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Background. International Classification of Diseases (ICD) diagnostic codes from acute gastroenteritis (AGE)-associated medical encounters are used for AGE disease burden estimates, yet the validity of AGE-related ICD codes in both pediatric and adult populations is unknown. We estimated the validity of AGE-related diagnostic codes in these populations using two different multi-regional AGE active surveillance platforms.

Methods. Diagnostic codes, demographic and clinical characteristics, and stool pathogen results from AGE-associated medical encounters were obtained for enrolled children <5 years old from seven sites in NVSN from December 1, 2011 to June 30, 2016, and for adult Veterans in four sites from SUPERNOVA from December 1, 2016 to February 28, 2018. SUPERNOVA also enrolled age- and time-matched non-AGE controls. Using AGE cases from the active surveillance networks, sensitivity and specificity of AGE ICD codes were estimated overall and stratified by age and health care setting using exact binomial tests.

Results. ICD codes were collected from 14,952 enrolled children <5 years old with AGE, and 625 enrolled adults (525 AGE cases and 100 controls). The sensitivity of all-cause AGE codes in children was 54% (9,127/14,952, 95% confidence interval [CI] 54–55%), and in adults was 54% (283/525; 95% CI 50–58%), with a specificity of 100% (100/100; 95% CI 97–100%). Stratified analyses demonstrated higher sensitivity of all-cause AGE codes in children in the inpatient as compared with outpatient setting: 59% (417/675; 95% CI 57–61%) vs. 53% (934/1827; 95% CI 52–54%). In adults, this trend was reversed; all-cause AGE codes had a higher sensitivity in the outpatient as compared with the inpatient setting: 72% (50/69; 95% CI 60–83%), vs. 51% (233/456; 95% CI 46–56%), respectively.

Conclusion. Across two different AGE active surveillance platforms, one enrolling only children and one enrolling only adults, the estimated sensitivity of all-cause AGE ICD codes were similarly low. This suggests that current national estimates for AGE disease burden may be underestimating the true burden of AGE pathogens in the United States, and emphasizes the importance of active, prospective surveillance.

Disclosures. All authors: No reported disclosures.

2155. Elevated Temperature Results in Earlier Diagnosis of Infectious and Inflammatory Postoperative Complications

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Background. Medical students are taught that wound, water and wound complications occur at specific post-operative times. This may influence the timing of work-up for specific complications. The goal of this study was to investigate the relationship between post-operative temperature curve and time to diagnosis of inflammatory complications.

Methods. We reviewed patients who underwent pancreatotomy at an academic health system from January 2015–February 2018. Clinical data including complications were extracted using definitions set by the National Surgical Quality Improvement Program and temperature was extracted from the Data Warehouse. Time of diagnosis, as determined by labs, microbiologic cultures, radiology and procedures, was extracted for each complication. Group-based trajectory modeling, a technique used to identify distinct clusters of temperature trajectories of patients in the postoperative setting was used to group patients into low- and high-temperature trajectories.

Results. Among 195 patients who underwent pancreatotomy, 35.5% (69/195) experienced at least one complication within 30 days of surgery. Of the patients who developed complications, 49% ($n = 34$) and 51% ($n = 35$) were classified into the low and high temperature trajectory groups based on their temperature trajectory. For most individual inflammatory complications, time to diagnosis was later in the low rather than high temperature groups (Figure 1) and this was significant when averaging all inflammatory complications (12.7d low and 8.6d high; $P = 0.002$). Time to diagnosis tended to be later in the high rather than low temperature trajectory but this was not statistically significant when averaging all non-inflammatory complications (11.7d low and 11.9d high; $P = 0.95$).

Conclusion. We identified earlier diagnosis of inflammatory complications in patients with elevated temperature trajectories. There was no difference in timing of diagnosis for non-inflammatory complications. Temperature trajectory modeling may allow for earlier diagnosis of patients at high risk for inflammatory complications.

Figure 1. Time to diagnosis by low (L) and high (H) temperature trajectories.

