

Gram-negative blood stream Infections (GNBSI): the first year of enhanced mandatory surveillance at a London teaching hospital

INTRODUCTION

In 2016, the UK government announced an ambition to reduce healthcare-associated (HCA) Gram-negative blood stream infections (GNBSI) by 50% by 2021/22. NHS Improvement (NHSI) mandated the reporting from April 2017 of *Klebsiella* species, and *Pseudomonas aeruginosa* BSI cases (in addition to *E. coli*) to Public Health England (PHE): enhanced mandatory surveillance.

Guidance on the definition of healthcare associated GNBSI was issued by PHE and NHSI in July 2017¹.

According to this guidance, a **healthcare associated GNBSI was defined as** a case in a patient who had:

- received healthcare in either the community or the hospital in the previous 28 days, including but not limited to:
 - indwelling vascular access devices (insertion, *in situ*, or removal)
 - urinary catheterisation (insertion, *in situ* with or without manipulation, or removal)
 - other devices (insertion, *in situ* with or without manipulation, or removal)
 - invasive procedures (eg endoscopic retrograde cholangiopancreatography, prostate biopsy, surgery including, but not restricted to, gastrointestinal tract surgery)
 - neutropenia (<500/microL at time of bacteraemia)
 - antimicrobial therapy, and/or
- had an intervention up to 12 months earlier that remained operational during the previous 28 day period eg urinary catheter, and/or
- onset at least 48 hours after admission, and/or
- onset within 28 days of discharge, and/or
- been receiving nursing home care

Opportunities to intervene “should not be lost”:

“The presence of a healthcare associated risk factor is enough to assume that the GNBSI is healthcare associated.”¹

AIM

Here we review the epidemiology, root causes, and potential preventability of the first year of enhanced mandatory surveillance of cases detected at the Royal Free Hospital (RFH), a London teaching hospital, to inform infection prevention and control actions.

METHODS

Individual patient hospital and summary care records from the NHS Spine were reviewed. GNBSI were categorised as community-onset (CO), HCA, or hospital onset (HO), as per published guidance¹. All cases were reviewed by the microbiology clinical team and specifically reviewed for the root cause and potential preventability by a consultant microbiologist.

Potential preventability was assessed in keeping with the NHSI guidance for healthcare association so that “opportunities to intervene were not lost”¹. Examples of the broad criteria for classification as potentially preventable included:

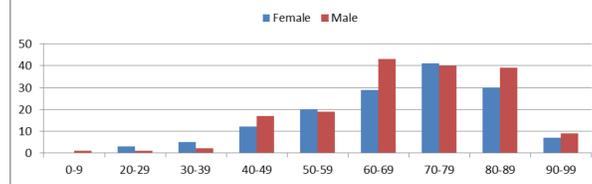
- Focus related to a device such as a urine catheter, intravascular line, or endotracheal tube.
- Focus related to a prior procedure or surgery.
- Prior antibiotics ineffective against the causative organism.
- Patients on a pathway where more rapid or alternative management may have prevented the infection.

Antibiotic sensitivity results were obtained from the laboratory information system. Data was analysed in Microsoft Excel. Chi-squared tests were performed using Open-Epi version 3.01 (www.openepi.com).

RESULTS

From April 2017 to March 2018, 318 BSIs were detected, 219(69%) *E. coli*, 62(19%) *Klebsiella* species, and 37(12%) *P. aeruginosa*. 171/318 (54%) of cases occurred in males. The predominance of males and females varied by age group (Figure 1).

Figure 1: GNBSI by age and gender (N=318)



79 cases (25%) were CO-non-HCA and 239 (75%) HCA: 94 (30% of total) HO, and 145 (46% of total) CO-HCA, of which 51 (16% of total) and 94 (30% of total) were associated with prior community and hospital care, respectively (Figure 2). Compared to CO cases, HO cases were more likely to be due to *Klebsiella* spp. (26/94 versus 36/224, P=0.010) or *P. aeruginosa* (17/94 versus 20/224, P=0.013) (Figure 2).

Figure 2: GNBSI by onset and organism (N=318)

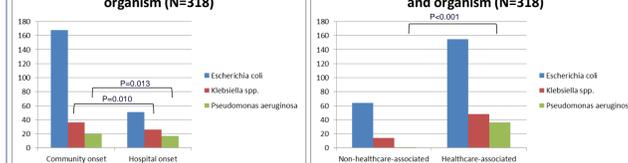
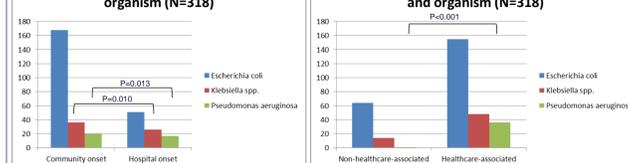


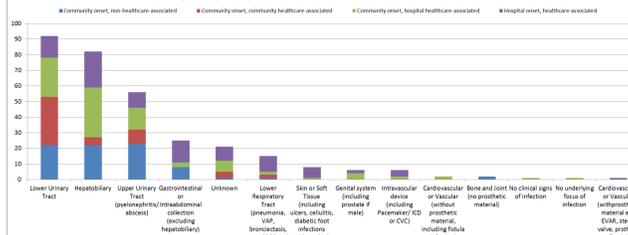
Figure 3: GNBSI by healthcare association and organism (N=318)



Compared to non-HCA cases, HCA cases were more likely to be due to *P. aeruginosa* (36/239 versus 1/79, P<0.001) (Figure 3).

