



Original Article

Quality Improvement of Antimicrobial Prophylaxis for Abdominal Hysterectomy in a Medical Center in Eastern Taiwan

Meng-Si Wu¹, Tzong-Bor Sun^{1,5*}, Ming-Hwang Shyr^{2,5}, Yu-Chi Wei^{3,5},
Tsung-Ying Chen^{2,5}, Tang-Yuan Chu^{3,5}, Yu-Huai Ho^{4,5}, Lih-Shinn Wang^{4,5}

¹Division of Plastic Surgery, Department of Surgery, Buddhist Tzu Chi General Hospital, Hualien, Taiwan

²Department of Anesthesiology, Buddhist Tzu Chi General Hospital, Hualien, Taiwan

³Department of Gynecology, Buddhist Tzu Chi General Hospital, Hualien, Taiwan

⁴Department of Infectious Disease, Buddhist Tzu Chi General Hospital, Hualien, Taiwan

⁵Department of Medicine, Tzu Chi University, Hualien, Taiwan

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Abstract

Objective: To prevent surgical site infections, we conducted the Breakthrough Quality Improvement Project to optimize antimicrobial prophylaxis for abdominal hysterectomy. The specific aims were to increase the proportion of patients who receive prophylactic antimicrobial therapy within 1 hour prior to incision and increase the proportion of patients whose prophylactic antimicrobial therapy is discontinued within 24 hours after the end time of surgery.

Materials and Methods: The Breakthrough model was introduced by the Taiwan Joint Commission on Hospital Accreditation. It consisted of experts' meetings, learning sections and action periods with Plan-Do-Study-Act cycles. The control group included 43 patients undergoing abdominal hysterectomy and 29 patients were enrolled as the experimental group. Timing and duration of antimicrobial prophylaxis, incidence of surgical site infection, and hospital and antibiotic costs were recorded.

Results: The patients who followed the recommendations had no surgical site infections within 30 days after the end of surgery. Prophylaxis administration within 1 hour prior to incision was significantly increased from 69.3% to 92.4%. Prophylaxis duration of less than 24 hours was significantly increased from 25% to 100%. The length of hospital stay, hospital costs and antibiotic costs were all reduced.

Conclusion: We successfully introduced the Breakthrough Project to improve the quality of medical care through antimicrobial prophylaxis. By applying this important management model, we were able to optimize the timing and duration of antimicrobial prophylaxis in patients undergoing abdominal hysterectomy. Our experience demonstrates that this is one of the choices for effectively dealing with quality of medical care issues. (*Tzu Chi Med J* 2008;20(2):112–118)

*Corresponding author. Division of Plastic Surgery, Department of Surgery, Buddhist Tzu Chi General Hospital, 707, Section 3, Chung-Yang Road, Hualien, Taiwan.
E-mail address: jtbsun@mail.tcu.edu.tw

1. Introduction

Surgical site infection accounts for a considerable proportion of all nosocomial infections. Apart from causing major morbidity and mortality, surgical infections increase hospital stays and therefore contribute to the cost of hospitalization (1–3). In addition to improvements in operating room ventilation, sterilization methods, and barriers and surgical technique, antimicrobial prophylaxis is an important factor in reducing infections. Increasing numbers of elderly surgical patients who have underlying chronic, debilitating or immunocompromising diseases, and the emergence of antimicrobial-resistant pathogens, have meant that effective antimicrobial prophylaxis cannot be overemphasized (4,5).

Many reports in the literature support the use of antibiotic prophylaxis for various surgical procedures (6–19). Timing and duration of antibiotic prophylaxis are important determinants for the effectiveness of the prophylaxis (20–23). The National Surgical Infection Prevention Project of the United States published antimicrobial prophylaxis for surgery guidelines in 2005 (24), which demonstrated that infusion of the first antimicrobial dose should begin within 60 minutes prior to surgical incision and that prophylactic antimicrobial agents should be discontinued within 24 hours of the end of surgery. These consensus were also included in the official documents of hospital accreditation and reimbursement in Taiwan. However, failure to follow the recommended guidelines of surgical antibiotic prophylaxis in daily clinical practice is not uncommon: either the wrong initiation time or prolonged antimicrobial duration because of physicians' lack of knowledge or confidence can occur. Therefore, we joined the Breakthrough Quality Improvement Project of the Taiwan Joint Commission on Hospital Accreditation (TJCHA) in 2006 to improve the antimicrobial prophylaxis of abdominal hysterectomies. The specific aims were: (1) to increase the proportion of patients having antimicrobial prophylaxis initiated within 1 hour prior to incision; (2) to increase the proportion of patients whose antimicrobial prophylaxis is discontinued within 24 hours after the end of surgery; (3) to evaluate the change in hospital stay costs and antimicrobial usage costs after application of the Breakthrough model.

