

Reducing Unnecessary Antibiotic Use in Elective Caesarean Sections: A Resident-Led Clinical Quality Improvement Project

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ABSTRACT

Introduction: Current guidelines advocate that single use of prophylactic antibiotics given at least 15 minutes before skin incision is as effective as a 5 day course of therapy after an uncomplicated caesarean section. However, the traditional practice of the hospital used intravenous (IV) antibiotics pre-operatively followed by 24 hour IV course, and oral antibiotics for 1 week subsequently. Preliminary survey also revealed that the first dose of antibiotics is not necessarily given at least 15 minutes before knife to skin.

Aim: This was a resident-led clinical quality improvement project which aims to promote single use of IV antibiotics for elective subsidized uncomplicated caesarean section cases, to be given at least 15 minutes before knife to skin, so as to eliminate unnecessary and variation in antibiotic use.

Methods: Five Plan-Do-Study-Act (PDSA) cycles were carried out between 23 April to 23 August 2013 to achieve our aim, and this was done mainly through education of our clinical staff of current evidence regarding antibiotic use for uncomplicated caesarean section cases.

Results: A total of 102 cases were included in our study over the given time frame of 18 weeks. The compliance to single dosing of antibiotics increased from 0% to 100% by the 10th week, with no reported surgical site infections in uncomplicated elective subsidized caesarean sections despite the elimination of post-operative antibiotics.

Conclusion: There was a reduction in usage of unnecessary antibiotics. The benefits of extension of this move to non-subsidized and/or uncomplicated emergency caesarean section will be multifold.

Keywords: Prophylactic antibiotics, single dose, elective, caesarean section, pre-operative

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INTRODUCTION

Starting in 2010, the residency program in obstetrics and gynaecology at SingHealth Singapore began a transition from an educational based model largely based on British training principles, to a new training model in accordance with the Accreditation Council for Graduate Medical Education-International (ACGME-I) standards¹. This new program aims to adequately prepare the next generation of obstetrician-gynaecologists to become competent and confident specialists with interest in lifelong learning, leadership skills, and the ability to adapt to the needs of their healthcare system. Resident-led quality improvement projects pave a way for residents to be actively involved to change clinical practice for the better, with a team sponsor to guide and overcome obstacles along the way.

In February 2013, our team of 5 residents identified the routine use of post-operative antibiotics in caesarean section operations to be excessive. Caesarean section is one of the commonest operations conducted at KK Women's and Children's Hospital (KKH), the largest maternity hospital in Singapore. It has been traditional practice for post-operative antibiotics use to prevent surgical site wound infection. Our current regime includes a single dose of IV cephalosporin (usually 1 gram of cefazolin), followed by a 24 hour IV dosing, which is changed to oral antibiotics for a week's duration thereafter. There is no specification of timing of prophylactic antibiotic prior to skin incision.

International guidelines support the use of prophylactic antibiotics before skin incision to reduce risk of maternal infection^{2,3,4}. The Society of Obstetrics and Gynaecology Canada (SOGC) further suggests that the timing of administration of prophylactic antibiotics should be 15-60 minutes prior to skin incision, and no additional doses are required⁵.

In view of the above guidelines, our team aims to reduce the use of unnecessary post-operative antibiotic in elective subsidized caesarean sections, and to optimize the timing of administration within 15-60 minutes prior to skin incision. The team sought support from the Division Chair, Professor Tan Kok Hian, as our sponsor.

METHODS

The PDSA model is a four step tool for developing, testing and implementing changes leading to improvement⁶ as shown in Figure 1. A plan is developed to test the change (Plan), and a test is carried out (Do). The data following implementing the test is analyzed (Study). Changes are then planned and implemented for the next cycle of change (Act).

The PDSA principle is applied to our clinical quality improvement project. The first PDSA cycle aimed to review the current situation without intervention. A random sample of 20 patients was reviewed in terms of use of post-operative antibiotics and timing of prophylactic antibiotics given prior to skin incision. Our current system work flow was also analyzed to identify areas of intervention.

