Abbreviations used in this issue
COVID-19 = coronavirus disease-2019
ESBL = extended-spectrum β-lactamase-producing
PCR = polymerase chain reaction
PPE = personal protective equipment
SARS-CoV-2 = severe acute respiratory syndrome coronavirus-2

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Welcome to the latest issue of Infection Prevention and Control.

Leading this issue are two selections on COVID-19 transmission. A Taiwanese study expands our knowledge on the transmission dynamics of COVID-19 and a UK study quantifies the impact of physical distancing on the transmission of COVID-19. Switching to bacterial disease, we include a paper that further informs the debate on horizontal versus vertical approaches to multidrug-resistant organism management and a genomic study highlighting the ongoing issues that NZ has with managing Group A streptococcal infection. Also featured are two studies that respectively assess the role of care bundles in the management of early sepsis and in the prevention of hospital-acquired pneumonia.

We trust that this issue of **Infection Prevention and Control** helps to keep you updated on the latest research and its implications for day-to-day practice. We appreciate your feedback so please keep sending your comments and suggestions.

Best regards,

Dr Chris Tofield
Medical Advisor, Research Review
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Contact tracing assessment of COVID-19 transmission dynamics in Taiwan and risk at different exposure periods before and after symptom onset

Authors: Cheng HY et al.

Summary: This prospective case-ascertained study conducted in Taiwan characterised the transmission dynamics of COVID-19 and assessed the transmission risk at different exposure window periods before and after symptom onset in a group of 100 patients (aged 11–88 years) with laboratory-confirmed COVID-19 and their 2761 close contacts (including 22 paired index-secondary cases). The overall secondary clinical attack rate was 0.7% (95% CI: 0.4–1.0%). The attack rate was higher among 1818 contacts whose exposure to index cases started ≤5 days of symptom onset (1.0% [95% CI: 0.6–1.6%]) versus those who were exposed later (0 cases from 852 contacts; 95% CI: 0–0.4%). Contacts (n=299) with exclusive pre-symptomatic exposures were also at risk (attack rate, 0.7% [95% CI: 0.2–2.4%]). The attack rate was higher in household (4.6% [95% CI: 2.3–9.3%]) and non-household (5.3% [95% CI: 2.1–12.8%]) family contacts than in healthcare or other settings. The attack rates were higher among those aged 40–59 years (1.1% [95% CI: 0.6–2.1%]) and those aged ≥60 years (0.9% [95% CI: 0.3–2.6%]).

Comment (MA): This well-conducted study from Taiwan adds to our knowledge on the transmission dynamics of COVID-19. It highlights the high transmissibility of SARS-CoV-2 around the time of symptom onset, thus confirming that contact tracing alone is insufficient to contain transmission without the addition of physical distancing policy. Just as importantly, it demonstrates just how low transmission rates are for contacts if the exposure to the source patient is more than 5 days after the onset of symptoms (zero in this study!). A separate virological study showed no viable (culturable) isolates of SARS-CoV-2 after the first week of symptoms. These studies have important infection control implications in terms of deciding when to remove a patient from isolation. We get too hung up on persisting PCR positivity of SARS-CoV-2 in certain patients, of dubious infection control significance!

Comment (MB): This was a very interesting study and I think highly relevant information to help guide the NZ response to COVID-19 going forwards, which is focused on early case ascertainment and rapid Public Health follow up. Unsurprisingly, household and non-household family members were at highest risk (≈5% of those exposed developed COVID-19) whereas healthcare workers classified as close contacts had a much lower risk (≈1%). Of note, healthcare workers were only regarded as close contacts if they were not wearing appropriate PPE. The vast majority of transmission appears to occur early, including probably for a short period of time prior to symptom development. Interestingly, they did not find any secondary cases in people whose first exposure to the case was after day five of symptoms, which included household members exposed only after this time. They also found no secondary cases in 91 close contacts of nine asymptomatic cases. The average interval between a case developing COVID-19 and then their contacts developing it (the 'serial interval') was 4–5 days. What this means is that all the action appears to be early on, so if contact tracing is going to control clusters of COVID-19 in the community then the response needs to be extremely quick – this will be a challenge!

