Evaluating the impact of clinical decision support systems for antimicrobial stewardship: ICNET

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Introduction

Antimicrobial stewardship (AMS) is a well recognised intervention in combating antimicrobial resistance (AMR), improving patient outcomes and reducing adverse drug reactions (ADR) including *C.difficile.*

Most U.K. hospitals have established AMS teams, compromising of specialist Infectious Disease/ Microbiology doctors and pharmacists. The focus of individual AMS teams is varied and often limited due time and staffing constraints. Identifying patients suitable for review can be time consuming with low reward, leading to AMS teams to focusing on high cost, broad spectrum, 'restricted' antimicrobials. This strategy has shown that opportunities to improve patient outcome, reduce broad spectrum exposure and *C.difficile* rates are often missed.[1]

Antimicrobial exposure has been directly linked to the development and spread of AMR both at individual and population levels[2-4]. In order to combat AMR, efficient, effective AMS is needed. Clinical decision support systems (CDSS) can aid efficiency and increase AMS interventions[5].

In 2016 CDSS was introduced at a single site London teaching hospital with an established, multi-professional AMS team. We analysed productivity and intervention data pre and post implementation of the ICNET pharmacy module.

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Methods

Data from 3 months post implementation of CDSS was retrospectively collated, and compared to the same 3 month periods in preceding years. The number of patients reviewed, total interventions, and types of intervention were adjusted for total daily defined doses (DDD) of intravenous antimicrobials.

Results

Productivity: In the 3 month study period the CDSS was used daily for a mean of 2hours 19min, to make a total of 2664 reviews and 298 interventions A review being when the AMS pharmacist uses the CDSS to ensure the prescription is appropriate and whether a formal ward round review or intervention is required. This is in comparison to preceding years where 138 and 169 interventions were made over the same 3 months in 2013 and 2014 respectively. The interventions were predominantly cessation of antimicrobials, however the trend in interventions changed post intervention. In 2013 49% of interventions were stopping medication and 30% change of therapy based on cultures and sensitivities compared to 25% and 17% respectively in 2016. In contrast to previous years' data, with the aid of the CDSS in 2016, a greater number of dose/drug optimisation (13%), escalation of antimicrobials (12%) and IV to oral switch (11%) interventions were made (figure 1.)

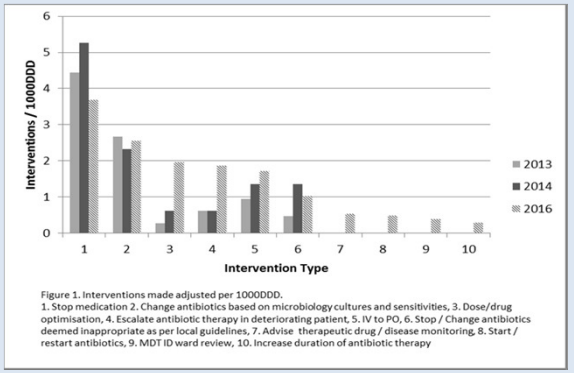

Figure 1. Interventions made adjusted per 1000DDD.
1. Stop medication 2. Change antibiotics based on microbiology cultures and sensitivities, 3. Dose/drug optimisation, 4. Escalate antibiotic therapy in deteriorating patient, 5. IV to PO, 6. Stop / Change antibiotics deemed inappropriate as per local guidelines, 7. Advise therapeutic drug / disease monitoring, 8. Start / restart antibiotics, 9. MDT ID ward review, 10. Increase duration of antibiotic therapy

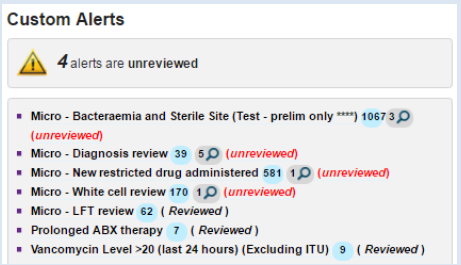

Figure 2a. CDSS triggers alerts set up by the user

Patient Identification: The CDSS enabled improved patient identification for review by the AMS team. Despite increased patient numbers, post-CDSS rollout, 46minutes on average was spent compiling a patient list for review, compared to 58minutes in 2015. The system enabled identification of patients through two mechanisms. First, automatically identifying those patients with positive microbiology from invasive sites and where there is microbiology-antimicrobial mismatch. Secondly, automatically identifying those receiving restricted antimicrobials or prolonged courses of non-restricted antimicrobials (figures 2a,b). The use of CDSS facilitated 15 interventions/1000DDD, an increase compared to pre-intervention baseline data (9.4/1000DDD in 2013; 11.5/1000DDD in 2014).

