Latest surveillance update

Alex Outhred

HK Paediatric Infection Control Workshop 2016

Outline

- Surveillance:
  - Pathogens
    - Bacteria
    - Fungi
    - Viruses
  - Syndromes
    - CLABSI
    - SSI
  - Other indicators with infection control implications

How to allocate infection control resources?

- Greatest prevention of harm
  - focus on problems that cause significant harm
  - focus on problems that have effective interventions
- Targets
  - bugs
  - hand hygiene
  - patient environment - cleaning etc.
  - devices - venous and urinary catheters
  - HCW competency
- Be aware of biases
  - human nature to focus on most interesting or easiest aspects of problem
  - cannot eliminate but can try to compensate
  - importance of multidisciplinary teams

Levels of surveillance

- Informal or low-level surveillance
  - within a ward or unit
  - internal monitoring within a laboratory
- Institution-based surveillance
  - throughout a hospital or clinic
- Regional or national institutional surveillance
  - hospitals reporting to a central body or authority
- Public health surveillance
  - mandatory reporting of all cases in community and institutions
  - eg. tuberculosis, yellow fever

How to interpret surveillance findings?

- Numerator often easy, denominator harder
  - denominator examples - occupied bed days, central line days
- Sometimes a benchmark is published, or other institutions can be used for comparison
- When there is no benchmark or comparator:
  - monitor for a period of time to establish mean, standard deviation (eg. 6-12 months)
  - prepare a Shewhart control chart (very helpful, try it)
  - develop an objective
    - no deterioration from current rate
    - intervene to improve rate

Surveillance of bacteria

- General antimicrobial resistance trends
- Organisms with clinical and infection control significance
  - MRSA and MSSA
  - *Clostridium difficile*
  - ESBL
  - CRE
  - VRE
  - MRAB
  - *Mycobacterium tuberculosis*
- Bacterial infections with clinical and infection control significance
  - healthcare-associated *Staphylococcus aureus* bacteraemia
  - central line-associated bloodstream infections (CLABSIs)
  - surgical site infections
  - early-onset neonatal sepsis
  - certain cystic fibrosis pathogens

Bacteria: antimicrobial resistance

- Laboratory-based surveillance:
  - perform susceptibility testing on clinically relevant isolates
  - monitor rates of antimicrobial resistance
  - analyse trends in antimicrobial resistance over time
  - eg. form hospital antibiogram committee with antimicrobial stewardship team and microbiologists, annual meeting to review major pathogens and resistant organisms
    - ensure empirical antimicrobial guidelines are appropriate
    - (for example, increasing rates of community ESBLs are a big problem here)
- Collaboration with research or public health labs
  - perform susceptibility testing for public health rather than clinical reasons
    - esp. for conditions with syndromic management, eg. STIs
  - perform typing of isolates to better understand reasons for changing susceptibility patterns

Bacteria: MRSA

- Distinguish between community and healthcare strains
  - antimicrobial resistance less reliable than in the past
    - more healthcare strains with oligo-resistance
    - more community strains with multi-resistance
  - rates of methicillin resistance in community-onset skin, bone and joint infections
  - rates of methicillin resistance in isolates likely to have been acquired in hospital
    - (flawed measure, sometimes community strains predominate here too)
  - gold standard - type MRSA strains to classify more accurately
    - can type representative sample of strains to conserve resources
- Staff training in specimen collection
- Use chromogenic agar or PCR
  - in general, chromogenic agar is the best option, unless early PCR result can be delivered and lead to significant change in patient or bed management

Bacteria: *Staphylococcus aureus*

- *S. aureus* - MSSA may not attract as much attention as MRSA, but...
  - infection outcomes are very similar between MSSA and MRSA
  - depending upon setting, rates of MSSA infection can be much higher
  - 30-50% of population are colonised with *S. aureus*
    - mixture of transient colonisation and long-term colonisation with “favoured strain”
    - “favoured strains” tend to outcompete new/invading strains at site of colonisation
    - also less likely to cause host infection than new/invading strains
  - remember “how to allocate infection control resources”!
- Potential surveillance indicators
  - rates of *S. aureus* bloodstream infection
    - community vs. healthcare-associated
  - rates of surgical site infection

Bacteria: *Clostridium difficile*

- Less of a problem in children than adults, but in certain groups:
  - older children, teenagers develop disease indistinguishable from adults
  - oncology patients
  - transplant patients
  - cystic fibrosis patients
- Diagnosis must be a combination of clinical and laboratory findings
  - evidence of toxigenic *C. difficile* in a patient with new or recurrent diarrhoea
- Typing is a mixed bag
  - useful to have big-picture view of predominant strains
  - different strains seem to have distinct clinical presentations and transmission rates
  - but WGS studies have shown that within a hospital, so many *C. difficile* introductions that trying to track from patient to patient is largely redundant
    - occasional small clusters associated with infection control failures
    - most cases are new introductions, only preventable with antimicrobial stewardship