Disclosures. All authors: No reported disclosures.

2156. Cyclical Continuum Modeling: A Process-Based Approach to Identifying and Quantifying Health Disparities in Patients with Serious Musculoskeletal Infections

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Background. Complex infectious disease processes, including serious musculoskeletal infections, may result in differential health disparities at successive phases in a clinical course. Previously, our group proposed the application of cyclical continuum modeling to the study of these complex clinical processes.

Methods. Using a retrospective cohort of over 1,600 adult patients in the University of New Mexico Health System with serious musculoskeletal infections, including septic arthritis, osteomyelitis, and/or infectious myositis, we performed preliminary proof-of-concept cyclical continuum modeling analyses. The experiences of patients in different racial/ethnic groups were compared using a logistic regression model adjusted for age and sex. Outcomes in multiple categories were reviewed—primary risk factors for limb loss (e.g., diabetes mellitus and peripheral vascular disease), secondary risk factors for limb loss (e.g., osteomyelitis and multiple musculoskeletal infection types), and outcomes or complications of infection (e.g., sepsis, antibiotic use, and amputation). Preliminary cyclical visualization tools were used to demonstrate differences in health outcomes across racial/ethnic groups.

Results. Although significantly younger than other members of the cohort, American Indian/Alaskan Native patients (17.7% of cohort) had high odds of primary and secondary risk factors yet low odds of amputation. Hispanic patients (40.2% of cohort) tended to have high odds of primary and secondary factors as well as amputation. Black non-Hispanic patients (2.6% of cohort) had high odds of primary risk factors and low odds of osteomyelitis, yet Black non-Hispanic patients were most likely to undergo an amputation. Initial cyclical visualization techniques showed promise for comparing the relative distribution of racial/ethnic disparities across the clinical course.

Conclusion. Health disparities encountered by patients with serious musculoskeletal infections may be studied using a process-based approach. Future development of cyclical continuum modeling methods should focus on applications of both relative and absolute epidemiological measures and cyclical visualization methods.

Disclosures. All authors: No reported disclosures.

2157. Design, Implementation, and Analysis Considerations for Cluster Randomized Trials in Infection Control and Hospital Epidemiology: A Systematic Review

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Background. A cluster randomized trial (CRT) is a comparative study in which clusters or groups rather than individuals are randomized to interventions or treatments. CRT are being utilized with increasing frequency in the study of interventions in infection control and hospital epidemiology. The aims of this study were (1) to identify critical design, implementation, and analysis principles to consider when planning a CRT of interventions in the healthcare setting and (2) to review published CRT in infection control and hospital epidemiology and synthesize key characteristics of these published studies using the principles identified above.

Methods. Authors reviewed articles and book chapters to identify key methodological principles relative to the design, implementation, and analysis of CRT. We undertook a systematic review of studies conducted between 1997 and 2017 in infection control and hospital epidemiology that used a CRT design, and evaluated each study on those key principles.

Results. Seven epidemiological principles were identified as most critical (Figure 1). Among the 44 studies included in the review, the most commonly used design was a CRT with cross-over ($n = 15$, 34%), followed by a parallel CRT ($n = 11$, 25%), and a stratified CRT design ($n = 7$, 16%). Twenty-two (50%) offered justification for their use of a CRT. Twenty (45%) accounted for clustering at the design phase when estimating sample size. Only 15 (34%) reported the intraclass correlation coefficient, coefficient of variation, or design effect. Fifteen studies (34%) obtained waived consent, 14 (32%) did not report how they dealt with consent, 8 (18%) studies obtained consent from individuals, and 7 (16%) sought consent at the cluster level. Seventeen studies (39%) matched or stratified at time of randomization, while 27 (61%) did not employ either of these techniques. Notably, 10 (23%) studies did not report any efforts to reduce the potential for bias and/or contamination. Twenty-seven (61%) accounted for clustering in their analyses.

