Transforming hospital capacity management: Experience from two academic medical centres

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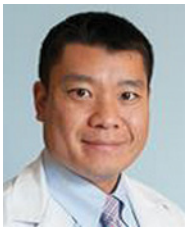

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Abstract Historically, capacity has been 'undermanaged' in health systems. Traditional mechanisms that rely on single departments to solve these problems are inadequate. New governance and managerial mechanisms are needed for redesigning care at the hospital and health system level. On the basis of our collective experience at two large academic medical centres, we identified four important elements of effective capacity management: a dedicated leadership role with a hospital-level view, centralised analytics defining universal metrics, aligned incentives across the institution and an engaged front-line staff. This paper shares case studies from two different academic medical centres, highlighting tools developed to manage patient flow and streamline operations while operating at high capacity.

KEYWORDS: capacity management, Command Center, patient flow, throughput, systems engineering

INTRODUCTION

Limited capacity and patient gridlock plague hospitals nationwide. A significant body of evidence now shows clear patient harm from not delivering 'the right care, in the right place at the right time'. 'Boarding patients', or patients who wait in the emergency department (ED) for an inpatient bed assignment, suffer higher inpatient morbidity and overall mortality and have longer total length of stay and lower patient satisfaction.[1–12] Operating room (OR) 'holds', in which a patient cannot transfer out of the OR owing to post-anesthesia care unit (PACU) or intensive care unit (ICU) space, generate expensive overruns and delay scheduled and urgent surgeries.[13–17] Many tertiary care centres are so gridlocked that they no longer serve their traditional function of accepting complex cases from outlying community hospitals; patients languish for days in facilities that cannot offer the needed specialist or procedure. In the context of innovative payment models and a transition to value-based care, matching the right patients to the right resources efficiently will be increasingly important.

Interdepartmental efforts are key to solving such patient flow and capacity problems. Many opportunities to streamline care and reduce waste occur at transition points or interactions between departments. In addition, effective collaboration between departments can unlock innovative solutions. Traditionally, hospitals have used committees to bring together representatives from

relevant departments; this approach can fall short on a number of fronts. First, the view taken is not broad or continuous enough to solve hospital-level capacity challenges; these committees usually have a very targeted mission, such as optimising length of stay or MRI scheduling. Secondly, people on the committee represent their departmental needs and goals rather than a greater goal, leading to competing agendas. Forward momentum may be limited by the need for consensus. Finally, committees often function with limited or department-specific data that may not align with other departments.

New governance and managerial mechanisms are needed to redesign care at the hospital and health system level. There is ever-increasing pressure on hospitals to deliver high-quality care, a near perfectly safe patient environment, high levels of service excellence and outstanding clinical outcomes — all while increasing operational efficiency. Academic medical centres have the added complexities of supporting educational and research missions, which add variability to operations. All these factors contribute to a complex operating environment that demands advanced management and systems engineering approaches. Here we present a framework for coordinated capacity management and highlight case studies from two different academic medical centres that manage patient flow and streamline operations while operating at high capacity.

IMPORTANT ELEMENTS OF COORDINATED CAPACITY MANAGEMENT

Capacity management has not been a traditional focus of hospital operations or strategy. From our experiences in developing this function at two academic medical centres, we highlight here four essential building blocks of an approach to capacity management (Figure 1).