We carried out a further 4 PDSA cycles with aims to promote our desired change. All subsidized uncomplicated elective caesarean section cases were included. Complex cases e.g. with bowel injury, prolonged surgery, increased body mass index were excluded. Our main intervention was via education to change the mindset of our clinical staff, including the obstetricians, house officers, anesthesiologists and nurses. A huge poster was placed in the elective caesarean section operating theatre to raise awareness. Education sessions were organized in conjunction with our infection control unit reaching out to our obstetric and anaesthesia teams, ward sisters and operating theatre staff to highlight on the current international recommendations for single dosing of pre-operative antibiotics at least 15 minutes before knife to skin for caesarean section cases to eliminate use of unnecessary antibiotics for these cases. The surgical site infection rates were reviewed to ensure no increase in post-operative infection cases. Cost analysis was also analyzed to demonstrate economic benefits.

WORKFLOW

Old workflow

The elective caesarean section patients reported to Same Day Admission (SDA) an hour prior to their scheduled operation time. They were assessed by

the junior doctor for fitness for operation, and were brought to the operating theatre induction room after changing to their operating gown. They were brought inside the operating theatre subsequently, and an IV plug was set prior to administration of spinal anaesthesia. Prophylactic antibiotics were then given prior to skin incision. Patients were transferred to postnatal wards after the operation, and post-operative antibiotics were ordered from there. This is shown in Figure 2.

New workflow

Changes implemented in the workflow include administration of prophylactic antibiotics prior to spinal anaesthesia in the operating theatre, no post-operative orders for antibiotics, as well as ensuring patients are not given post-operative antibiotics in the wards unless indicated. This is shown in Figure 3.

RESULTS

The first PDSA cycle revealed that all patients were routinely given post-operative antibiotics, and only 22.7% of cases had prophylactic antibiotics administered at least 15 minutes prior to skin incision.

Over a period of 18 weeks, 4 PDSA cycles were implemented in relation to the new workflow as shown in Figure 3. A total of 102 cases were included in our study over the given time frame. The results are summarized by week in Table 1.

Comparing 3 time points before the start of the study, midway through the study and at the end of the study as shown in Table 2, there is a statistical improvement in outcomes following our PDSA cycles. Fisher's exact test was used to compare proportions between 2 groups, and $p < 0.05$ was considered statistically significant.

Single dose prophylactic antibiotic regime

With persistence in education, we achieved 100% compliance to single dose prophylactic antibiotics by week 8, and this was sustained consistently for most of the subsequent weeks of analysis as shown in Figure 4. There appears to be a sharp drop in compliance at week 15. There were only two elective subsidized cases at week 15, and only one case was given post-

operative antibiotics by a new colleague, who may be unfamiliar with our protocol. Comparing results in our preliminary survey and at the end of our study, there was a statistical improvement in elimination of post-operative antibiotics ($p < 0.001$).

Prophylactic antibiotic administration at least 15 minutes prior to skin incision

Adherence to prophylactic antibiotic administration at least 15 minutes prior to skin incision was not optimal, with a median of 52.0% compliance. There was a sharp drop in compliance in week 10 of our study as shown in Figure 5. Sub-analysis of our data revealed a changeover of doctors into the department at that period, who might not be aware of the protocol in place to account for the lack of compliance. Of the 49 cases where antibiotics were not given appropriately, the mean time of administration was 8.8 minutes prior to skin incision. Comparing results in our preliminary survey and at the end of our study, there was a statistical improvement in appropriate timing of administration of antibiotics ($p = 0.03$).

Antibiotic side effects and compliance to dosage

Of the patients who were given post-operative antibiotics during our study period, a follow-up telephone survey showed that up to 16.0% of them reported adverse side effects like rash, diarrhea and nausea. In addition, 24.0% missed antibiotic dosing and did not adhere to the appropriate timing and dosage.

Cost benefits

The average number of subsidized caesarean sections at our hospital is 1,300 per year. Estimated cost savings from elimination of unnecessary antibiotic use post caesarean section cases amount to nearly SGD 10,000 per year.

DISCUSSION

The benefits of elimination of unnecessary use of antibiotics transcend that of adhering to current international guidelines. Antimicrobial resistance tends to be progressive and cumulative⁷. Unnecessary use may exacerbate the current problem, and awareness is important to minimize unnecessary use. Antibiotic resistance may be reduced with multi-

pronged efforts, but resistance levels rarely return to the earlier baseline⁸. This calls for prudent use of existing antibiotics.

