Effect of a Novel Financial Incentive Program on Operating Room Efficiency

Thomas M. Scalea, MD; Darlene Carco, RN; Melissa Reece, RN; Yvette L. Fouche, MD; Andrew N. Pollak, MD; Sushruta S. Nagarkatti, MD

IMPORTANCE Operating room (OR) turnaround times (TATs) and on-time first-case starts (FCSs) are commonly used measures of OR efficiency. Prolonged TATs and late FCSs occur frequently at academic medical centers.

OBJECTIVE To test the hypothesis that establishing a financial incentive program (FIP) for OR teams would improve efficiency, leading to decreased TATs and improved on-time FCSs.

DESIGN, SETTING, AND PARTICIPANTS Prospective study to evaluate the effect of an FIP on OR efficiency between March 1, 2013, and December 31, 2013, at a freestanding academic trauma hospital. Participants were all OR team members and included anesthesiologists, certified registered nurse anesthetists, nurses, and technicians.

INTERVENTIONS Operating room efficiency awareness education was conducted before FIP implementation beginning in February 2013. Each eligible OR team member achieving a TAT of 60 minutes or less or an on-time FCS was awarded 1 point. Reports listing individual performances were posted. Pay bonuses were awarded for achieving 1 of 3 progressive point totals in any month.

MAIN OUTCOMES AND MEASURES Outcomes were TAT, which was defined as “wheels out” to “wheels in,” and on-time FCS, which was defined as “wheels in” within 6 minutes of the scheduled start time.

RESULTS Before FIP implementation, the mean TAT varied between 77 and 83 minutes, with only 18% to 26% of TATs being 60 minutes or less; on-time FCSs averaged 29% to 34%. After FIP implementation, on-time FCSs improved from 31% to 64% \((P < .001)\), and TATs of 60 minutes or less increased from 24% to 52% \((P < .001)\). The cost of a 2-month FIP was $8340. We saved 13 minutes per TAT, for an estimated savings of $177,000. We estimate an additional savings of $33,000 for on-time FCSs, for a total hospital savings of $210,000.

CONCLUSIONS AND RELEVANCE A novel FIP improved OR efficiency. Given the small amount of money involved, it seems unlikely that financial incentives were solely responsible. Effectively communicating the importance of TATs and on-time FCSs and publishing individual results more likely increased staff awareness. Teamwork created by linking assignment of points to a team result likely contributed to success.
The rising cost of operating room (OR) procedures, coupled with decreasing reimbursements, has led most hospital committees to take a closer look at OR efficiency. Operating room efficiency is most commonly measured and easily quantified in terms of turnaround times (TATs) and on-time first-case starts (FCSs). The common perception, especially at academic medical centers, is that prolonged TATs and late FCSs are a necessary part of life. A survey conducted by Masursky et al showed that surgeons commonly overestimated TATs irrespective of their operative volume. This finding has led clinical and administrative leadership to set up multidisciplinary committees that focus on improving TATs and on-time FCSs.

Initiatives aimed at decreasing TATs and improving on-time FCSs have used team training programs, parallel processing, education, and specialized OR staff. However, the programs at large academic institutions involving different surgical services were unable to sustain results when leadership changed or team training ended. To sustain decreased TATs, Armour Forse et al used financial bonuses in addition to penalizing surgeons for delays by taking away start times.

The aim of our study was to establish a financial incentive program (FIP) at one of the largest academic trauma centers in the United States. The hospital was a point reward system was developed before and after FIP implementation using a percentage system agreed on by the OR committee. Results for the mean TAT, percentage TATs of 60 minutes or less, and percentage on-time FCSs were compared before and after FIP implementation.

**Methods**

This project was reviewed by the institutional review board for the University of Maryland School of Medicine. It was found not to involve human experimentation and did not require institutional review board approval, and informed consents were not needed.