2. Materials and methods

2.1. Duration, setting and population

We collected 15 months of data on associated measures from the data bank of the International Quality Indicator Project (IQIP) in the gynecological ward of a 1000-bed tertiary-care hospital in eastern Taiwan. There were 22 beds and four gynecological surgeons.

The trends of each measurement before, during and after the 3-month Breakthrough Improvement Project were analyzed (Fig. 1). A total of 72 patients were enrolled. The baseline control group consisted of 43 patients undergoing abdominal hysterectomy before the initiation of the Breakthrough Project. The experimental group consisted of 29 patients enrolled prospectively after the Breakthrough Project had begun. All patients were cared for according to the *Institutional Declaration of Patients Rights and Obligations*, which was modified from the principles of the Declaration of Helsinki on the treatment of human subjects. By clinical judgment, patients needing therapeutic antibiotics before surgery were excluded.

2.2. Breakthrough model

The Breakthrough Quality Improvement Project was conducted from September to November 2006. This model was developed by the Institute for Health Improvement (IHI) in Massachusetts and consists of two parts. The first part includes three fundamental questions: (1) what are we trying to accomplish? (setting aims); (2) how will we know that a change is an improvement? (establishing measures); (3) what changes can we make that will result in improvement? (selecting changes). The second part is the Plan-Do-Study-Act (PDSA) cycles to test and implement changes in a real work setting. Three 1- to 2-day learning sections interspersed with

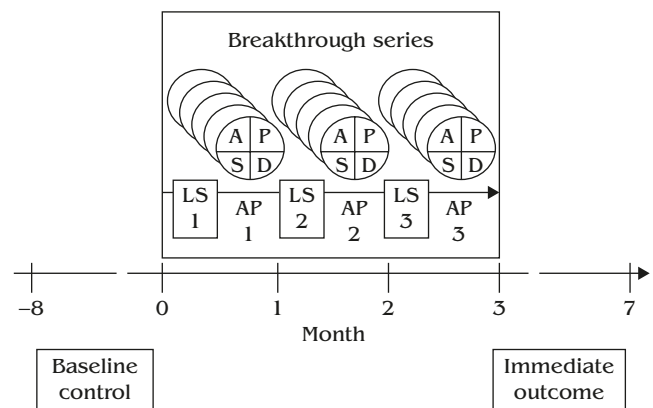


Fig. 1 — Scheme demonstrates the time frame of the Breakthrough Quality Improvement Project on antimicrobial prophylaxis for abdominal hysterectomy. The experimental design consisted of an 8-month baseline control period, a 3-month Breakthrough Project period and a 4-month follow-up. The Breakthrough Project included 3 learning sections and 3 action periods. Many Plan-Do-Study-Action cycles were developed during the action periods to solve specific problems and work out processes that were considered in the learning sections. P=plan; D=do; S=study; A=action; LS=learning section; AP=action period.

three 3- to 4-week action periods made up the main time frame of the Breakthrough series (Fig. 1). A nationwide experts' meeting was held before the first learning section to establish a collaborative charter and change package.

2.3. Recommended antimicrobial prophylaxis [24]

It was recommended that cefazolin 1g, intravenous infusion 3–5 minutes, for patients with body weight <80 kg (2g if body weight >80 kg) 30–40 minutes prior to incision be used. The same dose of cefazolin was administered every 3 hours before surgical wound closure. The antibiotic was discontinued before 24 hours after the initial dose and no oral antibiotic was prescribed. For patients allergic to β -lactam, clindamycin or vancomycin was considered. However, the infusion time needs to be 10–60 minutes for clindamycin and >60 minutes for vancomycin.