With rising healthcare expenditure in our local setting, it plays economic sense to eliminate unnecessary use of antibiotics, considering the increasing awareness of the direct and indirect costs of antimicrobial resistance. Achieving meaningful reduction in unnecessary antibiotic use without compromising clinical care and outcome is crucial, and is effected optimally through our quality improvement project.

Optimizing timing of antibiotic administration to at least 15 minutes before skin incision is important, but results have shown that it is difficult to achieve despite multiple reminders to our anaesthetic colleagues. Workflow analysis revealed obstacles

to achieving this target. These include lack of appropriate manpower (anaesthetists) to administer antibiotics prior to spinal anesthesia, pressure to avoid unnecessary delays in operating time for cost effectiveness, as well as stellar competency of our anaesthetic colleagues, completing spinal in a matter of minutes.

Continuation of our efforts is important following the completion of our improvement project. This is possible through education to raise awareness of current international recommendations, as well as subtle changes in workflow. Cyclical audits to evaluate appropriate use of post-operative antibiotics and timing of pre-operative antibiotic administration are useful. The benefits of possible extension of this move to private and/or uncomplicated emergency caesarean section will be multifold.

Figure 1 . Pictorial representation of a PDSA cycle

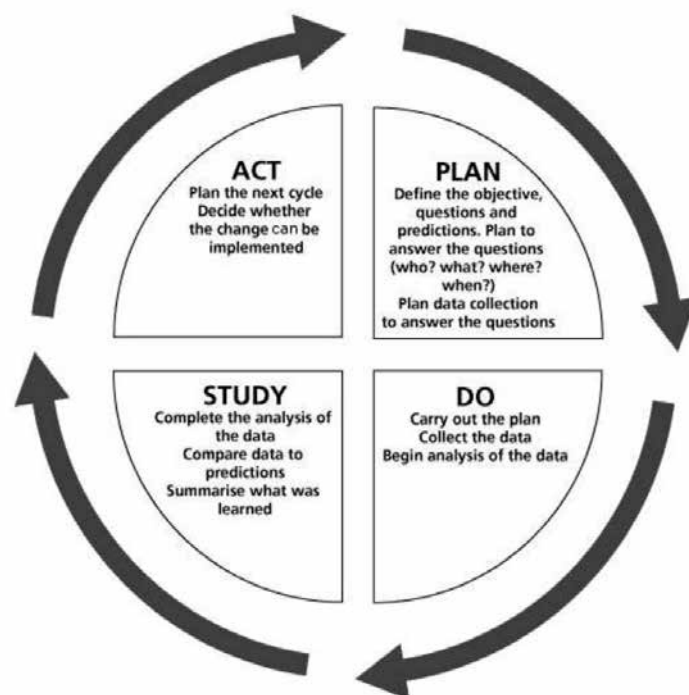


Figure 2. Old workflow

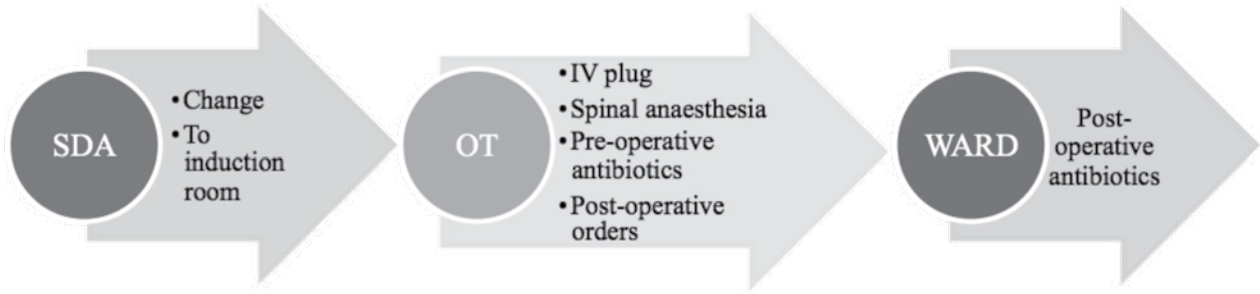


Figure 3. New workflow

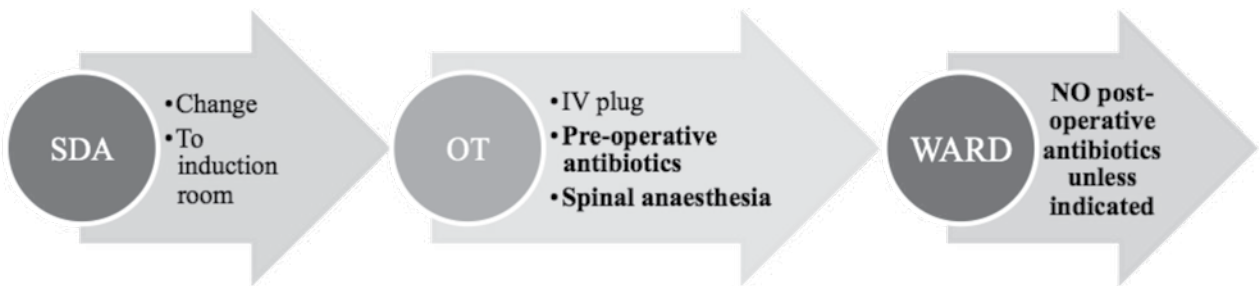


Figure 4. Run chart for compliance to single dose prophylactic antibiotic regime (no post-operative antibiotics)

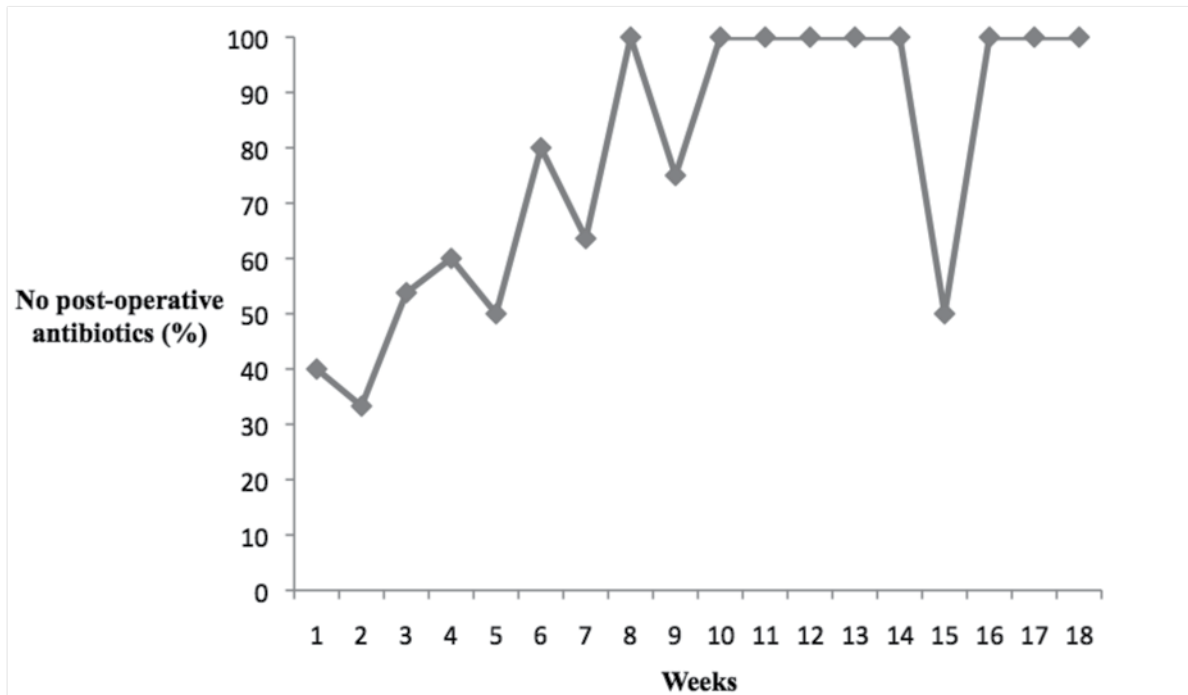


Figure 5. Run chart for compliance to correct timing of antibiotic administration at least 15 minutes prior to skin incision

