How do we sequence urgent cases?

A review applying the science of OR management by researcher Franklin Dexter, MD, PhD.

How can OR leaders determine what order to use for performing urgent cases added to the surgical schedule?

Research has shown there is a set of ordered priorities that can be used for virtually all operational OR management decisions. The advantage of these criteria is that they apply equally to staffing, scheduling, sequencing, assigning, and moving elective cases (see www.franklindexter.net/OR_Staffing.htm).

This article outlines the priorities and gives examples showing how they can be applied.

Obtain a medical deadline

Medical criteria are the top priority in scheduling urgent cases (Dexter et al, 1999a). In sequencing urgent cases based on medical criteria, the time window for the best possible care is not defined by when the case is scheduled but by when the condition resulting in the need for surgery occurred. Therefore, when a case is scheduled, information is needed about the medical deadline for when the case needs to start to avoid the risk of increased morbidity or mortality.

A medical deadline is based on a patient’s clinical condition and on use of evidence-based medical literature. The surgeon knows the date and time of the event occurrence that requires urgent surgery (eg, hip fractured), or equivalently when symptoms began (eg, right lower quadrant pain).

For example, consider a patient with a pulseless leg who requires a thrombectomy. The time that the patient first recognized the problem would be a reasonable estimate for when the thromboembolism occurred. The surgeon can calculate the medical deadline by adding the disease-onset time and an estimate of how soon (in hours or days) the case needs to start to avoid increasing the risk of morbidity or mortality (Dexter et al, 1999a). Data for this time estimate are available from observational studies in surgical journals and usually will be the sole basis that a surgeon has for making the decision. The answer will be approximate, because rarely are good data available for any one patient. But rarely will inaccuracy in the medical deadline affect case sequences.

Ordered priorities for sequencing urgent cases

A best possible sequence of the submitted urgent cases can be determined using medical deadlines and estimated case durations from historical cases of the same scheduled procedure. For purposes of this article, I will use the criterion that the cases are performed based on the ordered priorities of:

1. Safety first.
2. Surgeon and patient access to OR time. For this application, this means the cases are performed unless they cannot be performed safely at the hospital.
3. Maximizing OR efficiency. For this application of decision making on the day of surgery, this means minimizing overutilized hours, ie, the time OR teams have to work past scheduled hours (Dexter & Traub, 2002).
4. Minimizing the average patient waiting time. Waiting time is measured from scheduled start times for elective cases and from when the patient and surgeon are available for urgent cases. Often the average patient waiting time is the same as the surgeon’s waiting time.

Some readers may be used to Priority 4 being first-come first-served; in other
words, the first urgent case to be declared goes first. Example 1 shows that this will increase waiting times. Later examples show that first-come, first-served also cannot be applied systematically.

When there is more than one option after applying the four ordered priorities, then the decision can be made based on personal preferences of physicians, nurses, and/or patients.

Here are some examples of how the priorities apply:

**Example 1**

On Monday at 9 am, a surgeon posts an open reduction and internal fixation of multiple, comminuted, distal lower extremity fractures. The calculated medical deadline is 24 hours. The historical case duration from the OR information system is 5 hours. At 12 noon, another patient is scheduled for a laparotomy to drain an abdominal abscess. The patient has had fevers and leukocytosis for 2 days. The medical deadline is within 12 hours. The historical case duration is 2 hours. At 1 pm, one OR is about to finish its elective cases. Both surgeons and patients are available. Which case goes first? No OR is likely to finish before 5 pm. Turnover times are 0.5 hours long.

*Answer*

Whenever a new case is scheduled, a case is completed, case durations are updated, etc, decisions should be reevaluated.

This is how the priorities would be applied: Safety is not affected by the sequence of the 2 urgent cases. OR efficiency (ie, expected overutilized OR time on the day of surgery) is the same regardless of the sequence. If the orthopedic case goes first, the average patient waiting time would be 2.75 hours, where 2.75 hours = (5 hours + 0.5 hour)/2 patients. If the general surgery case goes first, the average waiting time would be 1.25 hours, where 1.25 hours = (2 hours + 0.5 hours)/2 patients. Thus, the patient needing a laparotomy would have surgery first, because that sequence minimizes the average length of time the patients wait.

If instead, Priority 4 were first-come, first-served, waiting time would be increased.

**Example 2**

The scenario is the same as above, except that a second OR also will open at 3 pm. The remaining ORs will all likely be filled until 5 pm, the end of the scheduled workday.

*Answer*

Safety is again not affected by the sequence of the 2 urgent cases. Because more than one OR is available during scheduled hours for the cases, OR efficiency is evaluated by considering the urgent cases in descending order of case duration (Dexter et al, 1999b; Dexter & Traub, 2002). Assigning the longer case to the OR that will be available at 1 pm and the shorter case to the OR that will be available at 3 pm results in less overutilized OR time than performing the shorter case first in the OR that will be available at 1 pm. Therefore, unlike in the preceding scenario, the longer case goes first even though that results in a longer average wait for the patients. This is because maximizing OR efficiency is a higher priority than minimizing patient delays on the day of surgery.

