



## Multidisciplinary neurosurgical rounds incorporating antimicrobial stewardship. Are they of benefit?



M. Creedon<sup>a,\*</sup>, H. Humphreys<sup>a,b</sup>, R. Connolly<sup>a</sup>, L. Gaughan<sup>c</sup>, M. Skally<sup>a</sup>, J. Caird<sup>d</sup>, J. Duddy<sup>d</sup>, P.J. O'Halloran<sup>d</sup>, T. Mandiwanza<sup>d</sup>, K. Burns<sup>a</sup>, B. Dinesh<sup>a</sup>, E. Smyth<sup>a</sup>, K. O'Connell<sup>a</sup>, F. Fitzpatrick<sup>a,b</sup>

<sup>a</sup> Department of Microbiology, Beaumont Hospital, Dublin, Ireland

<sup>b</sup> Department of Clinical Microbiology, The Royal College of Surgeons in Ireland, Dublin, Ireland

<sup>c</sup> Department of Pharmacy, Beaumont Hospital, Dublin, Ireland

<sup>d</sup> Department of Neurosurgery, Beaumont Hospital, Dublin, Ireland

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### ABSTRACT

**Background:** In an era of increasing antimicrobial resistance, appropriate antimicrobials are essential to optimise patient outcomes. In 2017, antimicrobial use prevalence (AMU) on the two neurosurgical wards in our tertiary teaching hospital varied from 23% on ward A to 33% on ward B with 67% and 100% 'appropriate' prescriptions, respectively. In July 2018, a weekly antimicrobial stewardship multidisciplinary round led by a senior neurosurgery registrar commenced, attended by the antimicrobial stewardship team (AST).

**Research question:** This report evaluates whether a multi-disciplinary approach on neurosurgical prescribing was beneficial, specifically in reducing AMU.

**Materials and methods:** The following data was collected on AST rounds for 30 weeks in total from August 2018 to July 2019: number of patients on antimicrobials, appropriateness and stewardship actions. A questionnaire was distributed to neurosurgical doctors on two occasions to canvass opinions and attitudes on antimicrobial prescribing.

**Results:** 1716 prescriptions were reviewed (mean 57.2 per week). Of these 321 (18.7%) included antimicrobial prescriptions; 200 on ward A (19.8%), and 121 on ward B (17%), representing a decrease in AMU from 2017. The majority of antimicrobial prescriptions, 271 (84.4%) were deemed appropriate. Stewardship actions were taken in 215 (67%) prescriptions.

Fifteen questionnaires were completed by neurosurgical doctors. The majority, 87%, stated the AST round was helpful overall. 93% indicated that informal training on the AST round was a source of education in antibiotic prescribing.

**Discussion and conclusion:** The weekly AST round provided a timely opportunity for multidisciplinary discussion, implementation of antimicrobial stewardship actions and opportunistic antimicrobial stewardship education.

### 1. Background

In an era of increasing antimicrobial resistance, judicious use of antimicrobials is more important than ever. Treating serious intra-cranial infections due to antimicrobial resistant bacteria is challenging, and not always successful (Rodríguez Guardado et al., 2008). Input from an antimicrobial stewardship team (AST) can be helpful in improving the appropriate use of antimicrobials, thereby reducing the risk of antimicrobial resistance, and preserving the efficacy of antimicrobials (National

Institute for Health and Care Excellence, 2015), (Charani et al., 2019), (Tanagho et al., 2015). It is recognised that surgeons need to be directly involved in the AST to provide leadership, inform appropriate decision making and achieve the best outcomes for their patients (Deguchi and Matsumoto, 2014). To our knowledge, there has been no significant assessment of the potential benefit of AST rounds in a neurosurgical setting or the view of neurosurgeons on its value.

Beaumont Hospital is an 820-bed tertiary referral hospital, with the national neurosurgery unit for Ireland. In 2017, a hospital-wide point

\* Corresponding author. Dept of Microbiology, Beaumont Hospital, Dublin, 9, Ireland.

E-mail address: [margaretrcreedon@gmail.com](mailto:margaretrcreedon@gmail.com) (M. Creedon).

