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Preoperative Clinic Visits Reduce Operating Room Cancellations and Delays

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Background: **Anesthesiologist-directed preoperative medicine clinics are used to prepare patients for the administration of anesthesia and surgery. Studies have shown that such a clinic reduces preoperative testing and consults, but few studies have examined the impact of the clinic on the day of surgery. The authors tested whether a visit to an anesthesia preoperative medicine clinic (APMC) would reduce day-of-surgery case cancellations and/or case delays.**

Methods: **The authors conducted a retrospective chart review of all surgical cases during a 6-month period at the University of Chicago Hospitals. Case cancellations and rates of first-start case delay over the 6-month period were cross-referenced with a database of APMC attendees in both the general operating rooms and the same-day surgery suite. The impact of a clinic visit on case cancellation and delay in both sites were analyzed separately.**

Results: **A total of 6,524 eligible cases were included. In the same-day surgery suite, 98 of 1,164 (8.4%) APMC-evaluated patients were cancelled, as compared with 366 of 2,252 (16.2%) in the non-APMC group ($P < 0.001$). In the general operating rooms, 87 of 1,631 (5.3%) APMC-evaluated patients were cancelled, as compared with 192 of 1,477 (13.0%) patients without a clinic visit ($P < 0.001$). For both operating areas, APMC patients had a significantly earlier room entry time than patients not evaluated in the APMC.**

Conclusions: **An evaluation in the APMC can significantly impact case cancellations and delays on the day of surgery.**

PREOPERATIVE anesthesiology clinics were originally developed to optimize the medical condition of a patient before surgery and anesthetic administration.[1] In the clinic, the anesthesiologist considers the special needs of a patient before the day of surgery and completes a thorough preoperative evaluation. Not surprisingly, preoperative anesthesia clinics have been shown to enhance patient safety[2] and satisfaction.[3,4] They may also improve hospital resource utilization before the day of surgery by reducing preoperative consults and laboratory testing.[4–7] In addition, visits to an anesthesia preoperative medicine clinic (APMC) have been shown to reduce the duration of hospital stay.[8] Although these benefits of a preoperative clinic visit are known, the impact of a preoperative clinic visit on cancellations and delays on the day of surgery has been less well studied. We hypothesized that a preoperative clinic visit would decrease day-of-surgery case cancellations and reduce case delays. The financial impact of even small improvements in operating room efficiency on the day of surgery could be significant to a hospital with a busy operating room schedule because cancelled cases may delay subsequent cases and waste expensive case setups. When case starts are delayed, valuable operating room time may be left unused, and staff time can be wasted.

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Materials and Methods

With institutional review board approval (University of Chicago, Chicago, IL), we conducted a retrospective data analysis of all surgical procedures requiring anesthesia at our institution from July 1 through December 31, 2003. Cases were divided into two groups: those performed in the 8-room same-day surgery suite, and those performed in the 15 general operating rooms. Data on all surgical cases were collected from the operating room scheduling database. Inpatients were excluded from the study because the APMC at our institution serves outpatients only. Also excluded were all cardiac surgery cases because these patients are not typically evaluated in the APMC. For patients with more than one scheduled surgery in the study period, only the first planned operative procedure was included.

A second database, containing all APMC visitors, was then cross-referenced with the operating room schedule to determine which patients had been seen in the clinic. The decision as to whether a patient is seen in the APMC at our institution is made by the referring surgeon. At a clinic visit, patients undergo a history and physical examination by an attending anesthesiologist, necessary preoperative tests and consults are requested, and previous studies are reviewed. An anesthetic plan is then formulated. In addition, patients are counseled regarding their medications and oral intake. American Society of Anesthesiologists (ASA) physical status scores and ASA base billing units were collected for all patients who underwent an operative procedure. APMC records were used to collect ASA physical status scores for patients who had a planned operative procedure that was cancelled on the day of surgery. For patients who were cancelled and not seen in the APMC, ASA physical status scores and ASA base billing units could not be collected. The type of surgery for each patient and their age was also collected from the published operating room schedule.

Cancellation rates at both operating sites during the 6-month period were tabulated. Cancelled cases were defined as cases on the final copy of the published operating room schedule that did not occur. By definition, emergency cases did not appear on the printed schedule, so these cases and cases performed on weekends and holidays were not included in the study.

To determine case delay times, all first-start cases during the 6-month study period were examined. First-start cases were chosen because delays in starting these cases are most likely caused by a problem with the case itself (rather than a previous case causing the delay).

