Patient Assignment Models in the Emergency Department

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KEYWORDS

- Rotational patient assignment • Provider in triage • Fast track
- Emergency department operations • Physician assignment

KEY POINTS

- Patient assignment systems are front-end operational tactics that can improve emergency department length of stay, rate of patients leaving without being seen, patient satisfaction, and resident education.
- There are multiple variations of patient assignment systems, including provider-in-triage/team triage, fast-tracks/vertical pathways, and rotational patient assignment.
- The patient assignment component of both provider-in-triage/team triage and fast-tracks/vertical pathways is likely to generate the greatest operational improvements in emergency departments with large numbers of lower-acuity patients.
- The patient assignment component of rotational patient assignment is likely to generate the greatest operational improvements in emergency departments in which there is neither guidance nor obvious incentives (such as financial) to encourage physicians to acquire ("pick up") patients.

INTRODUCTION

As emergency departments (EDs) around the world struggle to accommodate ever-growing numbers of patients,[1] novel workflow solutions are needed. This innovation is critical, because the traditional approach to crowding, building a larger ED, does not always reduce crowding.[2] Workflow smoothing often matters more than physical layout. Some EDs have experimented with patient assignment systems, where early assignment of patients to specific treatment teams has been found to improve patients' length of stay,[3] rates of leaving without being seen,[3,4] the quality of resident education,[5,6] and patient satisfaction.[3,4] In this article, the authors discuss the theory behind patient assignment systems and review variations and the potential benefits of different patient assignment strategies found in current literature.

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THEORY OF EMERGENCY DEPARTMENT PATIENT ASSIGNMENT SYSTEMS

Traditional queue management theory teaches that pooling identical customers into 1 centralized pool, attended by multiple similar servers, increases efficiency by decreasing the amount of time a customer waits.[7] Many EDs use a "pooled" workflow whereby any emergency physician can treat any patient. However, unlike the "customers" that queue management addresses, patients are not identical, nor are physicians. Patients with unique medical backgrounds present with a broad range of chief complaints and needs. Physicians also appear to have inherent traits that affect their workflow, including risk-aversion[8] and fear of malpractice.[9] These inherent traits may help to explain the observation that many clinicians can be stereotyped as having a "high" or "low" resource utilization profile.[10] These and other aspects of emergency medicine workflow suggest that queuing theory may require modification when assessing some aspects of ED operations.

Most EDs rely on physicians assigning themselves to waiting patients, voluntarily taking on additional work. However, physicians may not always act as perfect workers, because burnout, fatigue, and other factors can lead to behaviors that decrease efficiency. Physicians may "foot-drag," delaying disposition of assigned patients, in order to increase their apparent workload when patients are assigned by a monitoring nurse manager.[11] Placing ED physicians in close physical proximity to one another and allowing them to self-assign patients appear to decrease this foot-dragging behavior, possibly because of peer pressure; however, "social loafing," whereby individual workers decrease their effort in a group setting, may come into play as physicians wait to see whether other physicians self-assign to less-desirable patients.[12] This process is also referred to as "cherry-picking" and has been described in resident physicians.[13]

An automated system of patient assignment may decrease foot-dragging and social loafing by making these tendencies, in effect, counterproductive. If an individual ED physician is given a queue of his or her own patients without regard for workload, overall length of stay for patients decreases.[3,14] One possible reason is that pooled queues may not be optimal for "strategic servers" such as physicians, who have the ability to adjust the amount of time they spend on tasks and the order in which they take on duties.[14] In 1 example, patients were assigned to physicians at the time of triage. Physicians were expected to disposition their patients before shift completion, thereby incentivizing more efficient practice because these physicians were salaried and not compensated for additional work time. The assignment system appeared to counteract what had been a consistent slowing previously noted near the end of shifts, resulting in improvements in length of stay.[14]

Work prioritization also bears mention. ED physicians have multiple simultaneous tasks competing for their attention and must balance attention to old patients with seeing new patients. Intuitively, salaried compensation models would seem to favor the first behavior, whereas productivity-based models would favor the second. Patient assignment models may fare differently based on the compensation scheme at a facility, with rotational patient assignment models likely having their greatest benefit in those departments with less incentive to acquire new patients.

