An Audit of Perioperative Surgical Antibiotic Prophylaxis Administration in Patients Undergoing General Surgery at a Tertiary Hospital

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Introduction
The primary role of surgical antibiotic prophylaxis (SAP) is to reduce the risk of postoperative surgical site infections (SSI). SAP has been demonstrated to reduce the risk of SSI (1, 2, 3), as well as post-operative pneumonia and urinary tract infections (3). SSI’s are important preventable complications of surgery, associated with significantly increased morbidity and mortality, and greatly increased health care cost and resource utilization (2, 4, 5, 6, 7). SAP accounts for one-third to one-half of all antibiotics used (3), and is the most common indication for antimicrobial prescribing in Australia (9). Furthermore, SAP is associated with many complications including: 1) Adverse gastrointestinal side effects (including diarrhoea, nausea and vomiting), 2) Clostridium difficile infection, 3) Organ dysfunction and failure (for example, renal injury with gentamicin), 4) Hypersensitivity reactions (including anaphylaxis), and 5) The development of antimicrobial resistance (8).

It is vital, therefore, to ensure a high level of compliance with SAP guidelines to not only minimise the risk of SSI, but to concurrently minimise patient exposure to the complications of SAP and the costs associated with SAP to the health care system.

Objectives
The primary objective of this audit is to measure the compliance with perioperative SAP against the Therapeutic Guidelines: Antibiotic (3) within the general surgical population at RBWH. We have three secondary objectives for our audit. Firstly, we aimed to determine the underlying reasons for noncompliance. Secondly, we aimed to analyse the specific antibiotics used with regard to type, dose and timing. This information should allow us to identify specific trends in reasons for noncompliance. Secondly, we aimed to analyse the specific antibiotics used with regard to type, dose and timing. This information should allow us to identify specific trends in reasons for noncompliance. We especially recommend focusing this secondary objective on the specific antibiotics used with regard to type, dose and timing. This information should allow us to identify specific trends in reasons for noncompliance.

Methods and Materials
The Operating Room Management Information System (ORMIS) database at RBWH was used to identify all surgical procedures performed at the RBWH over a two week period between 1 February 2017 to 14 February 2017. From this list of surgical procedures, all general surgery cases were sequentially identified in this period, and included in this audit. Once the general surgery cases were identified, RBWH patient record-keeping databases including Automated Anaesthetic Record Keeping (AARK), integrated electronic Medical Record (iMAR), and The Viewer were reviewed to obtain the details of the antibiotic(s) administered in a predefined antimicrobial spectrum (e.g., intraperitoneal, the number, type, dose, timing, and route of administration of antimicrobial agents). Other demographic data was collected including: 1) Surgical procedure type, 2) Duration of surgery, and 3) Whether surgery was elective or emergency. Patient medical records were also examined for evidence SSIs, urinary tract infection, pneumonia and bacteremia to determine postoperative infection rates, involving an expanded search of the Auslab pathology results database. Antimicrobial information was kept in a de-identified password-protected spreadsheet file using Microsoft Excel 2010. For all cases, the initial dose of intraoperative antibiotic administration data was compared to the Therapeutic Guidelines: Antibiotic (3). If SAP complied fully with all aspects of administration (including correct indication, number, type, dose and timing) it was considered to meet guidelines. If the guidelines stated that no antibiotics should be given for a surgical procedure and this occurred, these cases were also deemed to have met guidelines. Redosing of intraoperative SAP in long duration cases was evaluated separately.

Reasons for not complying with guidelines were identified and collated and found to be distributed into ten categories. These are outlined in Table 1 - Categories of reasons for not meeting guidelines for the initial dose of intraoperative surgical antibiotic prophylaxis in this audit.

Approval to conduct this audit as a quality assurance activity was obtained from the RBWH Human Research Ethics Committee (HREC) (Reference Number: REC/17/RBWH/469).