Statistical Methods

Wilcoxon rank sum tests were used to test differences in ASA physical status scores and ASA base billing unit allocations in patients seen in the clinic and those not seen in the clinic. A two-sample *t* test was used to compare differences in age, and a Pearson chi-square test was used to compare the difference in types of surgery between the two groups.

Rates of cancellation were compared between APMC visitors and those not seen in the clinic using a Pearson chi-square test. A random-effects logistic regression model that treated days as random events was used to determine whether the cancellation rate was clustered on certain days due to nonrandom events (*e.g.*, surgeons who were ill, operating room closings). Results were verified using a *t* test to the Freeman-Tukey double arcsin transformed cancellation rate per month as suggested by Dexter *et al.*[9] A chi-square test was used to determine an association between ASA physical status score, type of surgery, and rate of cancellation in APMC-evaluated patients. A two-sample *t* test analyzed the impact of age on cancellation in APMC-evaluated and non–APMC-evaluated patients separately. Finally, a multiple logistic regression model examined the independent effect of an APMC visit on cancellation rate after adjusting for age, ASA physical status, and type of surgery. The differential effect of the APMC by age was also explored in the framework of logistic regression.

For the delay data, a Wilcoxon rank sum test was used to determine the statistical significance of the difference in median times for room entry between patients who visited the APMC and those who did not. A median regression model with bootstrapped standard error determined the independent effect of an APMC visit on room entry time after controlling for age, type of surgery, ASA physical status, and ASA base billing units.[10,11] All statistical analyses were performed separately for each operative site. A *P* value of 0.05 or less was considered statistically significant.

Table 1. Characteristics by APMC Attendance in the Same-day Surgery Suite

	APMC (n = 1,164)	Non-APMC (n = 2,252)	*P* Value
Cancellation of surgery, n (%)			< 0.001
Yes	98 (8.4)	366 (16.3)	
No	1066 (91.6)	1886 (83.7)	
ASA physical status, n (%)			< 0.001
I	101 (9.5)	782 (41.7)	
II	542 (51.0)	871 (46.5)	
III	388 (36.5)	199 (10.6)	
IV	32 (3.0)	23 (1.2)	
ASA base billing units, n (%)*			<0.001
3	232 (21.8)	732 (39.0)	
4	138 (13.0)	294 (15.7)	
5	225 (21.2)	561 (29.9)	
6	369 (34.7)	226 (12.0)	
≥ 7	99 (9.3)	63 (3.4)	
Age, mean ± SD, yr	54.9 ± 20.0	30.2 ± 23.7	< 0.001

* Among patients undergoing surgery.

APMC = anesthesia preoperative medicine clinic; ASA = American Society of Anesthesiologists.

Results

The study period included 6,524 cases. Of these, 3,416 were in the same-day surgery suite; the remainders were in the general operating rooms. Overall, the APMC attendance rate was 43% (2,795 of 6,524). During the study, 743 cases (11%) were cancelled.

Same-day Surgical Suite Cancellations

In the same-day surgery suite, 34% of patients (1,164 of 3,416) were evaluated in the APMC. ASA base billing units and ASA physical status scores for these patients were significantly higher than for patients not evaluated in the APMC (table 1). The average age of APMC-evaluated patients was 54.9 yr (SD, 20.0 yr) as compared with 30.2 yr (SD, 23.7 yr) for a non-APMC evaluated patient, and this difference was highly significant.

Overall, 464 of the 3,416 scheduled procedures (13.6%) were cancelled on the day of surgery. In the APMC group, 98 of 1,164 (8.4%) were cancelled, as compared with 366 of 2,252 (16.2%) in the non-APMC group (odds ratio, 0.47; 95% confidence interval [CI], 0.37–0.60; $P < 0.001$; table 1). Figure 1 shows the histogram of cancellations per day. On average, 26.9 surgeries (SD, 6.2) were scheduled per day, and 3.7 (SD 2.0) were cancelled per day. No clustering on date of cancellation was observed (intracluster correlation coefficient = 0; $P = 1.0$), suggesting little variation in the number of cancellations per day. Our result was verified

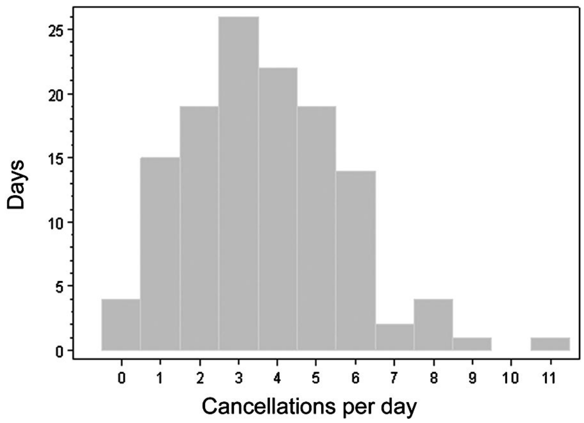

Fig. 1. Histogram of cancellations per day for same-day surgery suite (26.9 ± 6.2 surgeries scheduled per day).

by applying the *t* test to the transformed rates per month,[9] which demonstrated that the difference in cancellation rate between APMC visitors and nonvisitors was significant ($P < 0.001$).