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prevalence survey of antimicrobial use (AMU) demonstrated an AMU prevalence of 44% across the hospital, with a lower prevalence on the two neurosurgery wards (ward A; 23% and ward B; 33%). On ward B, 100% of antimicrobial prescriptions were deemed 'appropriate' (i.e., in accordance with hospital prescribing guidelines and/or advised by the Clinical Microbiology or Infectious Diseases (ID) teams). However, on ward A just 67% of antimicrobial prescriptions were recorded as appropriate. While a daily clinical microbiology ward round has taken place in the neurosurgical intensive care unit for over two decades, prior to 2018 there was no formal clinical microbiology ward round on the neurosurgical wards. As part of the hospital's antimicrobial stewardship programme, a weekly multidisciplinary AST round commenced on both neurosurgical wards in July 2018.

We describe the impact of a multi-disciplinary approach involving an AST round on neurosurgical prescribing, and specifically to optimise AMU. We also present the results from a survey of the neurosurgeons to canvass their opinions and attitudes on antimicrobial prescribing.

## 2. Methods

### 2.1. Data collected prospectively

In July 2018, a weekly multidisciplinary AST ward round commenced on both neurosurgical wards. The AST round was integrated into the daily neurosurgical ward round and commenced at 8am every Wednesday. The round was led by a senior neurosurgical registrar and attended by the neurosurgical team, the clinical nurse manager on each ward, the patient flow team and allied healthcare professionals, in addition to the AST (a consultant clinical microbiologist, clinical microbiology specialist trainee and antimicrobial pharmacist). For each inpatient, their medication prescription was reviewed, and if this included an antimicrobial, a discussion followed regarding the appropriateness of this prescription alongside a review of relevant positive laboratory results. Antimicrobial stewardship actions were then recommended by the AST and implemented in real-time during the AST ward round. Relevant laboratory results and recommendations were documented in the patient's chart on a standardised proforma.

Between August 2018 and July 2019, data was collected prospectively during an eight-week pilot study, following which preliminary results were analysed and reviewed, with resumption of data collection four months later for a period of 22 weeks. The following data was collected: the number of inpatients on each ward, number of patients prescribed an antimicrobial(s), appropriateness of antimicrobial prescriptions, and stewardship actions taken. 'Appropriate' antimicrobials were defined as those prescribed according to hospital guidelines and/or advised by the Clinical Microbiology or Infectious Diseases team. A proforma was used to collect data anonymously, and no patient identifiers were collected.

In addition to weekly data collection, a hospital wide point prevalence survey was performed in 2018 three months post commencement of the AST round, from which further data was on antimicrobial prevalence and appropriateness was recorded.

### 2.2. Surveillance of clostridioides difficile rates

Rates of hospital acquired *C. difficile* infection were continuously monitored throughout the study period as part of the hospital's healthcare associated infection surveillance programme. Rates were calculated as new hospital acquired cases per 10,000 bed days used (BDU).

### 2.3. Questionnaire

On two occasions, an anonymous questionnaire was distributed to neurosurgeons for completion at the end of the weekly AST round. The

questionnaire compiled by the AST and was partly based on a previously validated questionnaire (Pulcini et al., 2011). It consisted of twenty questions and included open and closed stems. Information was collected on previous training in antimicrobial prescribing and factors which influenced prescribing. Other questions assessed the perceived benefits of the AST round including impact on perceived personal knowledge and behavioural change.

### 2.4. Data analysis

Data was inputted and analysed using Microsoft Excel. Percentages and means were calculated for categorical data. Line graphs were generated to display the prevalence of AMU over time.

## 3. Results

### 3.1. Prospective data

The AST round was conducted on 51 occasions between August 1, 2018 to July 31, 2019, from which 30 weeks of data were collected. On average, the AST round took 1 h to complete. In total, 1716 medication prescriptions and administration records were reviewed (a mean of 57.2 per week); 1006 on ward A, and 710 on ward B. Of these, 321 (18.7%) included antimicrobial prescriptions; 200 on ward A (19.8%), and 121 on ward B (17%). The majority of the antimicrobial prescriptions (239; 74.5%) had already been discussed with the AST prior to the AMS round.