Reference: JAMA Intern Med. 2020 May 1. [Epub ahead of print]
Abstract

Quantifying the impact of physical distance measures on the transmission of COVID-19 in the UK

Authors: Jarvis CI et al.

Summary: These UK researchers evaluated whether physical distancing policies might be sufficient to control the COVID-19 epidemic by estimating their impact on the reproduction number (R_0), i.e. the average number of secondary cases generated per case. A questionnaire about peoples' contact patterns on the previous day was sent to a representative sample of adults the day after a lockdown was implemented across the UK. The lockdown patterns discerned were compared with patterns of social contact made during a non-epidemic period. The researchers determined that a 74% reduction in the average daily number of contacts per participant (from 10.8 to 2.8) was thought to be sufficient to reduce the R_0 from 2.6 prior to lockdown to 0.62 (95% CI: 0.37–0.89) after the lockdown, based on all types of contact, and to 0.37 (95% CI: 0.22–0.53) for physical (skin-to-skin) contacts only.

Comment (MA): This is an interesting article showing how we can attempt to objectively measure physical distancing policy, and all the caveats associated with trying to do this! In the longer term, to keep COVID-19 at low levels in NZ, we need to minimise new introductions at the border and keep the reproductive number below 1. For a fire you need fuel as well as a spark! Keeping the reproductive number low relies to a large degree, but not exclusively, on physical (social) distancing. Hugs and handshakes are off the menu for now, but old habits die hard… As the weeks and months roll on I think it is important for NZ to keep objectively monitoring the impact of its physical distancing policies using study methodology such as this, so that Public Health messaging can be stepped up when the need arises.

Reference: BMC Med. 2020;18(1):124
Abstract

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Evaluation of a benzalkonium chloride hand sanitizer in reducing transient *Staphylococcus aureus* bacterial skin contamination in healthcare workers

Authors: Bondurant S et al.

Summary: In this prospective study, 40 healthcare workers were recruited to compare, under real-life conditions, the effectiveness of a new hand sanitiser using 0.12% benzalkonium chloride as the active ingredient in reducing transient skin contamination with *Staphylococcus aureus* with that of a 70% ethanol-based hand sanitiser. Over the 2-week study period, the workers used the ethanol-based hand sanitiser for the first week and then the benzalkonium chloride product for the second week. A significant (p<0.01) reduction in total bacterial colony counts of *S. aureus* during the week that the healthcare workers used benzalkonium chloride was observed compared with the week that they used the 70% ethanol sanitiser.

Comment (MA): I included this paper as much for its flaws as its strengths. The main advantage of benzalkonium chloride, a quaternary ammonium compound, is that it has persistent bactericidal activity up to approximately4 hours after application. This is compared with alcohol, which has no persistence in its killing effect. It is interesting that the authors focused their study on *S. aureus*, which one would expect benzalkonium chloride to do well against from previous knowledge. Benzalkonium chloride struggles, however, against Gram-negative organisms and fungi, so its use as a "universal hand sanitiser" is limited. They also gloss over the fact that benzalkonium chloride can cause contact dermatitis. The authors argue that benzalkonium chloride may have an adjunctive role to alcohol-based hand hygiene in the reduction of nosocomial *S. aureus* infections, but do not delve into the practical difficulties of such a policy. The paper had a "promotional" feel throughout!

Reference: Am J Infect Control. 2020;48(5):522–526
Abstract

Contact isolation versus standard precautions to decrease acquisition of extended-spectrum beta-lactamase-producing Enterobacterales in non-critical care wards: a cluster-randomised crossover trial

Authors: Maechler F et al.

Summary: The aim of this cluster-randomised crossover trial was to establish the benefits of contact isolation compared with standard precautions for reducing the incidence density of ESBL-Enterobacterales (ESBL-E) colonisation and infection in adult medical and surgical wards with an active surveillance culture programme in four European university hospitals. Wards were randomised to continue standard precautions alone or implement contact isolation alongside standard precautions for 12 months, followed by a 1-month washout period and 12 months of the alternate strategy. Twenty wards, which admitted a total of 38,357 patients, were enrolled in the study. The incidence density of ward-acquired ESBL-E was 6.0 events per 1000 patient-days at risk (95% CI: 5.4–6.7) during periods of contact isolation versus 6.1 (95% CI: 5.5–6.7) during periods of standard precautions (p=0.9710). Adjusted multivariable analysis produced an incidence rate ratio of 0.99 (95% CI: 0.80-1.22; p=0.9177) for care under contact isolation versus standard precautions.