The R. Adams Cowley Shock Trauma Center (STC) is the only freestanding trauma hospital in the United States. The STC serves as the primary adult resource center for trauma in Maryland, providing the highest level of trauma care available. The STC is attached to the University of Maryland Medical Center, and the faculty are members of academic departments at the University of Maryland School of Medicine. However, the STC functions as a largely independent clinical and administrative entity, caring for critically ill and injured patients.

The STC has 8 dedicated trauma ORs. On Monday through Friday, 8 ORs run from 7 AM to 5 PM. Five ORs run from 5 PM to 7 PM, 3 ORs run from 7 PM to 11 PM, and 2 ORs run from 11 PM to 7:30 AM. A call team is available to flex the number up from 5 PM to 7:30 AM as needed. On weekends, the STC runs 4 ORs from 7:30 AM to 3 PM, 3 ORs from 3 PM to 7 PM, and 2 ORs from 7 PM to 7:30 AM. Dedicated nurses staff the trauma ORs, most of whom are committed exclusively to the trauma ORs. Additional anesthesiology support is provided by certified registered nurse anesthetists, who are for the most part dedicated to the trauma ORs as well.

The OR committee theorized that one major cause of lack of efficiency was lack of teamwork and incentive for the non-surgical members of the team. The OR committee constructed a point reward system for optimal TATs and on-time FCSs.

We defined TAT as the time from “wheels out” to “wheels in” of the OR. An acceptable TAT was arbitrarily set at 60 minutes or less. We defined an on-time FCS as the patient being in the OR within 6 minutes of the scheduled start time. Elective cases and emergency unscheduled cases were included.

An OR efficiency awareness education program was conducted for all staff before FIP implementation beginning in March 2013. Points were earned by each member of the OR team when the team achieved a TAT of 60 minutes or less or an on-time FCS. Each eligible OR team member who achieved these goals was awarded 1 point. The circulating nurse completed the TAT form, which included the time data and the reasons for delay if delay existed. All TAT forms were collected and verified by a senior clinical nurse using the OR’s electronic documentation system. Results were tallied per month (Figure 1).

Surgical support technicians and anesthesia technicians worked on a percentage system agreed on by the OR committee, instead of an individual point system, because they are involved in all ORs. If the overall TAT percentage of 60 minutes or less met or surpassed a target of 52%, all surgical support and anesthesia technicians each received a $50 bonus. If individual charge nurses’ overall monthly TATs reached a target goal of 60 minutes or less, they received a $100 bonus.

Monthly reports listing individual results were openly posted and updated each week. Rewards were then granted to each individual who reached a preset mark on a 3-level point tier. Staff who earned a minimum of 10 points per month received a bonus in their biweekly paycheck for the preset amount based on their job title. Certified registered nurse anesthetists received the highest amount, $100. Registered nurses received $50, and surgical scrub technicians received $40. If staff earned 15 and 20 points, respectively, the bonus amounts increased to $150 and $200 for certified registered nurse anesthetists, $100 and $120 for RNs, and $70 and $80 for surgical scrub technicians.

Data were collected as part of a process improvement project and were maintained by the nurse manager of the OR (M.R.). Data were then analyzed, and results were reported to the staff on a regular basis. Results were also reviewed monthly by the OR committee. Results for the mean TAT, percentage TATs of 60 minutes or less, and percentage on-time FCSs were compared before and after FIP implementation using t test.
Since that initial marked improvement, on-time FCSs have remained steady at approximately 55% (Figure 2). Turnaround times of 60 minutes or less increased from 24% to 52% (P < .001). This trend has continued, and no substantial change has occurred since. The mean TAT has continued to fall and is now at 60 minutes. The percentage of TATs of 60 minutes or less is 53%.