Surgery cancellations occurred more often among APMC patients with a higher ASA physical status score ($P < 0.001$; fig. 2). After controlling for age, ASA physical status, and type of surgery in a logistic regression model, the adjusted odds ratio of cancellation for an APMC visitor was 0.36 (95% CI, 0.27–0.47; $P < 0.001$). The impact of an APMC evaluation on cancellation was differentiated by age ($P = 0.01$), and the benefit with respect to cancellation was more pronounced in older patients. The odds ratios of cancellation in patients aged younger than 18 yr, 18–39 yr, 40–64 yr, and 65 yr or older were 0.74 (95% CI, 0.34–1.64), 0.51 (95% CI, 0.29–0.89), 0.40 (95% CI, 0.27–0.59), and 0.20 (95% CI, 0.12–0.32), respectively (fig. 3).

Same-day Surgical Suite Delays

Analysis of first-start room entry times in our same-day surgery suite demonstrated that the median in-room time for a patient seen in the clinic was 7:35 AM (interquartile

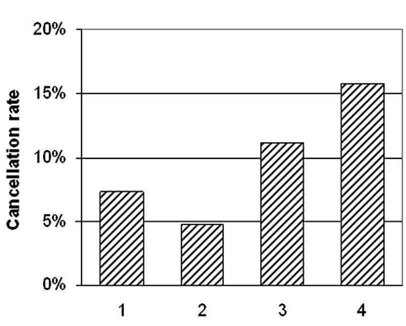

Fig. 2. Cancellation rate by American Society of Anesthesiologists (ASA) physical status among patients who visited the anesthesia preoperative medicine clinic and had surgery scheduled in the same-day surgery suite. Cancellations were more likely to occur among patients with a higher ASA physical status ($P < 0.001$).

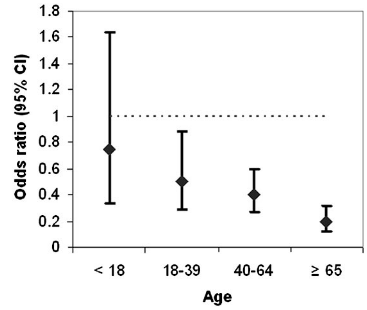

Fig. 3. Odds ratio (95% confidence interval [CI]) for cancellation for an anesthesia preoperative medicine clinic visitor according to age group in the same-day surgery suite. There was a significant anesthesia preoperative medicine clinic visit by age interaction ($P = 0.01$).

range, 7:31–7:42), and that for a patient not seen the median in room time was 7:36 AM (interquartile range, 7:30–7:46). After controlling for ASA physical status, ASA base billing units, type of surgery, and age using a median regression model, the median in room time for a patient evaluated in the clinic was 3 min less than for a patient not evaluated ($P < 0.001$). In addition, patients with higher ASA physical status scores had longer delays on the day of surgery ($P < 0.001$).

General Operating Room Cancellations

During the study period, 3,108 cases were scheduled in the general operating rooms, and 52% (1,631 of 3,108) of these patients were seen in the APMC. The ASA physical status scores and ASA base billing units were significantly higher among patients seen in the clinic than those not evaluated (table 2). The average age of an APMC patient was 54.6 yr (SD, 17.1 yr), compared with an average age of 38.4 yr (SD, 23.0 yr) for patients not seen. This difference was also highly significant.

Overall, 279 cases (9.0%) were cancelled on the day of surgery. Among APMC visitors, 87 of 1,631 (5.3%) were cancelled, as compared with 192 of 1,477 (13.0%) in patients without a clinic visit (odds ratio, 0.38; 95% CI, 0.29–0.49; $P < 0.001$; table 2). Figure 4 shows the histogram of cancellations per day. On average, 24.3 surgeries (SD, 4.9) were scheduled per day and 2.2 (SD, 1.6) were cancelled per day. As with the same-day surgery patients, there was no clustering on the date of cancellation (intracluster correlation coefficient = 0.02; $P = 0.18$), suggesting a relatively constant cancellation rate from day to day. A *t* test was also applied to the transformed cancellation rate per month,[9] and a significant difference in cancellation rate between APMC visitors and non-APMC visitors was observed ($P < 0.001$).