The AMU prevalence throughout the study period ranged from 8.5% to 27% of all patients reviewed (Fig. 1). Scheduled trainee doctor changeover occurred at week 10. An increase in AMU was noted soon after scheduled trainee doctor changeover, during weeks 11–16 (January to March 2019), particularly in ward B.

Overall, the majority of antimicrobial prescriptions, 271 (84.4%) were deemed appropriate; 169 on ward A (84.5%) and 102 on ward B (84.29%). The overall appropriateness of prescriptions from week-to-week ranged from 62% to 100%. 82 of the 321 prescriptions had not been previously discussed with the AST, and of these just 42.7% were deemed appropriate.

Antimicrobial stewardship actions were taken in 215 (67%) prescriptions. The most frequent actions taken included stopping antimicrobials or providing a review date in 88 (27.4%) and 98 prescriptions (30.5%), respectively. Other actions included escalation of antimicrobials in 13 (4%), and de-escalation or oral switch in 30 (9.3%). In total, the discharge of 21 patients (mean 0.7 patients per week), was facilitated through providing an oral switch option or outpatient parenteral antimicrobial therapy (OPAT) plan.

Data from the point prevalence survey performed in October 2018 found an AMU of 14% on ward A, compared to 17% in 2017, and appropriateness was unchanged at 100%. On Ward B, AMU reduced to 23% from 33%, and appropriateness improved from 67% to 100%. (See Figs. 2 and 3).

### 3.2. Surveillance

*C. difficile* rates remained consistently lower than the national average before and throughout the study period. There was an increase in hospital acquired *C. difficile* rates in 2019, which was also reflected nationally (HSE Health Protection Sur, 2022) (see Fig. 4).

### 3.3. Questionnaire

Excluding the consultants, the neurosurgical team at this time consisted of twenty-four trainee doctors, of whom eleven were registrars (senior), nine senior house officers (intermediate) and four interns (junior). In total, 15 questionnaires were completed, four by senior, five by

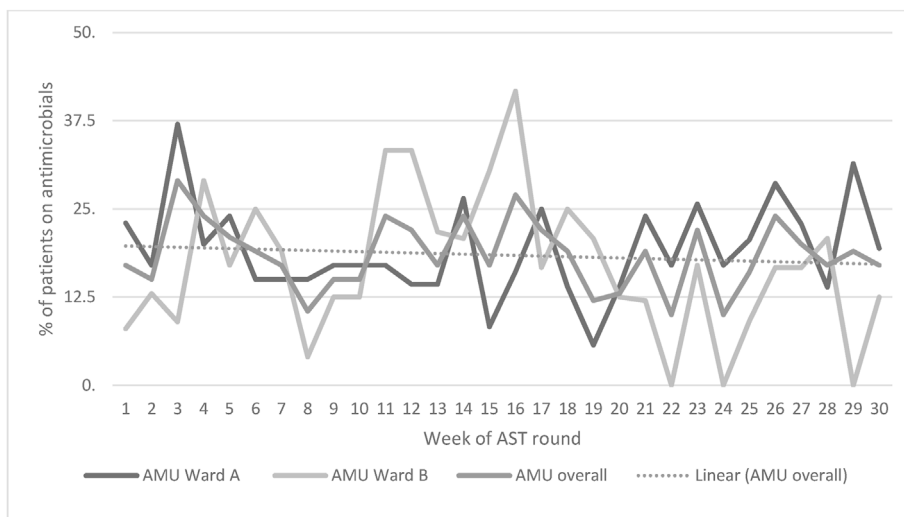


Fig. 1. Antimicrobial use prevalence over time.