Bacteria: extended-spectrum β-lactamase producers (ESBL)

- Community and healthcare-associated
- Community surveillance
  - rates of ESBL in community UTI
- Healthcare-associated surveillance
  - rates of ESBL in healthcare-associated BSI, CAUTI
  - screening
    - in Australia, many institutions remain uncertain of the value of routine ESBL screening
      - community rates are similar to healthcare-associated rates
      - in other words, may not be preventable
    - reserve for clusters and high-risk settings (BMT, NICU?)
- Routine testing protocols cover most circumstances
  - use stool sample on chromogenic agar for screening
- In Australia, rising rates of ESBL in community-associated *E. coli* infections are a major concern
  - includes early and late neonatal *E. coli* infections
  - change empirical guidelines to amikacin instead of gentamicin? carbapenems?!

Bacteria: carbapenem-resistant *Enterobacteriaceae* (CRE)

- Similar to ESBL but worse
  - except that at least in Australia, community CRE remain rare
  - resembles hospital ESBL problem of a decade ago before ESBLs moved into community
  - may have very few unsatisfactory treatment options
    - colistin, tigecycline, fosfomycin - all problematic
- Healthcare-associated surveillance
  - rates of CRE in healthcare-associated BSI, CAUTI
  - screening
    - for pragmatic reasons (resource allocation) often reserved for contacts of clinical case and high-risk settings (BMT, NICU?)
- Routine testing protocols cover most circumstances
  - use chromogenic agar (ESBL) for CRE screening
  - stool sample
    - problems with delayed collection of stool
    - problems if you accept “rectal” swabs instead (sent to lab with no faecal material)

Bacteria: glycopeptide-resistant Enterococci (VRE)

- Major problem in adult haemodialysis and BMT units
  - transmission but also clinical disease, difficult to treat
- Doesn't seem to cause much clinical disease in children
  - correct me if I'm wrong, but although we have VRE we see very little disease
- Our experience
  - transmission in oncology unit
  - transmission in NICU
  - so far little in solid organ transplant, dialysis or CF patients, but I'm expecting it one day soon
- Healthcare-associated surveillance
  - rates of VRE in healthcare-associated *Enterococcus* bacteraemia, CAUTI
  - screening
    - reserved for clusters and high-risk settings (eg. NICU, oncology for us)
- Lab aspects
  - routine protocols will find clinical cases
  - screen with stool sample and chromogenic agar
    (we also find VRE on our *Campylobacter* media)

Bacteria (and fungi): central line-associated bloodstream infection (CLABSI)

- Preventable, healthcare-associated infections leading to significant morbidity and mortality
  - high priority for surveillance
- Need denominator: line-days
  - troublesome to collect but worth the effort
- Numerator captures all significant central-line associated bacteraemia episodes
  - need formal guidelines and trained classifiers
  - typically single cultures of environmental or low-virulence commensal flora are not counted
- Clear target from literature: less than 1 CLABSI per 1000 line-days
  - lower is better of course
  - to lower institution-wide rates, target units with higher rates
- Achieve lower rates with central line management “bundle”
  - array of quality improvement measures: patient selection, line selection, line insertion, line access, line removal, training/certification for all personnel involved, auditing, surveillance

Bacteria: surgical site infections

- Start with common types of surgery
- Try to monitor elective and emergency procedures
  - appendices, sternotomies, spinal rods?
- Try to capture late infections (diagnosed after discharge) - not easy

Bacteria: early-onset neonatal infections

- Some infections clearly preventable
  - *Streptococcus agalactiae* (GBS), *S. pyogenes, Listeria monocytogenes*
  - detect trends over time, measure effectiveness of maternal/perinatal interventions
- Other infections harder to prevent
  - *Escherichia coli*
  - monitor antimicrobial resistance, ensure empirical therapy remains appropriate

Bacteria: cystic fibrosis

- Some pathogens detected with routine lab
  - MRSA
  - multi-resistant *Pseudomonas aeruginosa*
- Some pathogens may require screening programme
  - *Burkholderia cenocepacia*
  - *Mycobacterium abscessus*
  - eg. screen every 6 months in patients over 10 years
- Early detection may help reduce cross infection
- Valuable to monitor rates over time so that increased transmission will be noticed
  - eg. incidence of *M. abscessus* infection per 100 CF patient-years
    (strictly speaking should be age adjusted, but start with basics)

