (Godoy et al. 2015)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
10.(Harris et al. 2014)	Yes	Yes	Yes	No	Yes	Not clear	Not clear	Yes	Yes
11.(Harris et al. 2013)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12.(Heijne et al. 2012)	Yes	Yes	No	Yes	Yes	Not clear	Not clear	Yes	Yes
13.(Hoffmann et al. 2013)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
14.(Johnston et al. 2007)	yes	Yes	No	yes	yes	yes	yes	yes	yes
15.(Kanerva et al. 2009)	Yes	yes	Yes	yes	yes	yes	yes	yes	NA
16.(Lopman et al. 2006)	Yes	Unclear	Yes	No	Yes	Yes	Yes	Yes	NA
17.(Mattner, Guyot & Henke-Gendo 2015)	Yes	Yes	Yes	Yes	Yes	yes	Yes	Yes	NA
18.(Munir et al. 2014)	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
19.(Nenonen et al. 2014)	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	NA
20.(Nguyen & Middaugh 2012)	Yes	Yes	Yes	yes	yes	yes	yes	yes	no
21.(Ohwaki et al. 2009)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
22.(Partridge et al. 2012)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
23.(Rao et al. 2009)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No (1/2 responded)

24.(Rosenthal et al. 2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not clear	NA
25.(Schmid et al. 2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
26.(Sheahan et al. 2015)	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Unclear	NA
27.(Simon et al. 2006)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
28.(Sukhrie et al. 2011)	Yes	Yes	Yes	unclear	unclear	Yes	Yes	Yes	NA
29.(Sukhrie et al. 2012)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
30.(Tsang et al. 2008)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
31.(Tseng et al. 2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
32.(Tu et al. 2008)	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No
33.(Zheng et al. 2015)	Yes	No	No	Yes	Yes	Yes	Yes	Yes	NA

Review Question 3

Keys: Yes/No/Unclear/Not applicable (NA)

Reference	1. Was the sample frame appropriate to address the target population ?	2. Were study participants sampled in an appropriate way?	3. Was the sample size adequate?	4. Were the study subjects and the setting described in detail?	5. Was the data analysis conducted with sufficient coverage of the identified sample?	6. Were valid methods used for the identification of the condition?	7. Was the condition measured in a standard, reliable way for all participants ?	8. Was there appropriate statistical analysis?	9. Was the response rate adequate, and if not, was the low response rate managed appropriately?
(Blaney et al. 2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not clear
(Cheng, VCC et al. 2011)	Yes	Yes	Yes	Not Clear	Yes	Yes	Yes	Yes	Yes
(Haill et al. 2012)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
(Harris, Adak & O'Brien 2014)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
(Illingworth et al. 2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
(Liu et al. 2010)	NA	NA	Yes	NA	Yes	Yes	Yes	Yes	NA
(Morter et al. 2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA
(Park et al. 2010)	NA	NA	Yes	NA	Yes	Yes	Yes	Yes	NA
(Tung et al. 2013)	NA	NA	Yes	NA	Yes	Yes	Yes	Yes	NA

Appendix VII Documentation of the declared interest(s) of the author(s)

References	Declared interest(s) of the author(s)
(Beersma et al. 2009)	None declared.
(Cheng, FWT et al. 2006)	No details
(Cheng, VCC et al. 2011)	All authors report no conflicts of interest relevant to this article.
(Costantini et al. 2016)	P. R. C., L. E. L., and H. L. H. report grants and nonfinancial support from the CDC Foundation. All other authors report no potential conflicts.
(Cummins & Ready 2016)	No reported conflicts
(Danial et al. 2011)	None declared
(Franck et al. 2014)	This study was supported in part by the Helene E.B. Marck-wardts Foundation and the European Commission, Project no. 502571 (Enteric Virus Emergence, New Tools).
(Franck et al. 2015)	No reported conflicts
(Godoy et al. 2015)	None.
(Harris et al. 2014)	None.
(Harris et al. 2013)	None.
(Heijne et al. 2012)	No details
(Hoffmann et al. 2013)	None declared.
(Johnston et al. 2007)	no conflicts
(Kanerva et al. 2009)	None declared.
(Lopman et al. 2006)	The author(s) declare that they have no competing interests.
(Mattner, Guyot & Henke-Gendo 2015)	None declared.
(Munir et al. 2014)	No details
(Nenonen et al. 2014)	No details This study was supported by grants from Swedish Council for Working Life and Social Research (FAS 82010-0895).
(Nguyen & Middaugh 2012)	None.
(Ohwaki et al. 2009)	No details
(Partridge et al. 2012)	None declared.
(Rao et al. 2009)	All authors report no conflicts of interest relevant to this article.
(Rosenthal et al. 2011)	None.
(Schmid et al. 2011)	None declared.
(Sheahan et al. 2015)	No details
(Simon et al. 2006)	No details
(Sukhrie et al. 2011)	This study was financed by ZonMw, Netherlands.
(Sukhrie et al. 2012)	This work was supported by the ZonMw the Netherlands (grant number 125010002). No reported conflicts
(Tsang et al. 2008)	None declared. The norovirus project is supported by the Hospital Authority Infectious Disease Centre at Princess Margaret Hospital, the Centre for Health Protection and Hospital Authority, Hong Kong.
(Tseng et al. 2011)	None.
(Tu et al. 2008)	E. T.-V. Tu was supported by a University of New South Wales postgraduate award, and R. A. Bull was supported by an Australian

	postgraduate award.
(Zheng et al. 2015)	None to declare.
	Q 3
(Blaney et al. 2011)	No conflicts of interest
(Cheng, VCC et al. 2011)	All authors report no conflicts of interest relevant to this article.
(Haill et al. 2012)	None declared.
(Harris, Adak & O'Brien 2014)	None declared./This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.
(Illingworth et al. 2011)	None declared.
(Liu et al. 2010)	No details
(Morter et al. 2011)	None declared
(Park et al. 2010)	No details
(Tung et al. 2013)	This project was financially sponsored by GOJO Industries, Inc. through an unrestricted research grant to cover tuition and supplies for G.Tung. D. Macinga and J. Arbogast provided significant input into the overall study design, the choice of antimicrobial active ingredients, and the concentration ranges at which ingredients were evaluated. No commercial test products that would directly or indirectly compete with products manufactured by GOJO were evaluated in the study.