Surgery cancellations occurred more often among APMC patients with a higher ASA physical status score ($P = 0.06$; fig. 5). After controlling for age, ASA physical status, and type of surgery in a logistic regression model, the adjusted odds ratio of cancellation for an APMC visitor was 0.37 (95% CI, 0.28–0.50; $P < 0.001$). The

Table 2. Characteristics by APMC Attendance in the General Operating Rooms

	APMC (n = 1,631)	Non-APMC (n = 1,477)	*P* Value
Cancellation of surgery, n (%)			< 0.001
Yes	87 (5.3)	192 (13.0)	
No	1,544 (94.7)	1,285 (87.0)	
ASA physical status, n (%)			< 0.001
I	97 (6.3)	230 (18.1)	
II	849 (55.1)	749 (58.8)	
III	566 (36.7)	267 (21.0)	
IV	30 (1.9)	24 (1.9)	
V	0	3 (0.2)	
ASA base billing units, n (%)*			<0.001
3	111 (7.2)	314 (24.7)	
4	91 (5.9)	99 (7.8)	
5	175 (11.3)	212 (16.7)	
6	369 (23.9)	256 (20.1)	
7	366 (23.7)	147 (11.5)	
8	201 (13.0)	79 (6.2)	
9	3 (0.2)	8 (0.6)	
10	95 (6.2)	59 (4.6)	
≥ 11	131 (8.5)	99 (7.8)	
Age, mean ± SD, yr	54.6 ± 17.1	38.4 ± 23.0	< 0.001

* Among patients undergoing surgery.

APMC = anesthesia preoperative medicine clinic; ASA = American Society of Anesthesiologists.

influence of an APMC visit was differentiated by age ($P = 0.006$), and the beneficial effect was more pronounced in older patients. The odds ratios of cancellation in patients aged younger than 18 yr, 18–39 yr, 40–64 yr, and 65 yr or older were 0.31 (95% CI, 0.09–1.06), 0.95 (95% CI, 0.52–1.70), 0.33 (95% CI, 0.22–0.50), and 0.24 (95% CI, 0.14–0.41), respectively (fig. 6).

General Operating Room Delays

In the general operating rooms, the median in room time for non–APMC-evaluated patients was 7:37 AM (interquartile range, 7:31–7:46), whereas APMC evaluated patients had an in room time of 7:35 AM (interquartile range, 7:30–7:43). This difference was statistically significant ($P < 0.001$). After controlling for ASA physical status, ASA base billing units, type of surgery, and age, the results were similar (median 2 min longer wait for non–APMC-evaluated patients; $P = 0.015$). In addition, patients with higher ASA physical status scores had longer delays on the day of surgery ($P < 0.014$).

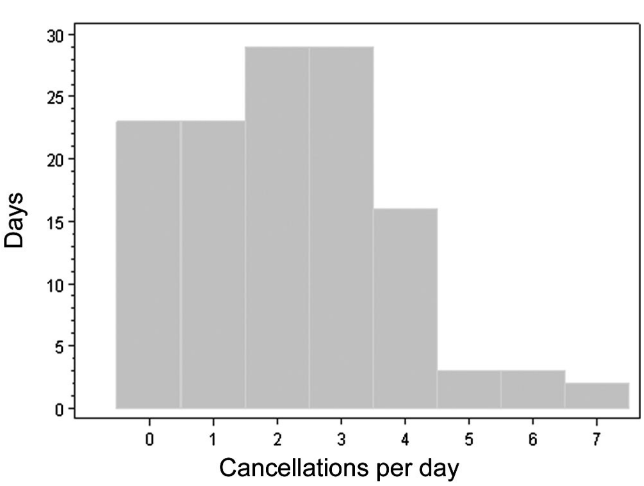

Fig. 4. Histogram of cancellations per day for general operating rooms (24.3 ± 4.9 surgeries scheduled per day).

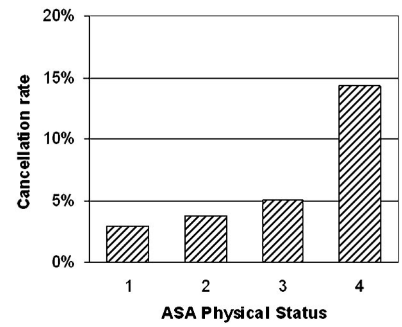

Fig. 5. Cancellation rate by American Society of Anesthesiologists (ASA) physical status among patients who visited the anesthesia preoperative medicine clinic and had surgery scheduled in the general operating rooms. Cancellations were more likely to occur among patients with a higher ASA physical status ($P = 0.06$).