2.4. Measurements

The following measurements were recorded. Some of them are indicators of the Taiwan Quality Indicator Project (TQIP) (25). Measurements are reported per 100 of the denominator.

2.4.1. TQIP measures

- 2b.7b antibiotic prophylaxis for abdominal hysterectomy within 1 hour prior to incision. Denominator is the number of abdominal hysterectomy patients receiving antibiotic prophylaxis. Numerator is the number of abdominal hysterectomy patients receiving antibiotic prophylaxis within 1 hour of incision.
- 2b.7d antibiotic prophylaxis for abdominal hysterectomy with a duration of <24 hours. Denominator is the number of abdominal hysterectomy patients receiving antibiotic prophylaxis. Numerator is the number of abdominal hysterectomy patients receiving antibiotic prophylaxis for a duration of <24 hours.
- 2a.11 surgical site infections for abdominal hysterectomy patients before discharge.

2.4.2. Non-TQIP measures

- Surgical site infections of abdominal hysterectomy patients within 1 month after surgery.
- Total inpatient hospital costs for abdominal hysterectomy patients.

- Cost of antibiotics for abdominal hysterectomy patients.

2.5. Statistical analysis

Data are expressed as values per 100 of the denominator or mean \pm standard error (mean \pm SE). Student's *t* test or Mann-Whitney rank sum test were used to analyze differential effects. A probability value of $p < 0.05$ was considered to be indicative of a statistically significant difference.

3. Results

3.1. Prophylactic antibiotics for abdominal hysterectomy patients

The trends of timing and duration of prophylactic antibiotics for abdominal hysterectomy patients are demonstrated in Fig. 2. The incidence of patients with antibiotic duration <24 hours reached 100% 2 months before the Breakthrough Project. The timing of prophylactic antibiotic administration was generally limited to 30–60 minutes before incision after the Breakthrough Project. The incidence of cefazolin infusion initiated within 1 hour prior to incision was significantly elevated from $69.3 \pm 8.73\%$ to $92.4 \pm 5.13\%$ after the Break-through intervention (Fig. 3A).

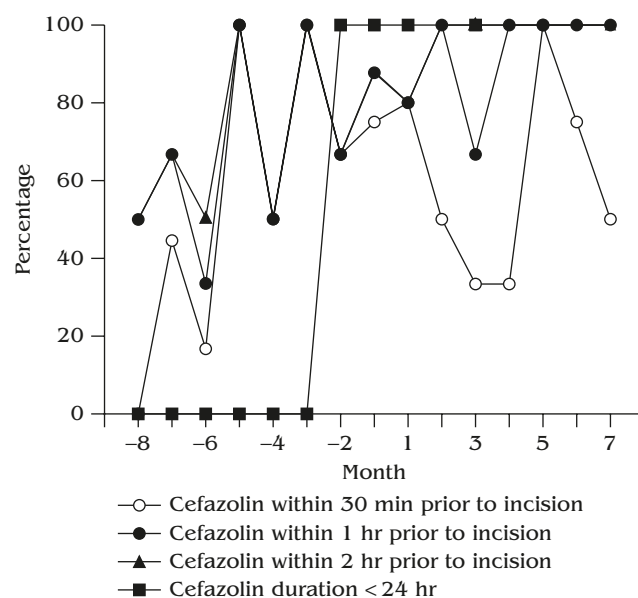


Fig. 2 — Trends analysis of antimicrobial prophylaxis for abdominal hysterectomy shows that the duration of cefazolin usage that was <24 hours is 100% and the antimicrobial infusion was given 30–60 minutes prior to incision more frequently after the Breakthrough Project.