Comment (MA): A lot of NZ hospitals no longer apply contact precautions for patients with ESBL *Escherichia coli* (ESBL-EC), whilst continuing with contact precautions for ESBL *Klebsiella pneumoniae* (ESBL-KP). It is a shame that this paper never intended to look at whether there was an outcome difference between ESBL-EC and ESBL-KP with regards to the impact of contact precautions. This is probably the major design flaw of the study. It was not sufficiently powered to look at this although a *post-hoc* analysis in the paper showed a non-statistically significant trend towards a benefit for contact precautions for ESBL-KP. So, this study to some extent supports current practice in NZ. However, the fact remains that most ESBL transmission happens in the community setting, not the hospital, regardless of whether it is ESBL-EC or ESBL-KP. There is increasing evidence that horizontal approaches to multidrug resistant organism management, as opposed to the vertical "screen and eradicate" approach, may be the best way forward for our DHBs and warrants further discussion at a national level.

Reference: Lancet Infect Dis. 2020;20(5):575–584
Abstract

Independent commentary by Michael Addidle

Michael Addidle is a UK trained Clinical microbiologist now working at both Pathlab and ESR laboratories in New Zealand. He holds fellowships in general medicine and clinical microbiology. He is involved in infection control in both public and private hospitals throughout the Bay of Plenty and Waikato regions. Michael has a keen interest in the pivotal role of the diagnostic laboratory in good diagnostic and antimicrobial stewardship.

Biphasic outbreak of invasive Group A *Streptococcus* disease in eldercare facility, New Zealand

Authors: Worthing KA et al.

Summary: These investigators used whole-genome sequencing and multiple bioinformatics approaches to retrospectively investigate the genomic epidemiology of a biphasic outbreak of invasive group A streptococcal disease at an aged-care facility. Analysis of isolates from the outbreak and isolates prospectively collected during the outbreak response found a single *Streptococcus pyogenes emm81* clone among residents and staff members. Outbreak isolates differed from non-outbreak *emm81* isolates by harbouring an integrative conjugative genomic element that contained the macrolide resistance determinant *erm(TR)*.

Comment (MA): This retrospective genomic study highlights the continuing issues that NZ has with Group A streptococcal infection, and its vulnerability to outbreaks in both the community and institutional setting. It also demonstrates the importance of staff member sampling, and the potential role of chemoprophylaxis in the control of such outbreaks. *Emm* typing *per se* does not really have the granularity to cut the mustard in Group A streptococcus outbreaks and whole genome sequencing is now the typing methodology of choice for this. I will be discussing the implications of this paper with my colleagues at the national reference laboratory! This study was mainly driven by Australian researchers, but we really should now be performing such research "in-house".

Reference: Emerg Infect Dis. 2020;26(5):841–848
Abstract

Independent commentary by Nikki Grae

Nikki Grae has been the senior advisor for the infection prevention and control programme at the Health Quality & Safety Commission since 2016. She has 12 years of infection prevention, quality, and patient safety experience in the healthcare sector. Prior to working at the Commission, she managed and led the infection prevention and patient safety programmes for a health system in the U.S. Nikki has also worked as a research scientist in cancer biology and microbiology. She has a Master of Science degree in microbiology. Nikki relocated to New Zealand to enjoy the friendly people and spectacular scenery while continuing her career in infection prevention and control.

SARS-CoV-2 RNA detection of hospital isolation wards hygiene monitoring during the coronavirus disease 2019 outbreak in a Chinese hospital

Authors: Wang J et al.

Summary: The objective of this study was to monitor the presence of SARS-CoV-2 on hospital environment surfaces and the PPE of staff in isolation wards in a Chinese hospital as well as in sewage from the wards. The presence of SARS-CoV-2 in staff was monitored via the collection of respiratory samples. During a 5-day period, 33 laboratory-confirmed SARS-CoV-2 patients were hospitalised in isolation wards. SARS-CoV-2 RNA was not detected in any of 36 object surface samples and nine staff PPE samples. Although the three sewage samples from the inlet of the pre-processing disinfection pool were positive for SARS-CoV-2 RNA, the sample from the outlet of the pre-processing disinfection pool was only weakly positive, and the sample from the outlet of the last disinfection pool was negative. The five sewage samples from the various points were negative by viral culture of SARS-CoV-2. None of the respiratory samples taken from staff in the isolation wards were positive.