Since implementing the FIP, no significant change in OR physician or nursing leadership has occurred. No substantial change has occurred in overall surgical faculty or nursing personnel. Admissions to the STC have been stable, with changes reflecting our usual seasonal variation (Table). The mean OR minutes have increased from between 88 817 and 91 161 to between 96 664 and 117 930 minutes. Orthopedic
cases and general surgery cases, which comprise the bulk of
the operative volume at the STC, have increased. The per-
centage of cases performed during daytime hours, defined
as 7 AM to 5 PM, has likewise increased, averaging approxi-
mately 75% to 80%.

The initial 2-month cost of the FIP was $8340. During that
period, we saved 13 minutes per TAT for an estimated savings
of $177 000. We estimate an additional savings of $33 000 for
a total hospital savings of $210 000. The cost of the program (Figure 3) has varied be-
tween $580 and $4730 per month. The amount of money de-
creased after May because the support staff did not achieve
the threshold needed to receive bonuses. November, the month
with the lowest amount paid, was also the month with the low-
est number of overall operative cases and the lowest amount
of incentive paid for the certified registered nurse anesthe-
sists, who are paid the highest rate. This rebounded in Decem-
ber because we met our targets and the support staff were paid;
therefore, the amount returned to the range paid in the first
through the third months.

### Discussion

Efficiency in the use of OR resources is at the heart of high-
value delivery of care in academic medical centers. As care has
become increasingly regionalized in academic medical cen-
ters, providing increasing proportions of complex care, surgi-
cal volumes have assumed a more important role in the finan-
cial viability of such centers. We recognized that we had
significant opportunity for improvement. In 2012, our mean
TAT ranged between 70 and 80 minutes, and less than 25% of
our TATs occurred in 60 minutes or less. The on-time FCSs
averaged only approximately 1 in 3.

We believed that the cause for this was multifaceted. We
sought to remove blame from the equation and motivate the
OR staff by appealing to their sense of teamwork. Trauma is
the quintessential team sport, and multidisciplinary care is at
the root of all trauma therapies. Therefore, tapping into that
sense seemed logical and has been successful. Given the small
amount of money that was actually involved per person, it
seems unlikely that the financial reward explains the dra-
matic results that we observed.

It is instructive to interpret our results in the context of
other academic medical centers. In 1994, Mazzei4 was one
of the first to provide objective baseline data regarding turn-
over times and on-time FCSs. During a 6-month period, the
author recorded turnover time and found it to be 36 min-
utes uniformly across the multiplicity of services operating
at the University of California, San Diego. This began to
serve as a national benchmark.1,2 Others have attempted to
identify causes of OR delays. Overdyk et al3 used a 3-step
process to identify these causes. A 2-week educational
period was followed by a process to identify causes of OR
delay. Staff were reassigned, and anesthesia providers and
OR nurses began to complete their tasks simultaneously.
The authors demonstrated a significant decrease in turn-
over time and first-case delays.

Our belief that team training can improve performance in
the OR is not new. Armour Forse et al2 commented on the role
of improving team communication and teamwork in OR
efficiency. Operating room team members were trained as pro-
gram champions or coaches, resulting in marked improve-
ments in on-time FCSs and turnover time, which they con-
cluded was secondary to their training program. The program
was terminated for lack of funds; perhaps not surprisingly, the

### Table. OR Use and the Use of OR Time by Shift

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<tbody>
<tr>
<td>Total OR minutes</td>
<td>91 161</td>
<td>92 651</td>
<td>88 817</td>
<td>105 832</td>
<td>110 234</td>
<td>102 132</td>
<td>117 930</td>
<td>115 611</td>
<td>96 664</td>
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<td>Orthopedic cases, No.</td>
<td>199</td>
<td>217</td>
<td>184</td>
<td>249</td>
<td>269</td>
<td>247</td>
<td>274</td>
<td>303</td>
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<td>General surgery cases, No.</td>
<td>143</td>
<td>148</td>
<td>137</td>
<td>166</td>
<td>184</td>
<td>172</td>
<td>193</td>
<td>184</td>
<td>120</td>
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<tr>
<td>STC admission, No.</td>
<td>713</td>
<td>688</td>
<td>553</td>
<td>655</td>
<td>711</td>
<td>734</td>
<td>761</td>
<td>672</td>
<td>670</td>
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<td>Cases performed, %</td>
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<tr>
<td>7 AM to 5 PM</td>
<td>68</td>
<td>69</td>
<td>74</td>
<td>78</td>
<td>78</td>
<td>78</td>
<td>82</td>
<td>83</td>
<td>69</td>
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<tr>
<td>5 PM to 11 PM</td>
<td>32</td>
<td>24</td>
<td>31</td>
<td>33</td>
<td>39</td>
<td>39</td>
<td>44</td>
<td>50</td>
<td>39</td>
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<tr>
<td>11 PM to 7 AM</td>
<td>24</td>
<td>24</td>
<td>21</td>
<td>25</td>
<td>36</td>
<td>32</td>
<td>38</td>
<td>43</td>
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Abbreviations: OR, operating room; STC, shock trauma center.

* The percentages exceed 100% because cases starting in one period and extending into another period are counted twice.
on-time FCS percentage dropped, and turnover time plateaued. However, when the OR implemented 2 new policies of taking away surgeon start times if they delayed cases and giving bonuses to OR personnel for on-time FCSs, turnover times again decreased.

We believed that it was important to strictly measure TATs and rigidly define TATs and on-time FCSs. Masursky et al demonstrated that surgeons usually overestimate the amount of time it takes to turn an OR over but that anesthesiologists were overall unbiased. Our data also show that addressing processing issues and personnel performance is effective in increasing OR efficiency. Olmstead et al demonstrated that parallel processing increases efficiency. This was echoed by Friedman and colleagues. Job satisfaction was also greater among OR staff when they were part of an efficient team. Linking physicians and nurses by using preoperative huddles has also been shown to increase on-time surgical starts. Finally, dedicated OR staff, in which OR teams are specialized, may be helpful, particularly for operative cases that involve special equipment.

Given a benchmark of approximately a 30-minute turn-over time, one could wonder if our goal of 60 minutes is in fact laudable. The STC cares primarily for patients who are injured and critically ill. The uniformity of purpose created by this single mission, we believe, is one of the reasons we were able to galvanize the staff. We appealed to their pride and their sense of competition. However, the STC performs almost no outpatient elective surgery. During the period studied, less than 10% of our cases entered as ambulatory patients. Instead, most were inpatients, many of them from the intensive care unit. We believe the effort that is necessary to transport such patients from an inpatient bed, particularly from the intensive care unit, justified an initial target of 60 minutes. We anticipate that, with time, we will be able to use lessons learned from this effort to further decrease TATs toward elective benchmarks and to improve other measures of efficiency.

An additional inherent limitation to our efficiency is that the STC delivers the full range of operative injury care to our patients. Therefore, it is difficult for us to identify specialty teams during any given shift. An OR staff member for an individual OR may have to shift from performing fracture fixation to an emergency laparotomy or thoracotomy. This gives us maximal flexibility and is associated with less subspecialization of OR staff. This flexibility perhaps contributes to increased OR times.

It is difficult to calculate real cost savings. Most OR costs are fixed. Real hospital savings would involve using less staff, whether nursing staff, support staff, or physician staff. We calculated savings based on time saved. This of course is somewhat artificial. However, we were able to shift an increasing number of cases to the 7 AM to 5 PM OR slot. Although we have no formal measure of surgeon satisfaction, the ability to operate during daylight hours almost certainly led to increased surgeon satisfaction. The increase in OR minutes justifies the modest expenditure of funds it took to keep the FIP in place.

## Conclusions

Last, one must ask if the lessons learned herein are translatable. It is unclear given the singularity of our mission, as well as the personality of OR staff who choose to work in this environment, that this model would be applicable in other centers. However, we believe that the principles used in our FIP are grounded in logic, and they are supported in the literature. Therefore, we anticipate that the concepts could translate to any OR.

### References