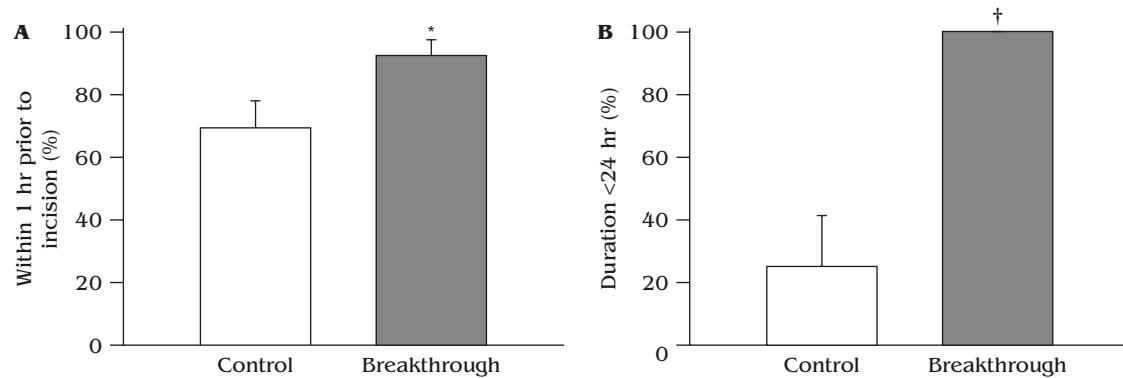


Fig. 3 — The Breakthrough Project for abdominal hysterectomy patients significantly increased: (A) the incidence of prophylactic antibiotics initiated within 1 hour prior to incision; (B) the incidence of prophylactic antibiotics for a duration of <24 hours. Control group, $n=43$; Breakthrough group, $n=29$. * $p<0.05$, Student's t test; † $p<0.05$, Mann-Whitney rank sum test.

The incidence of prophylactic duration was also significantly increased from $25.0 \pm 16.37\%$ to $100.0 \pm 0.00\%$ (Fig. 3B). Both incidences showed that our hospital was approaching and exceeding the incidences of hospitals that joined the IQIP in Taiwan and worldwide after the Breakthrough Project (Figs. 4 and 5).

3.2. Surgical site infection

One patient in the baseline control group developed a surgical site infection during her hospital stay. She had a National Nosocomial Infection Surveillance System (NNIS) Risk Index of 2 (26). The infection subsided after surgical drainage and the wound healed by secondary intention. No patient in the Breakthrough group developed surgical site infection during the inpatient period. The inpatient infection rates for each group were 2.32% and 0.00%, respectively. However, a 52-year-old woman in the Breakthrough group with a body weight of 52 kg and a NNIS Risk Index of 0, was found to have an infected hematoma in the pelvis 2 weeks after discharge. Tracing back to her perioperative medical records, she had 1 g cefazolin infusion initiated 85 minutes after incision. The overall surgical time was 120 minutes. No postoperative antibiotic was given. She was discharged on the third day after hysterectomy.

3.3. Hospital stay and costs

A trend of reduced hospitalized duration from 7.16 ± 0.72 to 5.86 ± 0.20 days was observed (Fig. 6A). The hospital and antimicrobial costs were normalized by means of the baseline control group. It was found that the normalized hospital costs were reduced to $81.4 \pm 3.32\%$ and the normalized antibiotic costs to $10.9 \pm 0.36\%$ (Figs. 6B and 6C).

4. Discussion

The Breakthrough Project on surgical antimicrobial prophylaxis effectively reduced hospital stay, hospital costs and antimicrobial costs for patients undergoing abdominal hysterectomy. Major concerns on antibiotic selection, dosage, timing, re-dosing and duration were all improved in clinical practice. A clinical path of a single preoperative dose of cefazolin without any postoperative antibiotics produced 100% antibiotic prophylaxis for less than 24 hours before the study. However, the timing of giving cefazolin 30–60 minutes before incision was not followed until the initiation of the Breakthrough Project. The timings for antibiotic prophylaxis administration are not mutually exclusive: those cases treated within the first 30 minutes should also be included in the 1 hour and 2 hour results. The ideal situation is the trend of cefazolin within 30 minutes prior to incision (Fig. 2) approaching 0% and that of 1 hour approaching 100%. Both indicators of prophylactic timing (92.4% within 1 hour) (Fig. 3A) and prophylactic duration (100% <24 hours) (Fig. 3B) are above the average level of the world IQIP hospitals after the Breakthrough Project (Figs. 4 and 5). The incidence of surgical site infection during the inpatient period was 0.00% in the Breakthrough group and 2.32% in the control group. Due to the small number of inpatient infections, it is difficult to stress statistical difference in the infection rate during the inpatient period. However, it was clear that there was no inpatient surgical infection in the Breakthrough group. Only one case in the Breakthrough group developed infection and that occurred 2 weeks after discharge. Not surprisingly, it was the patient who was not treated in adherence with the recommended prophylactic guidelines: cefazolin was given 85 minutes after incision because the first-line doctor in the emergency department forgot to prescribe prophylactic antibiotics. A meta-analysis of 2507 patients who underwent mesh