CATEGORIES OF PATIENT ASSIGNMENT SYSTEMS

Several versions of patient assignment systems exist in the literature, and these interventions fall into 3 broad categories. For two (provider in triage/team triage and fast-track/vertical pathways), patient assignment is a relatively minor

component of the strategy; for one (rotational patient assignment), it is the central component.

PATIENT ASSIGNMENT TO TRIAGE TEAMS

A single provider or multidisciplinary team may be used in place of a nurse in triage.[15] Earlier contact between physician and patient should theoretically lead to a shorter length of stay for that patient, because needed interventions can be initiated earlier. The use of a specific style of provider varies; attending physicians,[16] physician assistants,[17] and residents[18] have all been shown to provide potential benefits in this role.

One multidisciplinary triage team, called the Supplemental Triage And Rapid Treatment (START), improved length of stay for both discharged and admitted patients.[17] In this approach, an attending physician assessed the patient in the triage area, identified patients suitable for the START program, and placed initial orders. A midlevel provider working side by side with this physician followed the patient's care plan to completion. Although the ED already used a fast-track area, this new team successfully dispositioned approximately 20% of patients from triage, and this percentage increased to 29% in the 3-year follow-up assessment.[19] This model relies on the triage physician to identify patients suitable for the pathway, self-assigning patients to their care team and removing patients from the main ED waiting room pool. Similar programs at other hospitals resulted in 34.8%[20] and 48.9%[21] of patients being discharged from the triage area without being assigned to physicians in the main ED.

Empowering a triage team to disposition patients may work well in hospital systems seeing large numbers of lower-acuity patients. However, there are limitations to this method, particularly when compared with other forms of patient assignment.

First, this approach relies entirely on the motivation of the treating triage team. Many of the benefits of using a provider in triage stem from early dispositions and self-assignment of less complex patients from the waiting room pool. A hospital where triage teams initiate workup and transfer care to the main ED may not achieve the same benefits as those that focus on treating patients primarily for early dispositions. In 1 facility in which an additional shift for a physician in triage led to an overall improvement in length of stay,[22] secondary analysis of the data revealed that patients dispositioned by the triage physician had a dramatically decreased length of stay, whereas patients who had triage orders placed and their care transferred to another physician in the main ED had an increased length of stay. One possible explanation is that 55% of these patients had additional tests ordered by the second physician. Institutions with greater provider variability may benefit from selection of another model of patient assignment instead of using a provider in triage.

Second, most publications report benefits when adding a provider shift to cover the triage area, begging the question of whether adding a provider shift to the main ED instead may have brought about similar or even superior results. In 1 series of experiments, when a provider was added to triage, there was an improvement in throughput that disappeared if that provider was instead repurposed from fast track.[23,24] In a pediatric ED with a preexisting fast track, the reallocation of existing staff to place a provider in triage resulted in an improvement in length of stay for patients categorized as "urgent" or "nonurgent" but prolonged length of stay for "emergent" patients[25]; this is a trade-off that must be considered at the individual hospital level.

Finally, patient satisfaction may suffer. Although some studies report improvement in patient satisfaction scores with the use of a provider in triage,[26] others have found the opposite.[27]

PATIENT ASSIGNMENT TO FAST-TRACK AND VERTICAL PATHWAYS

Another model in which patient assignment plays a role is in the streaming of patients into different areas of the ED, staffed by separate providers, based on their initial presentation. This most common version of this model is a "fast-track."

In EDs using a "fast track," patients triaged as lower acuity or predicted to require limited resources are assigned to a specific area of the department. Physicians[28,29] or midlevel providers[30,31] then staff this area in partnership with an ED nurse or technician. Fast tracks can be effective in decreasing patient wait time[28] and length of stay[29,31] while improving patient satisfaction.[31] A variety of EDs have achieved success using a fast track, including trauma-only departments[28] and those at pediatric hospitals.[29]

Fast-track areas may improve throughput and resource utilization by modifying providers' approach toward patients. One pediatric study identified strict criteria (well-appearing children ages 2 months to 10 years with no history of immunocompromise or chronic conditions, presenting with a chief complaint of fever, vomiting, diarrhea, or decreased oral intake) to indicate suitability for a fast track. At times when the fast track was closed, these patients would be treated in the main ED. Assignment to the fast track resulted in improved length of stay as well as decreased rates of test utilization, admission, and intravenous fluid administration. Follow-up calls revealed that there were no statistically significant rates of self-reported improvement, unscheduled follow-up visits, and patient satisfaction between the groups treated in the fast track or the ED.[29] This finding suggests that some aspect of the fast-track environment encouraged treating physicians to decrease their own resource utilization without compromising clinical quality, possibly because of increased efficiency pressures or a "bias toward wellness." The study investigators also posit that the fast-track environment may have had a calming effect on the children when compared with the ED, making them less fussy and therefore more well appearing. Whether such an effect is generalizable to adult EDs remains to be seen.