Bacteria: tuberculosis

- Cases generally notifiable to public health authorities
  - triggers screening of contacts
    - find latent infection via cell-mediated immune response (Mantoux, IGRA)
    - chest X-ray
    - culture (eg. induced sputum)
- Every hospital diagnosis should be assessed for adequacy of isolation
  - risk of transmission to other patients
  - risk of transmission to staff members
- HCW performing chest physiotherapy have high risk of exposure

Bacteria: sexually transmitted infections

- Transmissible pathogens with antimicrobial resistance
  - worthy targets for surveillance programmes
  - eg. *Neisseria gonorrhoeae*
- Generally low rates in paediatric settings

Bacteria: environment

- Environmental surfaces
  - avoided by most clinical microbiology labs
  - can be hard to interpret
  - often easier to clean it again than to sample surfaces and wait for culture results
  - ATP bioluminescence detection holds some promise as rapid test of thoroughness of cleaning
- Sampling water for *Legionella*
  - likely to be flowing into your water supply from upstream
  - likes warm water
    - thermostatic mixing valves
    - cooling towers
  - need schedule of testing, protocol to respond to elevated CFU/L of *Legionella*
  - focus on high-risk areas first

Surveillance of fungi

- Patient or environmental survellance not commonly performed, except:
  - during construction
  - during maintenance of HVAC systems
  - during commissioning of oncology units, operating theatres etc.
  - investigating clusters
    - (eg. increased rates, or previously rare type of fungus)
- Environmental sampling for fungi should generally be performed by experienced labs
  - most clinical labs do not yet have this experience, or equipment such as air samplers
- Some units have seen acquired antifungal resistance (in *Candida albicans* or *Aspergillus fumigatus*)
  - first occurence must be confirmed using sequencing
  - monitoring antifungal resistance rates in these fungi over time becomes essential
- Transmission of *Pneumocystis* can occur
  - rates of confirmed *Pneumocystis* infection should be monitored over time
  - clusters need to be investigated

Surveillance of viruses

- Influenza
- Respiratory syncytial virus
- Rotavirus
- Norovirus
- Other vaccine-preventable viruses

Viruses: influenza

- Major pathogen affecting all ages
- Vaccine preventable
- Severe illness associated with:
  - immunocompromise
  - chronic lung disease
  - obesity
- Healthcare-associated infection can be significant
- Procedure:
  - collect nasopharyngeal aspirates or nasopharyngeal swabs
  - perform influenza testing (antigen test, PCR more sensitive)
  - classify all influenza cases as community-onset or healthcare-associated
  - monitor healthcare-associated influenza over time

Viruses: respiratory syncytial virus (RSV)

- Major pathogen in neonates, infants
- Severe illness associated with:
  - prematurity
  - immunocompromise
  - chronic lung disease
  - congenital heart disease
  - neuromuscular dysfunction
- Healthcare-associated infection is a significant problem
- Procedure:
  - collect nasopharyngeal aspirates from symptomatic patients
  - perform RSV testing (antigen test, PCR is more sensitive)
  - classify all RSV cases as community-onset or healthcare-associated
  - monitor healthcare-associated RSV infections over time
  - pattern will be seasonal, so long-term data is helpful
- Sequence typing is possible and likely to be informative
  - (so far I have not pursued this)

Viruses: rotavirus

- Major pathogen in neonates, infants
- Vaccine preventable
- Healthcare-associated infection is a significant problem
- Procedure:
  - inpatients with diarrhoea should have stool specimens collected
  - in addition to other pathogens (eg. *C. difficile*), rotavirus should be considered
  - testing should be performed using antigen tests (less sensitive) or PCR (more sensitive)
  - classify all rotavirus cases as community-onset or healthcare-associated
  - monitor healthcare-associated rotavirus infections over time

Viruses: norovirus

- Pathogen in children of all ages
- Healthcare-associated infection is a major problem
  - healthcare workers may also acquire the infection, can lead to unit closure
    (HCW may also develop sympathetic disease that cannot be confirmed by lab testing)
- Procedure:
  - inpatients with vomiting and diarrhoea should have stool specimens collected
  - in addition to other pathogens, norovirus should be considered
  - testing should be performed using antigen test or PCR (more sensitive)
  - classify norovirus cases as community-onset or healthcare-associated
  - monitor trends in healthcare-associated norovirus infection over time