Comment (NG): Transmission of SARS-CoV-2 on high-touch objects and other surfaces such as PPE is of significant interest as the cause of the global pandemic. While this study has many limitations, such as being a very small sample size, limited viral cultures done, and the methodology not being clearly detailed to fully understand the meaning of the results, it aligns with another small study conducted in Singapore. The conclusions from this study, and the Singapore study, highlight the importance of strict hand hygiene and environmental cleaning to prevent transmission of this virus among healthcare workers and patients. Until studies like these are performed and published, it is difficult to have definitive data to point to when communicating the science behind the policies and protocols.

Reference: Int J Infect Dis. 2020;94:103–106
Abstract

Association of a care bundle for early sepsis management with mortality among patients with hospital-onset or community-onset sepsis

Authors: Baghdadi JD et al.

Summary: This retrospective cohort study used data from four university hospitals in the US to assess the association of the Early Management Bundle for Severe Sepsis/Septic Shock (Sepsis-1) with mortality and organ dysfunction in patients with hospital-onset or community-onset sepsis. Of 6,404 patient encounters, 2296 patients (35.9%) had hospital-onset sepsis. Among 4,108 patients (64.1%) with community-onset sepsis, serum lactate level testing ≤3 hours of arrival in the emergency department or an inpatient area was associated with lower mortality (absolute difference [AD], -7.61%; 95% CI: -14.70% to -0.54%). Blood culture (AD, -1.10 days; 95% CI: -1.85 to -0.34 days) and broad-spectrum IV antibiotic treatment (AD, -0.62 days; 95% CI: -1.02 to -0.22 days) were associated with fewer vasopressor days. Among patients with hospital-onset sepsis, broad-spectrum IV antibiotic treatment was the only bundle component significantly associated with any improved outcome (mortality difference, -5.20%; 95% CI: -9.84% to -0.56%). Care that adhered to the complete Sepsis-1 bundle was associated with increased vasopressor days in patients with community-onset sepsis (AD, 0.31 days; 95% CI: 0.11–0.51 days) but was not significantly associated with lower mortality in either the community-onset (AD, -0.07%; 95% CI: -3.02% to 2.88%) or hospital-onset (AD, -0.42%; 95% CI: -6.77% to 5.93%) sepsis cohorts.

Comment (NG): Sepsis is associated with high mortality and was established as a global priority by the World Health Assembly in 2017. Early recognition and treatment affect the patient's outcome and therefore is key to reducing sepsis-related mortality. Sepsis management bundles vary globally, and this study focussed on the Sepsis-1 bundle, which has been used as a national quality metric for all acute hospitals in the US since 2015. This retrospective cohort study evaluated mortality rates and vasopressor days among patients that received the Sepsis-1 bundle. The bundle was associated with improved outcomes in patients with community-onset sepsis while only one component, early antibiotic administration, was associated with reduced mortality in patients with hospital-onset sepsis. For hospital-onset sepsis, the bundle reviewed in this study does not reflect the intent of a bundle if only one component should be prioritised. There is still much to be understood about early recognition and treatment of sepsis because not only does sepsis present in various ways, the diagnosis and treatment protocols are refined as new evidence is discovered. This study suggests that a standardised bundle may not be appropriate for all cases of sepsis.
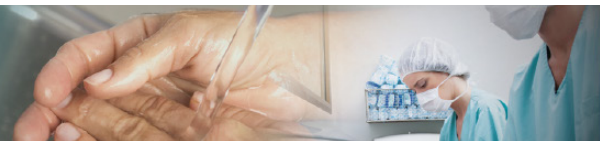
Reference: JAMA Intern Med. 2020;180(5):707–716
Abstract

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Use of non-sterile gloves in the ward environment: an evaluation of healthcare workers' perception of risk and decision making

Authors: Flores A et al.