"Vertical pathways," like fast tracks, assign ambulatory patients to specific ED providers in a dedicated area; the hallmark of vertical pathways, as the name suggests, is that patients are not placed horizontally onto stretchers. Whereas fast tracks tend to focus on Emergency Severity Index (ESI) 4/5 patients, vertical streaming often targets ambulatory ESI 3s. In 1 study, an ED with a preexisting fast track found added benefits when converting typical patient rooms to vertical zones.[32]

Advanced use of the fast-track/vertical pathway model includes using discrete event simulation to determine the number of fast-track beds to convert to "flexible" beds that could be preferentially given to high-acuity patients unless the main ED was not at capacity.[33]

ROTATIONAL PATIENT ASSIGNMENT

The patient assignment aspects of provider in triage/team triage and fast-track/vertical pathway models may work best for EDs managing large numbers of low-acuity patients. However, EDs with higher acuity may benefit from other models. Rotational patient assignment, whereby patients are algorithmically assigned to physicians working in the main ED, has proven successful in several settings, including those with high-acuity patients.

In 1 example of a rotational patient assignment system,[3] patients are automatically and algorithmically assigned to an ED physician upon registration via a computer program integrated with the medical record. Physicians receive 4 sequential patients at the beginning of their shift and are then placed into a rotational queue with other physicians who are on shift. Physicians are removed from the queue when they have

received a predetermined maximum number of patients for the shift or 2 hours before their shift is scheduled to end (whichever comes first) to allow physicians to appropriately disposition their patients before leaving. Patients are triaged and placed into rooms according to acuity, irrespective of physician assignment, and can be placed into any physical location within the ED.

The assignment program does not take patient acuity into account. Physicians are empowered and encouraged to trade with one another if an unsafe situation is encountered (2 simultaneous cardiac arrests assigned to 1 physician, for example). Practically, however, such trading is rare. Physician shifts are staggered throughout the day at intervals to optimally align provider availability with typical departmental patient arrival curves. If too many patients arrive for the designated physician shifts, an on-call provider is activated to help manage the load, but this (like patient trading) is a rare occurrence.

Changing from a typical physician self-assignment model to the above-described rotational patient assignment system was associated with significant operational improvements, including decreases in median length of stay (11%), arrival to provider evaluation (44%), rate of left without being seen (51%), and complaints (40%). Every physician in the group had a lower length of stay after the intervention, including those who were previously the fastest. Anecdotally, physicians reported improved satisfaction with the rotational system, which they describe as "brutally fair." Nurses also report benefits, because they immediately know which physician to approach with abnormal electrocardiograms, requests for pain medications, or other concerns. This model has delivered sustained operational improvements with only minor changes to the system over recent years.[34]

One study that compared the above model to the physician in triage noted no statistically significant difference in length of stay between the 2 models,[16] but elected to use rotational patient assignment because of physician and nursing preference and a subjective belief that rotational patient assignment was a superior workflow.

One difficult constraint in this model is lack of space as it relates to the timing of patient assignment. If a computerized system assigns patients to physicians at the time of arrival, ED boarding and wait times for emergency bed availability can have an outsized impact on the ability of physicians to see their assigned patients. In periods of peak volume, physicians may be assigned to multiple patients in the waiting room with no dedicated space to evaluate them. One solution would be to switch the time of assignment from patient arrival to assignment to a physical bed, although this would likely result in the loss of several efficiencies. In an assignment-on-arrival system, physicians generally monitor their patients in the waiting room, review electronic records, order initial tests, and alert the charge nurse to abnormal vitals or concerning histories that may not have been detected in triage. Physicians may walk to the waiting room to meet their patients during triage or use set-aside areas adjacent to the waiting room to perform a brief initial history or physical examination. Literature supports the decision to keep assignment at the time of patient arrival, because wait time[35] and length of stay[14,35] are both improved when patients are assigned at the time of arrival compared with the time of bedding.