Viruses: other vaccine-preventable

- Measles
  - probably the most transmissible pathogen that infects humans
    - true aerosol transmission
    - basic reproductive rate in non-immune is ~20
    - eg. transmission by passing through same airspace ~1 hour after source patient
  - perform infection control assessment of every case of measles linked to the hospital
- Varicella zoster virus
  - perform infection control assessment of every case of varicella or zoster in the hospital
  - both varicella and zoster have potential for airborne transmission
    - (not as infectious as measles, but higher than most respiratory viruses)
- take action to prevent, or reduce severity of, disease in contacts
  - check vaccination history
  - catch-up immunisation
  - measles or varicella zoster immune globulin
- transmission occurring in a healthcare environment is a sentinel event,
  - definitely worth monitoring

Other aspects: hand hygiene

- Essential infection control activity throughout hospital
- Personal responsibility of all staff members
- Adopt a hand hygiene framework
  - eg. WHO “Five Moments”
- (Educate staff, ensure access to washbasins, soap, alcohol-based handrub)
- Audit compliance with the hand hygiene framework
  - by moment
  - by category of employment (eg. nursing, medical, allied health)
  - by location or unit in hospital
- Monitor hand hygiene compliance rates over time
- Consider public display of compliance rates by unit
  - for patients, families and visitors to see
- Participate in regional / national reporting frameworks

Other aspects: sterilisation and high-level disinfection

- For a microbiologist, sterilisation is always preferable to high-level disinfection
  - so many headaches with high-level disinfection!
- Sterilisation
  - process indicators
  - chemical indicators
  - biological indicators (eg. *Geobacillus stearothermophilus*)
- High-level disinfection
  - Two philosophies
    - contaminate with a test organism and verify disinfection
      - which test organism?
      - quarantine device until results??
    - culture rinse water for microbes
      - how often?
      - how many patients at risk by the time results come back??
  - Recent outbreaks of CRE infection linked to (inadequate) high-level disinfection of duodenoscopes/ERCP in USA and Germany

Other aspects: antimicrobial stewardship

- Essential activity throughout hospital
- Help prevent antimicrobial resistance
- Help ensure appropriate and effective use of antimicrobials
- Potential surveillance indicators/tools:
  - measure total antimicrobial exposure
    - defined daily dose (difficult in paediatrics)
    - one alternative is days of therapy
    - categorise agents into high and low risk eg. red drugs, orange drugs, green drugs
  - audit tools such as “5x5” -
    - sample at least 5 patients per week
    - is there a documented indication for antimicrobials?
    - is the antimicrobial regimen concordant with guidelines?
    - if non-concordant with guidelines, is there a documented reason for non-concordance?

Other aspects: healthcare worker immunity

- Healthcare workers exposed to vaccine-preventable diseases at work
- Threat to HCW, and indirect threat to patients if there is further transmission
- Two potential approaches:
  - mandatory compliance - all HCW are assessed, and if they do not comply with vaccination policy, they are not permitted to work
  - encouragement - all HCW are provided information and access to vaccination
- Indicators:
  - no need for indicators if universal enforced mandatory compliance?
  - otherwise, monitor proportion of staff members with either documented dose of vaccine, or documented antibodies

Other aspects: healthcare worker TB status

- Healthcare workers can transmit tuberculosis to their patients
  - Risk assessment of healthcare workers is important for patient safety
  - Assess cumulative time spent in high-incidence countries
    - every time this ticks over, HCW should be referred for reassessment
  - Assess previous known exposures to tuberculosis
  - Assess BCG status
- HCW who fall into higher exposure category should be formally assessed
  - one or more of - Mantoux, interferon gamma release assay, chest X-ray
- Compliance may be poor unless programme is mandatory
  - risk to patients is real and significant eg. in NICU
- Monitor:
  - proportion of HCW compliant with risk assessment
  - proportion of HCW referred for formal TB assessment (Mantoux/IGRA/CXR)

Other aspects: healthcare worker exposures

- Healthcare worker exposures are sentinel events
  - examples:
    - needlestick injuries
    - HCW TB exposure
      - acquisition of latent or active tuberculosis
  - monitor number of events, number of staff members exposed
  - risk level of each event (risk of harm to staff member)
  - whether appropriate follow-up was completed
  - (other aspects not directly related to infection control - leave, compensation, insurance)

Summary

- Surveillance:
  - Pathogens
    - Bacteria
    - Fungi
    - Viruses
  - Syndromes
    - CLABSI
    - SSI
  - Other indicators with infection control implications
- Numerous potential targets of surveillance
  - always go back to “resource allocation” concept, prioritise accordingly
  - can try negotiating for additional funding to address particular issues if resources insufficient