Dedicated leadership with a hospital- or health system-wide view

In a decentralised academic medical centre, there is an ongoing balance between

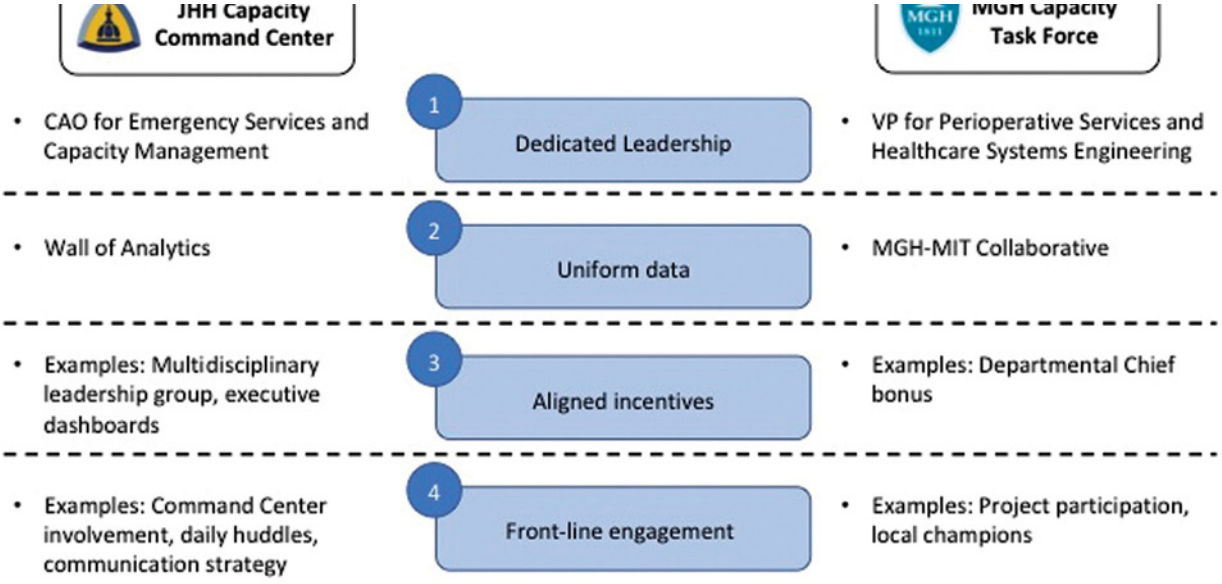

Figure 1: Essential elements of coordinated capacity management

consensus and committee-based decisions and the 'command and control' or centralised decision-making approach that is often used in the private sector.[18] At both the Johns Hopkins Hospital (JHH) and Massachusetts General Hospital (MGH), an essential executive leadership role was added to own the capacity function and to centralise decision making.

In both cases, the executive leading capacity management reports to the highest leadership level of the hospital. This is essential for three reasons: (1) decisions around capacity management must dovetail with overall strategic priorities; (2) reporting to the highest leadership level can provide political backing that may be needed for operational changes and (3) a leader outside of the traditional departmental structure can help maintain a degree of independence.

Capacity cannot be managed from within a single department because capacity creation through Lean-style waste elimination often targets processes that involve multiple departments or that take place between departments. In addition, both long-term strategic decisions and day-to-day operational decisions require a view across the institution; for example, the decision of whether to accept a transfer from another hospital or assign an ICU bed to a patient in the ED might incorporate knowledge of each patient's acuity and wait time, ED wait times, pending ICU transfers, OR schedules and holds, institutional strategic priorities and much more.

Visibility and uniformity of data and definitions

Likewise, when a specific effort to manage capacity involves multiple stakeholders and departments, a 'common language' is needed. Data definitions must be unified and come from a central source. For example, when defining length of stay, the ED may start the 'clock' at the bed request, whereas an inpatient department may start the clock at patient arrival on the unit or at the time of inpatient admission order. As another example, at JHH, definitions of 'occupancy' varied considerably by perspective; midnight occupancy used for budgetary purposes was inadequate for patient flow optimisation. Both institutions have adopted a new term, 'operational occupancy', to describe real-time bed utilisation. Finally, capacity management depends on access to both real-time data for situational awareness as well as longer-term trend data for informing future operational improvements.

A capacity management function must also make visible important metrics, in keeping with the old adage that you cannot improve what you do not measure. Some of these may be crucial real-time data feeds with planned responses for real-time management. At JHH, the Wall of Analytics in the Capacity Command Center centralises real-time data feeds across many domains. At both JHH and MGH, capacity efforts have included tracking and publication of 'unused bed time', or bed downtime between patients. Visibility into this metric has then allowed for performance improvement efforts that have reduced patient wait time. Important areas of focus for metrics include current inpatient occupancy, current and expected incoming demand from all sources, internal and external transfers and ED/PACU capacity.

There is also an increasing need for sophisticated analytic ability and predictive modelling skills; modelling, in particular, allows for 'experimentation' before pilots or may obviate the need for pilots to see the effects of changes altogether.[19–21] The analysts on the capacity management team need access to a wide range of clinical and administrative data and also need to have the technical expertise to build independent databases that link disparate data sources. Engineers and analysts with these skills may not be paired with traditional functional or operational units but are an essential component of an effective office of capacity management.

