RESEARCH GROUP: The Pharmaceutical Science and Practice Research Group

Project Title:
An evaluation of the impact an antibiotic stewardship, informed by identifying antibiotic usage thresholds utilising non-linear time series analysis, has on MRSA incidence rates in hospitals

Supervisor(s):
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Level: PhD

Background to the project:
Antibiotic resistance is a major threat to public health worldwide. In Northern Ireland, the Department of Health, Social Services and Public Safety (DHSSPS; 2012) published the Strategy for Tackling Antimicrobial Resistance (STAR) 2012-2017. This strategy aimed at developing and implementing adequate antibiotic stewardship in NI Trusts, encouraging research aiming at improving healthcare services, and enhancing the surveillance of antibiotic use and resistance. Methicillin resistant *Staphylococcus aureus* (MRSA) contributes significantly to the burden of healthcare-acquired infections (HCAIs). Antibiotic use was demonstrated to be associated with an increased risk of MRSA colonisation and infection in several studies. Antibiotic stewardships were established to inform adequate antibiotic prescribing practices. The challenge for antibiotic stewardships, however, is to balance providing adequate antibiotic treatment with preventing the emergence of antibiotic resistance. Recently, Lawes *et al.* explored the relationship between antibiotic use and MRSA, the authors managed to create thresholds for antibiotic use (point at which further antibiotic use has minimal impact on developing and spreading resistance) to control MRSA rates.

We believe that the introduction of an antibiotic policy, designed based on identifying thresholds for antibiotic use to control MRSA rates, can significantly decrease the incidence of MRSA in the Antrim Area.
Hospital. This will serve as a pilot study for the implementation of this type of policy to hospitals in Northern Ireland.

**Objectives of the research project:**

The primary aim of this study is to investigate the effect of an antibiotic policy, derived based on non-linear time-series analysis using local epidemiological data, on the incidence of MRSA in the Antrim Area Hospital. Secondary objective will be to determine the effect of this policy on the incidence of *Clostridium difficile* infection (CDI) and extended-spectrum β-lactamases (ESBLs) producing organisms.

Specific objectives are as follows:

i. To model the relationship between volumes of antibiotic use, infection control agents, and the monthly incidence of MRSA, using the non-linear time-series analysis, with the aim of identifying thresholds in antibiotic use that will influence MRSA incidence rates.

ii. To develop and implement an antibiotic policy, designed based on the identified antibiotic use thresholds, in Antrim Area Hospital.

iii. To monitor and measure the hospital adherence to this policy through the intervention period.

iv. To measure and analyse the study outcomes: changes in the monthly incidence of MRSA, CDI, and ESBL producing organisms, and changes in the resistance profile of MRSA and ESBL producing organisms.

**Methods to be used:**

1. This study will take place in Antrim Hospital in the NHSCT. The NHSCT is geographically the largest Trust in Northern Ireland and Antrim Hospital serves a population of 420,000 people.
2. Ethical approval and research governance approval will be sought from the Office of Research Ethics Committees Northern Ireland and from the Northern Trust research governance office prior to commencement of the project.

3. Database for the project will be established through collecting specific data as follows. Monthly number of patients identified with MRSA, CDI, ESBL-producing organisms will be identified from the clinical microbiology laboratory information system. Each case patient will only counted once, i.e. repeat isolates during the same hospital stay will be excluded. Bed occupancy data will be obtained at monthly intervals to calculate the incidence of MRSA per 100 bed-days. Monthly antibiotic usage supplied to each ward will be obtained from the hospital pharmacy information system, and will be expressed as a number of DDDs per 100 bed-days. Data will also be collected from the pharmacy information system on the monthly quantities of chlorhexidine (litres), alcohol-impregnated wipes (number), gloves (number of pairs), mupirocin (grams), alcohol-based hand rub (litres) and supplied to all wards over the study period. These quantities will be normalised as per 100 bed-days.

4. The relationship between MRSA, infection control and antibiotic use in Antrim will be modelled using the non-linear time series analysis as described elsewhere. Based on this analysis, the consumption of the identified antibiotic classes, in order to avoid antibiotic selection pressures predicting increases in MRSA, will be determined (i.e. thresholds in antibiotic use).

5. An antibiotic policy will be then devised, to take into account the identified thresholds, i.e. the hospital antibiotic consumption of certain identified antibiotics should be reduced to a level that is below the determined threshold. The planned antibiotic policy, that will be implemented over 12 month intervention period, will be developed in collaboration with the Trust microbiologists and the medical and surgical teams.

6. The effect of the antibiotic cycling policy on the incidence of MRSA, CDI, and ESBLs producing organisms will be evaluated using time series analysis. In order to determine whether the implementation of an antibiotic cycling policy significantly changed the incidence of HA-MRSA, an intervention model will be built using the segmented regression of the interrupted time series analysis.
Skills required of applicant:

A 2:1 honours degree in pharmacy, very good management skills and IT literacy

References: