Characterisation of risk factors associated with antibiotic resistance in urinary isolates in the community: an Infection Intelligence Platform exemplar study

Objective

Urinary tract infections (UTIs) are amongst the most common infections treated in community and hospital settings. Initial antibiotic treatment of UTI is usually empirical, that is, where the prescriber has no definitive information on the organism or its antibiotic susceptibility. Overall, the prevalence of antimicrobial resistance is increasing and specifically so for antibiotics commonly used for UTI.

By linking NHS surveillance data to routinely collected administrative health data, this study aimed to investigate risk factors for antibiotic resistance in urine samples.

Methods

Data linkage and patients

All positive samples, with a valid CHI, included in the Health Protection Scotland “Surveillance of Antimicrobial Resistance in Urinary Isolates in Scotland” dataset in the period from January 2012 to June 2015 were analysed. All NHS Boards are required to submit susceptibility data for up to fourteen antibiotics on 400 positive urinary samples per quarter. Samples were assigned a resistance status of Susceptible, Resistant or Multi-drug resistant based on the antibiotic susceptibility data recorded.

Samples were then linked to the following national data sources held by NHS National Services Scotland in order to identify potential predictors of resistance:

- Prescribing Information System (PIS) community prescribing data
- Scottish Morbidity Records (SMR01) hospital data
- National Records of Scotland (NRS) mortality data

Statistical analysis

Multinomial logistic regression was used to determine the effect of each covariate, where the resistance status (susceptible, resistant or multi-drug resistant) was the outcome measure and susceptible was the reference category. A p-value of p<0.05 was considered significant.

For all-cause mortality analysis, Kaplan-Meier plots and log-rank tests were used to determine the effect of factors at univariate level and Cox Proportional-hazard model was used for multivariate analysis.

Results

40,984 positive urine samples were examined. Overall, 11,647 (28.4%) urine samples were susceptible, 18,445 (45.0%) were resistant and 10,892 (26.6%) were multi-drug resistant. Around a quarter of the cases (25.7%) had no antibiotic prescribing in the six months prior to infection. Older age, increasing comorbidity and care home residence were all found to be associated with resistance and multi-drug resistance. Cumulative antibiotic exposure had a clear dose-response effect (p<0.001). Those prescribed 1-7 DDDs of nitrofurantoin in the six months prior to a positive sample were 2.18 times (95% CI: 1.98-2.40) more likely to have a multi-drug resistant infection, compared to a susceptible infection, rising to 7.65 times (95% CI: 5.96-9.82) for 29+ DDDs. Those prescribed 29+ DDD of trimethoprim were 10.35 (95% CI: 7.78-13.78) times more likely to have a multi-resistant infection.

Figure 1: Effect of cumulative prescribing at 6 months – multi-drug resistant samples compared to susceptible samples.

Cases with either a resistant or multi-drug resistant sample were found to be more likely to die within the study period than those with a susceptible sample. Those with a resistant infection had an increased risk of mortality of 1.18 (95% CI 1.10-1.27; p<0.001) and those with a MDR also had an increased risk of 1.18 (95% CI 1.09-1.27; p<0.001).

Figure 2: Survival function of susceptible, resistant and multi-drug resistant cases.

Lessons learned

This study has demonstrated the use of the UTI Snapshot in identifying risk factors for resistance. The methodology of linking patient-level data used in this IIP exemplar study could be expanded to include other types of infection and could be repeated on a regular basis to identify newly emerging risk factors.

Conclusions

This study, part of NHS Scotland’s Infection Intelligence Platform, has identified the risks of occurrence of both resistant and multi-drug resistant infections and demonstrated a clear effect of cumulative antibiotic exposure in the community. Such quantification is key to ensuring and supporting robust antimicrobial stewardship policy and, going forward, this evidence can be used to populate risk models and help support clinical decision making.

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