Aligned incentives

No single department can manage patient flow across the institution, but many must contribute. Indeed, individual department priorities may at times directly conflict with capacity goals. For example, repurposing a surgical bed to a medical bed to offload the ED may prevent or delay a procedure that could be profitable to the surgical department. Ultimately, consistent messaging across departments is essential; staff must understand the interconnected nature of hospital flow and appreciate that success in one area depends on another. To help departments understand and resolve these tensions, capacity management efforts must have the authority to negotiate priorities that may seem at conflict.

To engage departments in the institution's capacity mission, metrics, bonuses and other incentives need to be aligned for departmental leadership. That is, every department and functional unit that plays a role in patient admissions, OR cases, transfers from outside hospitals or other elements of patient flow needs accountability for the broader capacity goals as well. Without this alignment, individuals and leaders will have a view of 'success' that is too parochial and does not match the needs of the broader institution. At MGH, for example, department chief and senior leadership bonus pools were tied to each department's measurable contribution to reducing ED congestion. While each department had the freedom to choose how their department would contribute, their compensation was based on a common metric.

Front-line engagement and culture change

Front-line staff are critical to capacity management. Patient gridlock and patient flow breakdown often exert great pressure on them; they may have to de-escalate angry and fearful patients and families, perform care outside of their traditional scope of practice or advocate for individual patients such that every routine case requires exhausting 'heroics'. They also have the most direct view into solutions and are the instruments of process change.

A well-designed approach to capacity management will engage front-line staff. First, visibility and communication are essential. Staff need to know that leadership is working to improve the clinical and patient care environments, whether via e-mail updates, a physical command centre or leadership walk rounds. Secondly, project teams should include front-line staff who can champion and troubleshoot solutions. Thirdly, the actions and priorities of capacity management must be clear to front-line staff so that they are aware of the common objective. Lorsch and McTague have written that process changes transform culture rather than the other way around.[22] As capacity management efforts redesign hospital processes, attention to the 'hearts and minds' and morale of the front-line staff will underpin success.

While we believe that the preceding four concepts are essential to having an effective capacity management system, the implementation at each institution will vary depending on local considerations. In a majority of cases, putting the concepts into practice need not require creation of brand new resources but rather a redeployment of existing structures and resources. For example, staff within the hospital that contribute to patient flow (eg bed management, admissions) can be integrated into a capacity optimisation team.

In addition, incentive payments for capacity goals can be created without net new spending by putting a greater proportion of departmental payments or leadership salary at risk contingent on attaining hospital-level goals. Next we describe two academic institutions that have implemented the important elements of coordinated capacity management discussed.

THE JOHNS HOPKINS HOSPITAL CAPACITY COMMAND CENTER

JHH is a 1,154-bed tertiary care facility located in Baltimore, MD. It is the flagship hospital for the Johns Hopkins Health System. In the Baltimore, MD and Washington, DC areas, the health system includes five hospitals — two academic teaching hospitals and three community hospitals. JHH handles more than 48,000 inpatient admissions and 65,000 emergency visits annually. Average operational occupancy across all inpatient units is 90 per cent, with a 95.1-per cent average occupancy for the Department of Medicine. In 2014, the Board of Trustees of JHH identified patient delays as a major threat to the Johns Hopkins' patient care mission and allocated resources for a partnership with GE Healthcare and the creation of the Judy Reitz Capacity Command Center (CC).

The CC was built on systems engineering principles and modelled on command centres used in other industries, such as oil and gas and air traffic control. It occupies 5,500 square feet of space in the heart of the hospital and includes 38 workstations, 3 conference rooms and 8 offices surrounding a 'Wall of Analytics' — 13 real-time analytic tiles (Figure 2). Principal elements of this novel health system command centre include automated visual displays of real-time data providing a global view, strategic co-location of teams, predictive analytics, standard work and rules-based protocols and a clear chain of command and guiding tenets. In addition, advanced simulation modelling was used in prioritising capacity management system design efforts and is now used routinely in planning and in operations. The command centre itself is considered a tool that serves the function of managing capacity for the Johns Hopkins Health System. The centre and the management approach represent efforts to adopt system engineering principles — used in other industries — into healthcare management.