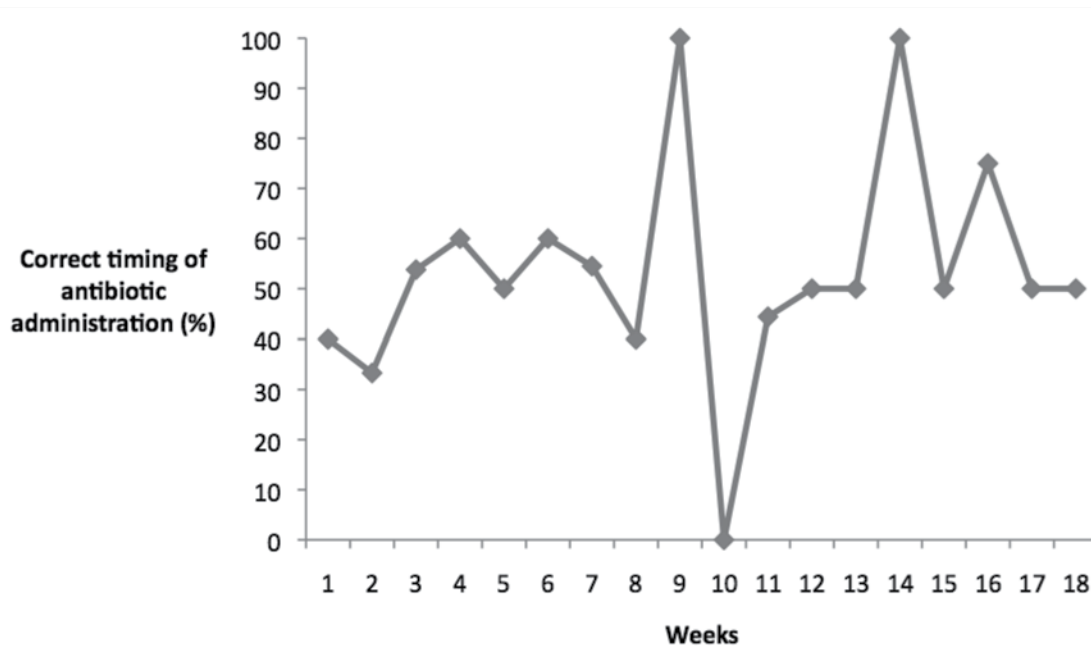


Table 1. Summary of results over 18 weeks

| Weeks | No. of subsidized elective caesarean sections, n | No post-operative antibiotics given, n (%) | Correct timing of antibiotics given 15-60 minutes prior to skin incision, n (%) |
|--------------|---|---|--|
| 1 | 5 | 2 (40.0%) | 2 (40.0%) |
| 2 | 6 | 2 (33.3%) | 2 (33.3%) |
| 3 | 13 | 7 (53.8%) | 7 (53.8%) |
| 4 | 5 | 3 (60.0%) | 3 (60.0%) |
| 5 | 2 | 1 (50.0%) | 1 (50.0%) |
| 6 | 5 | 4 (80.0%) | 3 (60.0%) |
| 7 | 11 | 7 (63.6%) | 6 (54.5%) |
| 8 | 5 | 5 (100%) | 2 (40.0%) |
| 9 | 4 | 3 (75.0%) | 4 (100%) |
| 10 | 3 | 3 (100%) | 0 (0%) |
| 11 | 9 | 9 (100%) | 4 (44.4%) |
| 12 | 4 | 4 (100%) | 2 (50.0%) |
| 13 | 6 | 6 (100%) | 3 (50.0%) |
| 14 | 2 | 2 (100%) | 2 (100%) |
| 15 | 2 | 1 (50.0%) | 1 (50.0%) |
| 16 | 4 | 4 (100%) | 3 (75.0%) |
| 17 | 8 | 8 (100%) | 4 (50.0%) |
| 18 | 8 | 8 (100%) | 4 (50.0%) |
| Total | 102 | 79 (77.5%) | 53 (52.0%) |

Table 2. Summary of results at 3 time points: before start of study, midway through the study and end of study

| Weeks | No. of subsidized elective caesarean sections, n | No post-operative antibiotics given, n (%) | Correct timing of antibiotics given 15-60 minutes prior to skin incision, n (%) |
|---------------------------|---|---|--|
| Preliminary survey | 22 | 0 (0%) | 5 (22.7%) |
| Weeks 1-10 | 59 | 37 (62.7%) | 30 (50.8%) |
| Weeks 11-18 | 43 | 42 (97.7%) | 23 (53.5%) |

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