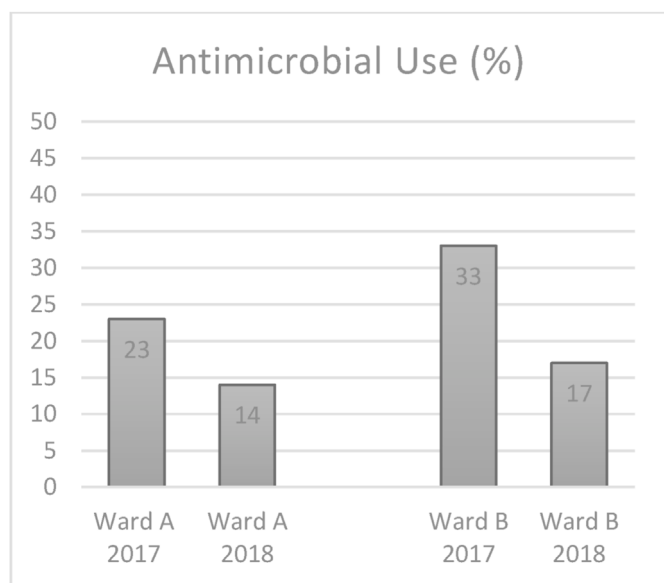


Fig. 2. Result of the PPS survey of AMU pre-intervention (2017) and post-intervention (2018).

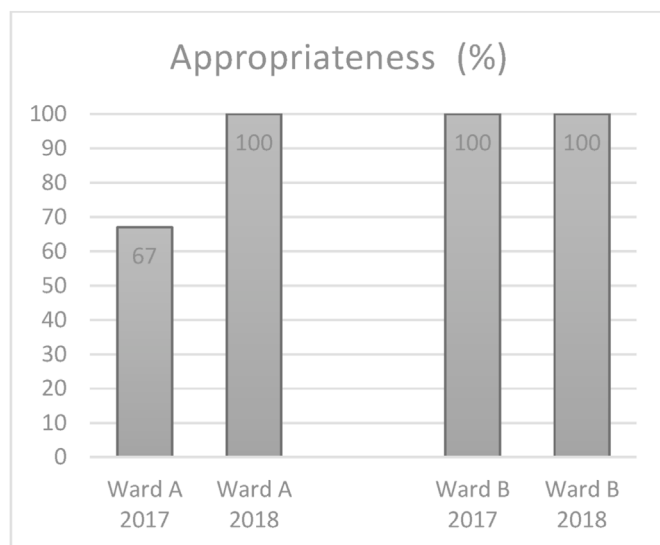


Fig. 3. Result of the PPS survey of appropriateness of antimicrobials pre-intervention (2017) and post-intervention (2018).

intermediate and three by junior trainees, with training experience not stated in three completed questionnaires.

Questionnaire responses are summarised in Table 1. Thirteen (86.7%) respondents found the AST round helpful overall. Fourteen respondents (93%) stated the AST round was helpful in prescribing the most appropriate antibiotic regimen for their patients. Informal training (e.g., by the clinical microbiologist on the ward) was a source of education in prescribing in fourteen respondents (93%) and four (27%) indicated that this was their only source of training in antimicrobial stewardship. Free text comments included “the AST round is helpful in focusing prescribing practice” and “worthwhile continuing”. One respondent (a senior trainee) found the AST round unhelpful and believed it unnecessarily prolonged their round.

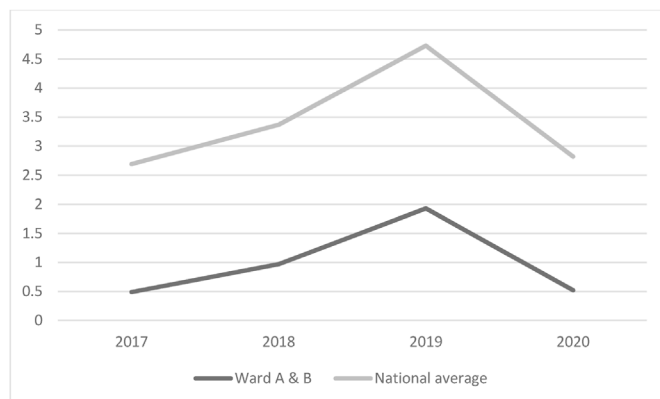


Fig. 4. Rates of hospital acquired *C.difficile* per 10,000 bed day units.