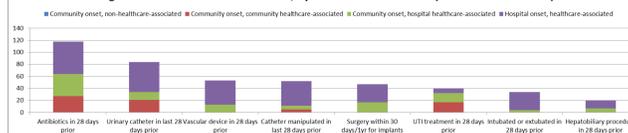
The most common primary foci were lower urinary tract (UT) 92 (29%), hepatobiliary 82 (26%), upper UT 56 (18%), and gastrointestinal or intra-abdominal 25 (8%). These four foci comprised 80% of cases (Figure 4).

Figure 4: primary focus of GNBSI, by healthcare association (N=318)



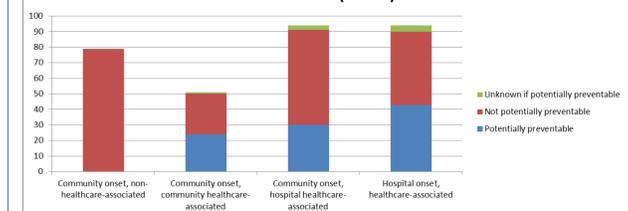
The most common HCA risk factors were: prior antimicrobial therapy 118 (37%), urinary catheter 84 (26%), vascular device 53 (17%), and prior surgery 47 (15%) (Figure 5).

Figure 5: Main risk factors for GNBSI, by healthcare association (total risk factors=448)



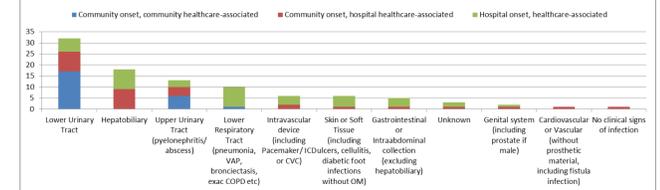
Potentially preventability was assessable in 310 cases (97%), of which 97(31%) were thought to be potentially preventable: 43 (48%) of HO cases, and 54 (38%) CO-HCA cases, of which 24/50 (48%) and 30/90 (33%) of cases associated with prior community and hospital care, respectively were thought to be potentially preventable (Figure 6).

Figure 6: GNBSI potential preventability by onset and healthcare association (N=318)



The primary foci most frequently associated with potential preventability were lower UT, hepatobiliary, upper UT, and lower respiratory tract (Figure 7).

Figure 7: Potentially preventable GNBSI by primary focus, onset and healthcare association (N=97)



Examples of potentially preventable CO, community-HCA cases included:

- Patients with long term urinary catheters as the focus of infection.
- Patients treated for urinary tract infections (UTI) by their GP with antibiotics to which the subsequent GNBSI was resistant (e.g. trimethoprim).

Examples of potentially preventable CO, hospital-HCA cases included:

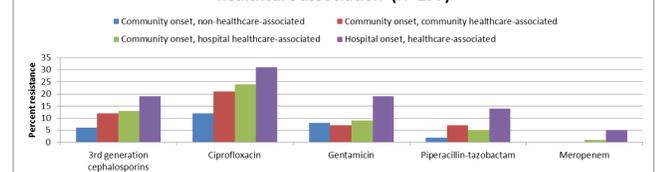
- Patients with surgery in the prior 28 days.
- Patients who had UTI treatment in the prior 28 days.
- Patients with a long term urinary catheters as the focus of infection.
- Patients with know hepatobiliary disease, some following ERCP
- Patients with intravascular devices including dialysis lines.

Examples of potentially preventable HO cases included:

- Patients with prior surgery including renal transplant and liver transplantation, and hepatobiliary surgery for malignancy
- Patients with urinary catheters, intravascular devices, or endotracheal tubes as risk factors for infection (Figure 7).

Resistance rates to selected antibiotics were lowest in CO-non-HCA cases, higher and similar in CO, community HCA cases and CO, hospital HCA cases, and highest in HO cases (Figure 8).

Figure 8: resistance rates to selected antibiotics, by origin and healthcare association (N=277)



DISCUSSION

The most common foci of infection were the urinary tract and hepatobiliary and gastrointestinal tracts. Compared to a recent study of *E. coli* BSI in England² our cases were more likely to have a hepatobiliary focus (26% versus 16%, P<0.001) which may reflect our large tertiary hepatopancreatobiliary surgery service.

These findings support our efforts to focus on infection prevention and control measures targeting these systems. This includes the use of bladder scanners and catheter passports, and audits of surgical prophylaxis and surgical site infection prevention bundles.

The criteria for potential preventability were deliberately broad. It is unlikely that all the potentially preventable cases could ultimately be prevented.

Beyond the acute Trust, collaborative work with community healthcare services to improve catheter care and UTI prevention and treatment could contribute to further reductions in GNBSI.

REFERENCES

- Guidance on the definition of healthcare associated Gram-negative bloodstream Infections, Public Health England, © NHS Improvement, June 2017 Publication code: IG 33/17
- Abernethy J, et al. Epidemiology of Escherichia coli bacteraemia in England: results of an enhanced sentinel surveillance programme. Journal of Hospital Infection 2017; 95:365-375.