Conclusion. CRT in infection control and hospital epidemiology are common but are still lacking in methodological rigor. It is crucial to continue improving the design and reporting of these studies to better evaluate the effectiveness of interventions.

Figure 1. Key epidemiological principles to consider when designing and implementing a CRT in hospital epidemiology and infection control

- 1- Identify the design type and justify the use of CRT
- 2- Account for clustering when estimating sample size and report ICC/CV
- 3- Obtain consent or waived consent
- 4- Define the level of inference
- 5- Consider matching and/or stratification
- 6- Reduce the potential for bias and/or contamination
- 7- Account for clustering in the analysis

Disclosures. All authors: No reported disclosures.

2158. Introducing the Population Standardized Infection Ratio (SIR): A Metric that Marries the Device SIR to the Standardized Utilization Ratio (SUR)

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Background. The device standardized infection ratio (SIR) has been used to compare units' and hospitals' performance for different publicly reported infections. Interventions to reduce unnecessary device use may select a higher risk population that is not accounted for in the current risk adjustments, leading to a paradoxical increase in SIR for facilities that may be high performers. The standardized utilization ratio (SUR) adjusts for device use for different units and facilities.

Methods. We calculated the device SIR (calculated based on actual device-days) and population SIR (defined as Σ observed events / Σ predicted events based on predicted device days) accounting for the facility SUR for both central line-associated bloodstream infections (CLABSI) and catheter-associated urinary tract infections (CAUTI) in 84 hospitals from a single system. The observed and predicted events were compiled at the unit-level and aggregated to facility and system-level SIRs for calendar years 2016 and 2017.

Results. The central line SUR was 1.02 for 801,737 central line-days, with the device SIR of 0.78 and the population SIR of 0.80 (+2.6%, relative increase). On the other hand, the urinary catheter SUR was 0.89 for 758,966 urinary catheter-days, with the device SIR of 0.87 and the population SIR of 0.77 (-11.5%, relative decrease). The cumulative attributable difference for CAUTI with a SIR of 1 was -107 for the device SIR compared with -185 for the population SIR (73% increase in events prevented). Facilities with a wider variation in SUR tended to have a greater difference in device vs. population SIRs (Figures 1 and 2).

Conclusion. Population SIR takes into account device utilization, making it an attractive metric to address overall risk of infection or harm to a patient population, and reduces the risk of selection bias that may impact the device SIR with interventions to reduce device use.

Figure 1. Population and device SIR difference vs. SUR away from 1 (CLABSI) (SIR difference of zero not shown).

Figure 2. Population and device SIR difference vs. SUR away from 1 (CAUTI) (SIR difference of zero not shown).

Disclosures. All authors: No reported disclosures.

2159. Methodological Threats to the Standardized Infection and Standardized Antimicrobial Administration Ratios

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Background. Standardized ratios, such as the CDC's Standardized Infection Ratio (SIR) and Standardized Antimicrobial Administration Ratio (SAAR), are used to assess hospital infection control and stewardship programs. While there has been a focus to improve adjustment factors in the prediction models for these ratios, there remain limitations to these methods in assessments of program effects.

Methods. We use a previously published mathematical model of an intensive care unit to simulate transmission of *Staphylococcus aureus* and the administration of antimicrobials to treat it. This approach allows for the calculation of an MRSA LabID SIR and Anti-MRSA adult ICU SAAR score with perfect adjustment, where the only difference between the simulated ICUs is due to random chance. We then evaluated the interpretations and statistical significance of these ratio measures as gauges of hospital program performance.

Results. Over a single year of 200 simulations, the models produced SIR/SAAR scores ranging from 0.47 to 1.73, with a median of 0.99, representing a considerable spread of scores obtained due to chance. The P -values measuring if these measures were different from 1.0 were significant in 86% of those facilities. Extending the simulation past one year exacerbated this tendency to over-identify scores as significant, and also showed that 53.5% of hospitals had improving (26%) or worsening (27.5%) of scores due to regression to the mean. This scenario could be falsely interpreted as the result of interventions put in place in response to their first year scores.