Organism	Specimen date	Specimen type	Ward	Follow up: Medication	Consultant	Admission	Discharge	Gentamicin	Augmentin	Cephalexin	Ciprofloxacin	Nitrofurantoin	Trimethoprim
Escherichia coli	26-Feb-2017 15:36	Mid stream urine	Accident And Emergency	CO-AMOXICLAV 500MG/125MG TABLET	A&E Consultant	26-Feb-2017 17:39		Susceptible	Resistant	Susceptible	Susceptible	Susceptible	Resistant

Figure 2b. CDSS compares 'bugs' with 'drugs' and identifies and flags any microbiology-antimicrobial mismatches

Mobile information: Real time information of all antimicrobials, blood tests and microbiology is available on a tablet or laptop. This has enabled the AMS team transition from a office based service to a patient facing, ward based service providing infection related clinical reviews.
AMS team notes can be written and stored on the CDSS to prompt future monitoring and interventions, streamlining workflow and handover between AMS team members. (figure 3).

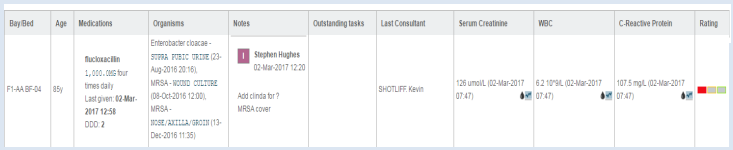

Figure 3. Patient profile preview . A quick view of antimicrobial, microbiology current bloods and notes. A more extensive view is available when the patient profile is opened.

Real time data capture: Continuous input on the activity of the AMS team and the impact on patient care was automated through the CDSS. This has allowed for continual audit of AMS practice and the instant feedback of prescriptions allows off guideline prescribing to be tackled early. This in turn has facilitated work to meet national remunerated targets on optimising antimicrobial use.

Discussion

The study hospital has had an established AMS team for a number of years. With no change in team size the implementation of CDSS has resulted in increased activity, efficiency and effectiveness. CDSS has resulted in a shift of focus on AMS ward rounds. Historically patients were identified by dispensing records of 'restricted' antimicrobials which was both time consuming and channelled towards a policing and restrictive AMS role. This can lead to an attritional relationship between the AMS and responsible clinical team. CDSS has widened AMS reviews to include long antimicrobial courses and revised AMS to be patient focused as opposed to drug focussed.

There are fiscal implications associated with efficient AMS working practice. In the UK, recently set national quality and innovation targets have high financial rewards for reductions in antimicrobial use. Separate to this, at a local level AMR and inappropriate antimicrobial prescribing can worsen patient outcome. Specifically, associated increased length of stay, readmissions and mortality all have financial implications for healthcare providers.

Since implementation of CDSS, interventions more frequently focus on escalating antimicrobials, providing patients reviews and even increasing course lengths. Separate workstreams are currently evaluating the long term impact of these interventions, including on patient outcomes, length of stay, treatment failure and mortality, and the financial implications of CDSS adoption

Conclusions

Initial evaluation of the impact of CDSS on AMS at the study hospital as shown increased efficacy and efficiency within the AMS team. The use of CDSS has been effective in terms of case finding, AMS team productivity, and workflow auditing. More importantly, patient infection management has been optimised. It has contributed to the success of the study hospital achieving nationally set remunerated targets. Whilst confounding issues make analysis on length of stay, morbidity and mortality complex, future multicentre prospective work, in progress, will elucidate this area.

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