Discussion

We found that patients seen in our preoperative clinic were cancelled less often and experienced fewer case delays than patients not seen. This observation was true even though patients seen in the clinic had higher ASA physical status scores, had higher ASA base billing units, and were older. Because ASA physical status score was independently associated with an *increased* cancellation rate, it is unlikely that our observations were the result of differences in severity of illness between patient groups. These data suggest strongly that our preoperative clinic played a significant role in reducing cancellation rates and case delays in our hospital. Although previous stud-

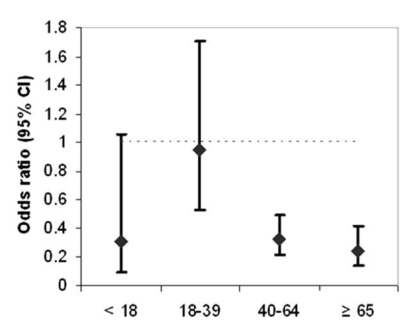

Fig. 6. Odds ratio (95% confidence interval [CI]) for cancellation for an anesthesia preoperative medicine clinic visitor according to age group in the general operating rooms. There was a significant anesthesia preoperative medicine clinic visit by age interaction ($P = 0.006$).

ies have shown that APMC visits reduce preoperative costs[12,13] and improve patient safety and satisfaction,[2,3] our study demonstrates that an APMC visit also decreases unused operating room time on the day of surgery.

A high rate of case cancellations has significant consequences. In addition to the negative impact that a case cancellation has on patient and staff satisfaction, cancellations also have potentially severe financial implications on hospital operations. When a case is cancelled, many dollars are potentially wasted on unnecessary setups, including sterilization, disposable instruments, and sutures. Many more dollars are lost when appropriated operating room time is not billed. Previous studies have suggested that revenues lost from cancellations range from $1,430 to $1,700 per hour plus variable costs in hospitals not on a fixed budget.[9]

A reduction in case delays might also have great financial implications. Although preventing delays alone may not free up sufficient time to add an extra case to the operating room schedule,[14,15] reducing delays could affect hospital staffing costs when operating rooms are running at or above full capacity (> 60% overtime utilization)[14,16] or when staffing costs are paid hourly instead of salaried (a growing trend with *per diem* staffing arrangements). Because the cost of a surgical minute has been estimated at $10,[17] even small reductions in case delays have the potential to save significant amounts of money when extrapolated across a busy operating room suite. In addition, in an operating room running at or near capacity, daytime delays can result in the use of overtime staffing, which can increase the per-minute cost of operating room utilization by 50–75%.

The sheer volume of daily cases in an institution may make funding of an APMC visit for all patients prohibitive. However, our study suggests that certain populations are more likely than others to benefit from a clinic visit. Older patients should be sent to clinic, because our data show that older patients (aged > 60 yr) had the greatest reduction in cancellation rate (odds ratio, 0.22) when they were seen in the APMC. This study also suggests that patients with more medical comorbidities should visit the clinic preoperatively.

This large, retrospective study of service data has several limitations. Because patients could not be randomly assigned to attend the APMC, selection bias may have skewed our results. To detect bias, we examined ASA physical status (as a measure of medical comorbidity), ASA base billing units (as a crude measure of operative case complexity), age, surgeon, and surgical procedure in both patient groups. We demonstrated that patients with higher ASA physical status scores were more likely to be cancelled on the day of surgery. Nevertheless, patients evaluated in the clinic had more medical comorbidities but were less likely to experience a cancellation than patients who were not seen in the clinic. This finding suggests that if patients were randomly assigned to attend the APMC, the impact of a visit on case cancellation might be even greater. Unfortunately, no ASA physical status scores or base billing units were available for cancelled patients not seen in the clinic. To address this issue, a prospective study could be performed with ASA physical status scores and ASA base billing units attributed to all patients, whether or not they were evaluated in the APMC, before the day of surgery. Finally, reasons for surgery case cancellation and delay were not reliably available in the medical record and therefore could not be assessed in the study.

In summary, we found that an APMC visit can impact the day of surgery by reducing both case cancellations and case delays. Although work in the past has shown that a clinic can reduce hospital costs before and after the day of surgery, this is one of the first studies to show a significant impact of a preoperative clinic visit on the day of surgery. With these results in mind, we believe that an APMC visit should be supported for many or all patients scheduled to undergo surgery.

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