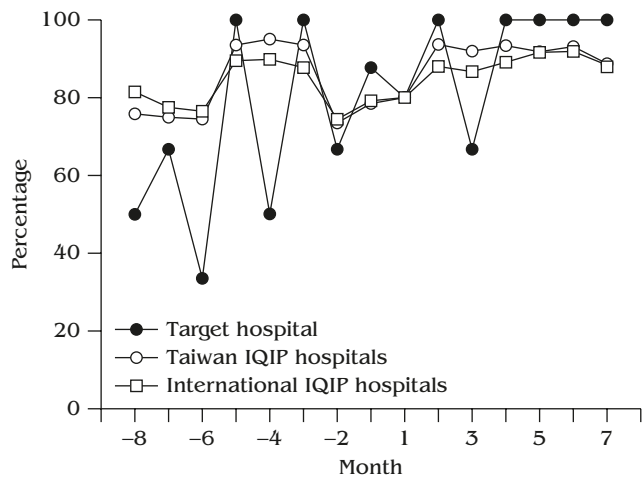


Fig. 4 – The trend of antimicrobial prophylaxis given within 1 hour prior to incision for abdominal hysterectomy patients in the target hospital was compared to those of the International Quality Indicator Project (IQIP) hospitals in Taiwan and worldwide. The trend gradually approached the level of IQIP hospitals and reached 100% after the Breakthrough Project.

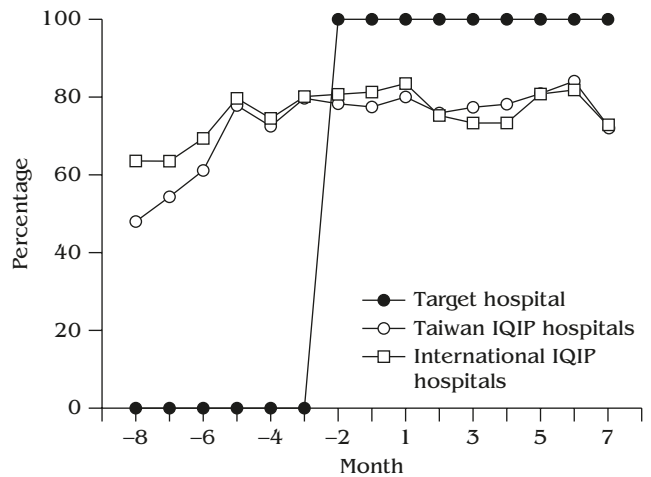


Fig. 5 – The trend of antimicrobial prophylaxis duration of <24 hours for abdominal hysterectomy patients was compared to those of the International Quality Indicator Project (IQIP) hospitals in Taiwan and worldwide. The trend exceeded the level of IQIP hospitals and was 100% during and after the Breakthrough Project.