Results
A total of 975 surgical procedures were performed at RBWH over the two week audit period. Of these, 135 general surgical cases were identified and included in the analysis. The most common types of surgery performed were laparoscopic abdominal surgery (40.7%), urologic surgery (34.1%), and skin surgery (22.2%). The administration of the initial dose of antibiotic met guidelines in 45.2% of cases, and SAP was appropriate in 62.2% of cases. Therapeutic Guidelines: Antibiotic (3) states that the initial dose of SAP should be timed relative to surgical incision, and that SAP should be given zero to 60 minutes before skin incision. In this audit, the median time of SAP administration before skin incision was 7.5 minutes (IQR = 1 to 15 minutes; minimum = 69 minutes before skin incision; maximum = 40 minutes after skin incision).

There were a low number of long duration surgical cases that required SAP redosing in this audit. Most of the long cases captured in this audit had appropriate redosing of antibiotics (71.4%). Within the data set, there were a total of 134 doses of antibiotics given over the 135 surgical procedures. In 23 cases (17.0% of all surgical procedures) no antibiotics were given. This was compliant with SAP guidelines in 13 of these 23 cases (50.0%).

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Discussion
In our audit, there was poor compliance with intraoperative SAP guidelines (62.2%). Our SAP compliance rates are comparable to the overall national rates determined in the Australian National Surgical Antimicrobial Prescribing Survey (SNAPS) from 2016 (7). In this audit intraoperative SAP was administered appropriately at a rate of 67.4% of surgical procedures across all surgical specialties, and at a rate of 55.4% for abdominal surgery.

Reasons for Noncompliance
The most common reason for noncompliance with SAP guidelines in our audit was a failure to administer SAP in the recommended time frame. This is reflective of similar standards in other Australian studies (6, 7, 8). In the SNAPS study 45.7% of inappropriate antibiotic doses were administered outside of the recommended window, compared to our audit where 36.0% of cases of inappropriate SAP were administered outside of the recommended time frame. This corresponds to 13.3% of all surgical cases in our cohort. The majority of reasons for noncompliance with guidelines in our cohort result in suboptimal SAP via inappropriate timing, too long an interval between prophylactic dose and surgery, or too early in the recommended window of administration, putting patients at an increased risk of SSI from suboptimal SAP. Conversely only 16.0% of cases of inappropriate SAP (6.0% of all cases) resulted in too broad an antimicrobial spectrum, which provides adequate SSI protection, but potentially exposes to an increased risk of antibiotic complications, in particular gastrointestinal side effects, Clostridium difficile infection and the development of antimicrobial resistance.

Type of Antibiotic
In the majority of cases the correct antibiotics were administered for each surgical procedure. Most commonly cephazolin was the antibiotic administered, and when administered there was a high compliance rate with guidelines (98.7%) (9). Most commonly cephazolin was the antibiotic administered, and when administered there was a high compliance rate with guidelines. The surgical cases can be classified into classes: a) infections in which the guidelines state that cephalosporin should be given immediately, b) infections in which the guidelines state that cephalosporin should be given within 1 hour, and c) infections in which the guidelines state that cephalosporin should be given on an individual basis. The surgical cases can be classified into classes: a) infections in which the guidelines state that cephalosporin should be given immediately, b) infections in which the guidelines state that cephalosporin should be given within 1 hour, and c) infections in which the guidelines state that cephalosporin should be given on an individual basis. There is the potential for improvement in our compliance with SAP guidelines.

Conclusions
Our audit demonstrates that we have poor overall compliance rates with SAP guidelines during general surgery procedures at RBWH. Our compliance rates are in line with other audits and studies performed in Australia, and better than previously reported rates at RBWH. The most common reasons for noncompliance with SAP guidelines were inappropriate timing and omission of antibiotics. In a majority of cases there appeared to be valid reasons for noncompliance with guidelines. There is the potential for improvement in our SAP compliance, and therefore potential to improve our SSI risk.

References
1. Therapeutic Guidelines Limited; March 2018 edition
3. Human Research Ethics Committee (HREC) (Reference Number: REC/17/ RBWH/469).
4. The evidence and understanding of the importance of compliance
5. It is vital, therefore, to ensure a high level of compliance with SAP guidelines to not only minimise the risk of SSI, but to concurrently minimise patient exposure to the complications of SAP and the costs associated with SAP to the health care system.
6. The primary objective of this audit is to measure the compliance with perioperative SAP against the Therapeutic Guidelines: Antibiotic (3) within the general surgical population at RBWH.
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