In a second example, patients were assigned to teams consisting of an ED physician, 2 ED nurses, and an ED technician.[4] The assignment was made after the initial nursing triage screening was complete. Room assignment depended on team assignment, with specific ED rooms assigned to each ED team. New physicians received fewer patients to their teams during their first few months of employment. Physicians stopped receiving patients 4 hours before the end of their shift and could leave whenever they completed work on all assigned patients. Implementation of this system led

to improved patient satisfaction, decreased wait time, and lower rates of patients leaving without being seen.

Another variation of this model takes patient acuity into account. One ED in Hong Kong split 4 doctors into 2 separate teams.[36] Patients were split into "emergent/urgent" or "semiurgent/nonurgent" queues. Teams received patients from both queues on a rotational basis.

Several factors differed in this version of rotational patient assignment compared with those mentioned above. A senior physician who was screening incoming patients would reassign patients if wait times began to differ more than 30 minutes between the 2 teams and would begin to see patients primarily if the wait time became more than 1 hour. Because 2 physicians worked within each team and did not individually receive patient loads, this system relied much more on peer pressure and inherent physician dedication to efficiency than the above-described individual assignment systems. The study did not report several crucial operational metrics (such as length of stay) but did find a decrease in the primary outcome of patient wait time.

Rotational patient assignment has been compared with acuity-based split-flow patient streaming.[37] In the first of 2 EDs within the same Taiwanese health care system, 1 physician treated all urgent cases (designated "resuscitation" or "emergency" on arrival to triage), and an additional 2 physicians treated all other patients. In the second ED, a computerized system assigned patients in rotational fashion to the 3 physicians on shift. When compared with the split-flow department, the rotational patient assignment department demonstrated a 0.4-hour increase in length of stay for discharged patients and a 1.6-hour decrease in length of stay for patients admitted to the intensive care unit. Physicians working in the split-flow department ordered fewer laboratory tests but did not differ on rates of computed tomographic scans when compared with the physicians in the rotational assignment model. There are limitations in this study, because different physicians staffed the 2 EDs, and operational differences at each institution may have influenced results.

Academic training programs employing resident physicians have also reported success with rotational patient assignment systems. Not only do such systems benefit patients, improving length of stay[5] and patient satisfaction,[38] but they also benefit residents as well. Rotational patient assignment interventions improved resident and faculty satisfaction,[5] resident perception of quality and amount of teaching,[6] and patients seen per hour by individual residents.[6] Resident assignment systems prevent cherry-picking and ensure resident exposure to a broad range of ED cases.

One study reports the feasibility of rotational team assignment incorporating multiple levels of learners paired with nursing staff.[38] The department in question created 2 teams that received patient assignments in a rotational fashion: red (third-year emergency medicine resident, rotating intern and medical student, one or 2 nurses) and blue (second- and first-year emergency medicine residents, one or 2 nurses). Perhaps unique to this model, nurses continued to receive patient assignments even if previous assignments (patients) physically remained present in their beds; this reportedly placed additional pressure on both nursing staff and physician staff to prioritize efficiency. Attending physicians did not receive patient assignments. Patient satisfaction increased significantly with this new team-based assignment, although the article did not report on critical operational outcomes.

SUMMARY

Although simple queuing theory may suggest that "pooled" models will improve efficiency, a nuanced understanding of ED operations suggests that there are important

exceptions to this rule. Patient assignment systems are deviations from simple queues that may result in improved patient flow. The improvements in throughput attributable to patient assignment may be relatively small in systems such as physician in triage/team triage and fast-track/vertical pathways, or large in systems such as rotational patient assignment.

Research examining patient assignment systems is in its infancy, with few trials published in the literature. These systems, and particularly rotational patient assignment, are associated with significant improvements in departmental operations, patient satisfaction, and resident experience when applied in an academic setting. At 1 facility, these gains have proved to be durable over time.

Patient assignment systems will likely continue to evolve as ED leaders experiment with novel methods to optimize flow. Although basic patient assignment systems have been effective, future work in this area may leverage machine learning and artificial intelligence to optimize assignments.

DISCLOSURE

The authors have nothing to disclose.

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