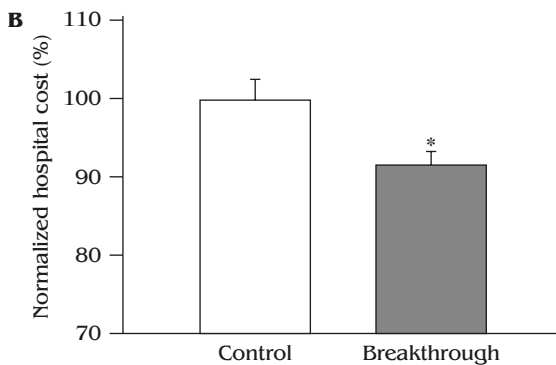
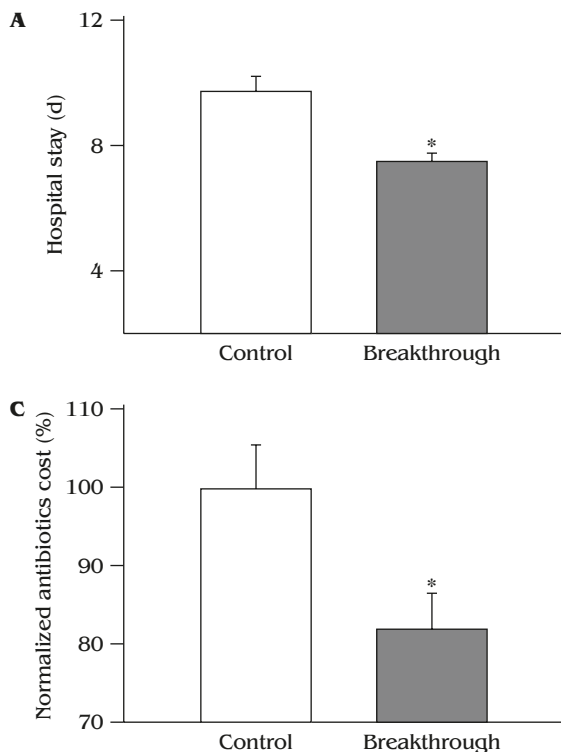


Fig. 6 – Changes in: (A) hospital stay; (B) hospital costs; and (C) antibiotic costs after the Breakthrough Project were compared to the baseline control. For hospital financial reasons, the costs were normalized by means of the control group. Control group, $n=43$; Breakthrough group, $n=29$. * $p<0.05$, Mann-Whitney rank sum test.

inguinal hernioplasty showed that antibiotic prophylaxis decreased the rate of surgical site infection by almost 50% [27]. Our experience was compatible with the concept that antibiotics given after incision do not provide adequate protection from surgical site

infection. The Mie Surgical Infection Research Group demonstrated that the incidence of surgical site infection in elective gastric cancer surgery was similar for both single-dose and multiple-dose antibiotic prophylaxis regimens [28]. It is clear that the timing

of initiation is the key for antimicrobial prophylaxis and not the length of time the antibiotic is administered. So we conducted this Breakthrough Project to consolidate this important concept and change the clinical behavior of surgeons.

The keys for successful improvement in the quality of medical care are the support of the administration system and the involvement of clinicians. We received direct support from the office of the superintendent and an efficient team was set up once the TJCHA had made the call. Members included a vice superintendent who acted as a team supervisor, a senior surgeon as team leader, a gynecological chief, an operating room head nurse, the chairman of anesthesiology, nursing practitioners, physicians of infectious disease subspecialties and quality improvement staff. The leadership was established directly from the top and authorized by the chairman of the gynecology department. Familiarity with the TQIP system also played a major role in facilitating implementation of the recommended antibiotic prophylaxis regimen. We had about 30 interdepartmental meetings every year to feedback and discuss quality of medical care indicators. Most of the physicians agreed that to improve the quality of medical care is one of the aims of our hospital. Practically, the team treated the clinicians as customers. We explained the importance of quality improvement in antibiotic prophylaxis. We let the first-line staff understand that this was not about criticism but a continuous improvement in quality of care. Evidence-based literature and references were provided in the collaborative charter and change package from the TJCHA. Most surgeons were convinced, and changed their concepts and behavior after objective statistical data was made available. For example, orthopedic and cardiac surgeons started to reduce the antibiotic prophylactic duration to 24 hours for knee arthroplasty and coronary artery bypass surgery.

5. Conclusion

This Breakthrough Project brought the administration system of antimicrobial prophylaxis to the attention of surgeons and they then focused on this specific issue. We successfully increased the rate of antibiotic prophylaxis given within 1 hour prior to incision, increased the rate of antibiotic prophylaxis duration that is not longer than 24 hours, and reduced length of hospital stay, hospital costs and antibiotic costs. All the patients who followed the prophylactic antibiotic recommendations did not suffer surgical site infection within 30 days of surgery. A continuous effort to reinforce the concept of antimicrobial prophylaxis to all health workers is necessary to maintain and spread the gain.

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