Summary: This UK study evaluated the accuracy of healthcare worker risk assessment and decision making regarding the use of non-sterile gloves (NSG). A cross-sectional survey, followed by qualitative semi-structured interviews, was conducted in two acute National Health System (NHS) Trusts and a community social enterprise. Unqualified staff were significantly (p<0.0001) more likely than qualified staff to report NSG use when it was not indicated. The primary and secondary motivating factors for staff to wear NSG were for personal protection and the protection of patients, respectively. Staff were also motivated by a desire to be seen as being professional and were more likely to follow the example of senior workers.

Comment (MB): I was interested to review this paper because glove use when not required is a pet hate of mine (including in the current COVID-19 climate)! Not only is it unhelpful in many situations, there is evidence that it may increase the risk of transmission of various pathogens through complacency, reduced hand hygiene, and gloves possibly being a more effective fomite than human skin, in addition to creating unnecessary waste. There were quite a few useful references in this paper as ammunition against unnecessary glove use. Some of the findings from this paper were that unqualified staff were more likely than qualified staff to report glove use when not indicated and that the main motivators were personal protection, rather than patient protection. Many interviewees reported seeing other staff who would use gloves as an alternative to hand hygiene and only 43% said they would always clean their hands prior to putting gloves on. The results of this type of study are likely to be highly specific to local culture, with this having been carried out in the NHS, but nonetheless it provided some interesting food for thought.

Reference: J Infect Prev. 2020;21(3):108–114
Abstract

Independent commentary by Max Bloomfield

Max is an Infectious Diseases Physician and Clinical Microbiologist working at Capital & Coast DHB and Wellington Southern Community Laboratories. He has an interest in antimicrobial resistance, diagnostic stewardship and the microbial composition of sourdough bread. He trained at University College Hospital London and Wellington Hospital, gaining fellowship with the RACP and the RCPA. He has higher degrees from the University of Cambridge and Queen Mary University of London.

A successful program preventing non-ventilator hospital-acquired pneumonia in a large hospital system

Authors: Lacerna CC et al.

Summary: To develop and evaluate a programme to prevent hospital-acquired pneumonia (HAP), a prospective, observational, surveillance design was used to identify HAP before and after a bundle of seven interventions for hospitalised high-risk patients. The seven interventions were mobilisation, upright feeding, swallowing evaluation, sedation restrictions, elevated head of bed, oral care, and tube care. The setting was 21 hospitals of an integrated healthcare system caring for 4.4 million members. Over a 6-year period, HAP rates decreased from 5.92 to 1.79 per 1,000 admissions (p=0.0031) and from 24.57 to 6.49 per 100,000 members (p=0.0014) while HAP mortality rates decreased from 1.05 to 0.34 per 1,000 admissions and from 4.37 to 1.24 per 100,000 members. In terms of antibiotic therapy per 100,000 members, carbapenem days (694 to 463; p=0.0020), aminoglycoside days (154 to 61; p=0.0165), vancomycin days (2,087 to 1,783; p=0.002), and quinolone days (2,162 to 1,287; p<0.0001) all declined significantly. Only cephalosporin use increased, which was due to an increase in ceftriaxone days (264 to 460; p=0.0009).

Comment (MB): This paper demonstrated impressive reductions in HAP associated with the introduction of a prevention bundle that involved the application of relatively simple interventions to patients identified as high-risk for HAP. They also saw concomitant significant reductions in antibiotic use for HAP. Prevention bundles for ventilator-associated pneumonia are commonly used, however less so for HAP, so this was a relatively novel study. Their pre-intervention incidence of HAP was around six cases per 1000 admissions. I do not have a feel for whether this is a high, low, or middling rate, which would have implications for generalisability of these finding to the NZ setting. HAP is a commonly misdiagnosed condition, so routine coding data would likely be very inaccurate to determine NZ rates. The way they identified HAP was interesting: they used an algorithm to extract descriptors of consolidation from chest x-ray reports and then combined this with discharge summary reports of pneumonia occurring >48 hours after admission. It would be interesting to try to replicate this in the NZ setting to in the first instance know how common HAP is, and then see if we can reduce the incidence!

Reference: Infect Control Hosp Epidemiol. 2020;41(5):547–552
Abstract