**Table 1**  
Questionnaire responses from neurosurgical doctors<sup>a</sup> (number = 15).

	Number who agreed (%)
1. Source of antimicrobial stewardship education	
Informal/opportunistic on ward	14 (93%)
Self-directed	7 (47%)
Online	5 (33%)
Attended lectures on antibiotic prescribing	4 (27%)
2. Factors influencing antimicrobial prescribing	
Clinical microbiology advice	15 (100%)
Hospital guidelines	14 (93%)
Senior colleague	13 (87%)
Previous experience	13 (87%)
Pharmacist advice	8 (53%)
3. Impact of antimicrobial stewardship round – knowledge and behavioural change	
More confident in making an accurate diagnosis of infection	13 (87%)
More confident in antibiotic choice and duration	13 (87%)
More confident in antibiotic choice for central nervous system penetration	11 (73%)
More confident in antibiotic dose and interval	12 (80%)
More confident in antibiotic route choice	11 (73%)
Increased understanding and awareness of multi-drug resistant organisms	12 (80%)
More confident in interpreting microbiology results.	11 (73%)
More likely to consult hospital antimicrobial guidelines	13 (87%)
More aware of regular review of intravenous lines and catheters	13 (87%)
Increased awareness of performing hand hygiene	12 (80%)
4. Impact of antimicrobial stewardship round- benefit for patients	
Helps in prescribing the most appropriate antibiotic regimen for the patient	14 (93%)
Helps in prescribing shorter duration of antibiotics	14 (93%)
Helps in switching patients to oral antibiotics	14 (93%)
Helps in making decisions re outpatient antimicrobial therapy (OPAT) decisions	13 (87%)
Helps in enabling discharge of patients	11 (73%)

<sup>a</sup> Excluding consultants.

#### 4. Discussion

Antimicrobial resistance is a major threat to global health, and it is known that unnecessary and excessive use of antimicrobials is a key driver of antimicrobial resistance (O'Neill, 2014). In addition, inappropriate use of antimicrobials can lead to adverse effects such as *C. difficile* infection, which can result in prolonged hospital stays (Forster et al., 2012). In order to preserve the efficacy of antimicrobials and protect patients, the prevention or minimizing of these outcomes is of crucial importance.

Despite this threat, studies have shown that antimicrobial decision-making might be considered as a secondary task by surgeons (Charani et al., 2017). One study which evaluated the treatment of healthcare acquired infections (HAI) in surgical patients found that in 73% of HAIs, the clinicians' treatment differed from recommended practice (Leeds et al., 2017). A Swiss study found that 49.3% of antimicrobial prescriptions in surgical patients were inappropriate, and that the 'error rate' in antimicrobial prescriptions was higher in surgical wards, compared to medical wards (Cusini et al., 2010). Therefore, multi-disciplinary input from an AST team is necessary to improve prescribing in surgical patients.

The implementation of a weekly AST ward round in our hospital coincided with a reduction in AMU when compared to a point prevalence survey in our hospital in 2017, i.e., from 23% in 2017 to 14% on ward A and 33%–17% on ward B. The national point prevalence survey of antimicrobial use in Irish hospitals in 2018 reported an overall median AMU prevalence of 38.6%, with a higher median AMU prevalence of 44.4% in surgical patients (Hogan-Murphy et al., 2019), hence the AMU in our cohort compared favourably. Throughout the period of data collection AMU remained low, with a trend towards reduced AMU. An increase in AMU was noted in ward B from weeks 11–16 which may have been accounted for by seasonal variations in antimicrobial prescribing,

but a scheduled trainee doctor changeover occurred at week 10, which may also have contributed to changes in antimicrobial prescribing.

Appropriateness remained high overall throughout the study period, at 84%, and improved on ward B when compared to the point prevalence survey in 2017 from 67% to 100%. It was noted that in most appropriate prescriptions, there had already been input from the Clinical Microbiology team. This serves to underline the benefit of the AST round in encouraging the neurosurgical team to engage with infection specialist services.

Rates of *C. difficile* remained consistently below the national average before and throughout the study period. A rise in hospital associated acquired cases in 2019 was likely to be related to an increase in the *C. difficile* ribotype 002, which was associated with outbreaks in acute Irish hospitals in late 2018 to 2019 (HSE Health Protection Sur, 2022). Despite this outbreak, rates on the neurosurgical wards remained below the national average. These low rates may reflect the comparably low AMU on these wards.