In my experience, in practice, on weekday afternoons, most decisions are made based on the goal of minimizing overutilized hours. How long patients wait in the afternoons is affected by the choice of OR allocations.

**Example 3**

At 4:45 am, a 14-year-old boy is brought to the emergency department. He has had abdominal pain for 36 hours. He has been vomiting, is febrile, and has rebound tenderness predominantly in the right lower quadrant. At 6:45 am, Dr Jones calls the ORs to schedule the case. The medical deadline provided is within 2 hours. The estimated case duration is 1 hour. Every OR is full with scheduled elective cases. Should an OR have its first elective case of the day postponed?
Answer

Because patient safety is preeminent, one or more elective case(s) will have to be delayed by 1 hour. This is because, among children requiring appendectomy, the risk of gangrenous and perforated appendicitis is greater among patients having surgery more than 37 hours after the onset of symptoms (Lau et al., 1987).

Example 3 continued

The expected times that the last cases of the day will end in each OR are 1 pm for OR 1, 1:30 pm for OR 2, and 3:30 pm or later for the other ORs. The appendectomy could be performed in either of those 2 ORs. OR 1 has 4 short cases scheduled in it. OR 2 has 1 long case scheduled. Which OR should be delayed in its start?

Answer

OR efficiency is maximized on the day of surgery by minimizing overutilized hours (Dexter & Traub, 2002). Scheduling the case either into OR 1 or into OR 2 would result in no overutilized OR time. Thus, the decision is unlikely to affect OR efficiency.

The next highest priority is to reduce patient delays on the day of surgery. The patient who will undergo the appendectomy is going to have surgery right away so does not need to be included. Scheduling the appendectomy in OR 1 would result in an average patient waiting time of 0.8 hours longer than expected, where 0.67 hours = (4 patients each delayed by 1 hour / 6 patients). Scheduling the appendectomy in OR 2 would result in an average patient waiting time of 0.2 hours longer than expected, where 0.17 hours = (1 patient delayed by 1 hour / 6 patients). Therefore, the appendectomy is performed in OR 2.

Example 3 shows that Priority 4 cannot be first-come, first-served because it is insufficient when urgent cases are mixed with elective cases (Dexter et al., 2004).

Example 4

A hospital has an OR team on-call from home on weekends. Upon arriving and setting up on Sunday morning at 8 am, the call team finds there are 2 cases to be done. One case was submitted the night before: insertion of an inferior vena cava filter, which is expected to take 1 hour. The second case was just called in: an open reduction and internal fixation of an ankle fracture, expected to take 3 hours. The patient needing ankle surgery is ready now. The patient needing filter placement will be ready in 45 minutes. Which sequence of cases should be used?

Answer

Medical deadlines are satisfied regardless of the sequence of the 2 cases. Since the OR team is on-call from home, all OR time is overutilized time. Maximizing OR efficiency means minimizing the total hours OR nurses and anesthesia providers are in-house. The 3-hour case is started first, because that sequence results in a more efficient use of OR time.

Example 5

A hospital allocates all but one OR from 7 am to 5 pm for elective cases. One OR is kept free for urgent cases and is allocated (ie, staffed) from 7 am to 11 pm. In addition, 2 OR teams are planned every workday to be on call working overtime until all but one OR is finished.

Today, at 5:30 pm, many ORs finish nearly simultaneously. At 5:45 pm, the remaining 3 cases are reviewed, in the sequences submitted. All have medical deadlines to start within 2 hours. One patient has multiple orthopedic fractures, with an estimated case duration of 4 hours. A woman will undergo exploratory laparotomy and partial salpingectomy, with an estimated case duration of 1.5 hours. The third case is incision and drainage of a penetrating leg wound, with an estimated duration of 1.5 hours.

How should the cases be sequenced?

Answer

On the day of surgery, OR efficiency is maximized by minimizing overutilized
hours (Dexter & Traub, 2002). The cases are considered in descending sequence of case duration (Dexter et al, 1999b). The 4-hour case is scheduled into the OR time allocated for urgent cases. Based on medical deadlines, the other 2 cases cannot wait until after that case is completed.

Expected overutilized OR time is the same whether one OR team on-call stays late and does both cases, or both teams stay and each does one case. Thus, OR efficiency is not affected by the decision.

The average length of time patients wait will be less if both teams stay to each finish one case. Consequently, both cases are started right away.

As in Example 3, first-come, first-served is not sufficient as Priority 4 for decision making. If Priority 4 is to minimize waiting time, all decisions are made. The point is that first come, first served cannot be applied systematically.

Comments

Some surgeons may alter medical deadlines to obtain a higher priority for their cases. This can be monitored and reviewed by the surgical services committee (Dexter et al, 1999). Nonetheless, in my opinion, nothing is more important in sequencing urgent cases than having the appropriate OR allocations for urgent cases. For example, regardless of how urgent cases are sequenced, if urgent cases frequently postpone elective cases, physicians, nurses, and patients will be dissatisfied. Improved case sequencing will not solve a problem caused by lack of an OR allocated for urgent cases.

Summary

Because the medical deadline is determined in hours, there is a precise mathematical definition for OR efficiency, and the impact on patient delays can be estimated. The priorities described above will give a single answer to a sequence of urgent cases.

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