In addition to implementing stewardship actions, the AST round also provided opportunities to educate trainee doctors on antimicrobial prescribing and infection prevention and control. In our study, we found there was little formal teaching/learning in antimicrobial prescribing, with 27% of respondents stating informal teaching/learning was their only resource. These findings are similar to those of a study conducted across five London hospitals, in which the majority of trainee doctors reported that the prescribing of antimicrobials occurred with inadequate knowledge (Gharbi et al., 2016). The majority of respondents in our study stated that the ward round improved their perceived personal knowledge, including choosing the correct agent and planning duration. The ward round may also have helped to induce behavioural change. Respondents stated they were more likely to use the local hospital guidelines smartphone app when prescribing and were more aware of infection prevention and control issues. Another benefit of the AST round was improved perceived patient flow on the neurosurgical service by facilitating discharge via OPAT or by providing oral switch options.

In order to implement sustained change, antimicrobial stewardship programmes need to be adapted to local cultures and institutions (Paskovaty et al., 2005). A study performed in a London teaching hospital highlighted that as surgeons' time on the ward is limited due to commitments in operating theatre and clinics, antimicrobial decision making may be delegated to junior team members (Charani et al., 2019). This may also make multi-disciplinary input more difficult, as it may be challenging to engage with senior decision makers who may spend less time on the ward. We found that a once weekly multi-disciplinary neurosurgical ward round adapted to the neurosurgical team's schedule led to improved engagement with senior members of the team. There were opportunities to implement stewardship interventions, such as stopping antimicrobials, with 27.4% of antimicrobial prescriptions discontinued in real time during the AST round.

As well as providing feedback on antimicrobial prescribing data to prescribers, successful antimicrobial stewardship programmes should also seek feedback on areas that could be improved on in order to help in implementation of stewardship actions (Skodvin et al., 2021). In our questionnaire, one trainee stated that the AST round led to delays in the working day. Since the study, we have made the round more efficient through the identification of all patients on antimicrobials prior to the round and focusing discussions on these patients only.

Our AST ward round was founded on the core principles for successful antimicrobial stewardship programmes established by the US Centers for Disease Control and Prevention which include leadership, accountability, pharmacy expertise, implementing at least one recommended action and education (Centers for Disease Control and Prevention, 2019). We believe that leadership and accountability were factors that were critical to the success of the ward round, whereby direct involvement of the neurosurgical team, including senior trainees (but not consultants) contributed to decision making. The value of the rounds could be further enhanced by the involvement of consultant neurosurgeons on the round,

even if they were available before and afterwards to discuss individual patients.

Limitations to this study include that data on AMU and appropriateness prior to the implementation of the AMS ward round was limited, making it difficult to accurately quantify the impact of the ward round. Data collection was non-continuous, meaning trends in antimicrobial prescribing were less explicit. The data set was limited to facilitate real-time data collection and indications for antimicrobials were not collected, and thus, it was not possible to ascertain whether inappropriate antimicrobials were being used for treatment or for prophylaxis. Questionnaires were distributed only to trainee doctors, and the sample size was small. It might have been more informative to distribute the questionnaires to other members of the multidisciplinary team to ascertain their opinion on the AMS round.

## 5. Conclusions

This study serves to highlight the benefit of multidisciplinary AST rounds, led by the neurosurgical team, in promoting antimicrobial stewardship, reducing AMU, and maintaining low rates of hospital-acquired *C.difficile* infections. These factors are all beneficial in reducing patient morbidity and duration of stay. We believe that the AST round also provided opportunities to deliver regular informal education on antimicrobial prescribing and infection prevention and control. However, this needs to be studied over a longer period and in other centers, to confirm its value. Finally, in order to further improve antimicrobial prescribing, surgical training schemes should include formal education on antimicrobial stewardship, and hospitals should provide targeted education sessions at trainee doctor changeover.

## Ethics

The data was collected anonymously and as part of optimal patient care. Hence, ethical permission was not deemed necessary.

## Funding

The conduct of this study was not supported by external or other funds but was conducted during ongoing clinical and academic activities.

## Declaration of competing interest

HH has been in receipt of research funding from Astella and Pfizer in recent years and has received a consultancy fee from Pfizer in the last three years. All other authors have no conflicts of interest to declare.

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