Figure 2: The Johns Hopkins Judy Reitz Capacity Command Center

A chief administrative officer for emergency services and capacity management and a director of nursing were named to co-lead capacity management efforts. A core leadership team comprising top administrators, clinicians and analysts supports the CC and guides strategic efforts. Four front-line teams essential to patient movement operate within the CC: the Hopkins Access Line (transfer line for outside physicians), Admission Services, Lifeline Transport and Bed Management. The initial goals of the CC and capacity optimisation efforts were as follows: (1) to expedite admissions from the ED and reduce ED boarding; (2) to streamline perioperative flow and eliminate OR holds and (3) to facilitate critical transfers from outside facilities.

MASSACHUSETTS GENERAL HOSPITAL CAPACITY TASK FORCE

MGH, located in Boston, MA, is a tertiary academic medical centre with 1,046 licensed beds (approximately 999 are operational on a daily basis). There are over 50,000 total admissions and approximately 63,000 ED visits annually. In 2015, there were 249 days of above 95 per cent occupancy. This high occupancy led to frequent bottlenecks in efficient patient placement. In response to these challenges, senior leadership at MGH formed the capacity task force (CTF), chaired by the president in recognition that effective capacity management requires a centralised non-departmental solution. The CTF's three main areas of focus were decreasing avoidable hospitalisations, reducing readmissions as a way to decrease admissions and addressing delays in patient placement. Each group was chaired by senior leaders (including some department chairs) of the institution. The CTF was created in recognition of the fact that capacity management is an important function in effective hospital management.

Although the CTF's name may imply a traditional committee structure, it functions more independently and has its own support functions and resources, reducing the reliance on departments to perform these roles. The CTF is led by the Vice President for Perioperative Services and Healthcare Systems Engineering. The CTF's analytics support is provided by the MGH-MIT Collaborative, which is a partnership between MGH and the Massachusetts Institute of Technology Operations Research Department in the Sloane School of Management. The MGH-MIT Collaborative uses systems engineering principles, including predictive analytics, simulation modelling, pooling and queuing methods to support CTF projects and strategic guidance. The CTF is also supported by the hospital's process improvement and project management teams. The addition of process improvement expertise is a recognition that major transformations to improve capacity challenges require understanding and redesigning of workflows.

CASE STUDIES

Capacity efforts at JHH and MGH have spanned a broad range of topics, including perioperative throughput, bed utilisation and allocation, transitions of care, full and harmonised utilisation of all hospitals in a system, transfers from outside hospitals and high-capacity 'surge' plans. Next we include two case studies that illustrate the power of centralised capacity management and reinforce the essential elements presented earlier.

JHH resolution process

The capacity management team was tasked with expediting the egress of patients from the ED to reduce wait times. It was noted that there were delays in admitting patients owing to lack of an 'accepting' service; with the exception of the general Department of Medicine units, all admissions to speciality units required

an admission approval. In some instances, a patient would be caught in 'limbo' in the ED owing to lack of an accepting service, sometimes with ED length of stay exceeding 24–48 hours and ED physicians making more than 10 phone calls for an agreement. Complex patients whose care involved multiple subspeciality teams were most likely to be affected.

A 'resolution process' was devised to expedite disposition for disputed cases. The process was triggered by a call from the ED attending to the CC. The CC would then invite the relevant attendings to a conference call to discuss the plan of care and align on a disposition. The process was specifically designed to facilitate a faculty-level discussion. Often, consensus was rapidly reached. If agreement was not reached, a disposition would be recommended by the CC nursing bed manager with the support of the CC medical director, taking into account hospital-wide bed availability. A physician advisory council that included representatives from surgery, medicine, neurosciences, critical care and emergency medicine reviewed all resolution cases monthly. In reviewing each case, the council would determine (1) whether the ultimate placement was safe and appropriate; (2) recurrent systems issues and themes and (3) needed departmental or individual physician follow-up and feedback.

Since inception, there have been over 150 calls to the resolution line. Ninety-seven per cent of cases reviewed were determined to have a safe placement. Although there were outliers, most calls took an average of 3–5 minutes; in the first three months of the programme, time from activation of the CC to acceptance ranged from 11 to 28 minutes. Multiple systems issues have been identified and addressed through the multidisciplinary physician advisory council.

The resolution process was a mechanism for centralising decision making, as the decentralised process of 'shopping around' for an accepting service was leading to unacceptable delays for complex cases. The physician advisory council provided a check on this decision making. In addition, the process allowed the CC to track the number of escalations requiring resolution calls. It also served to engage front-line physicians and provide a degree of accountability to individual physicians and departments through feedback.

MGH block reallocation

In 2008, MGH ran an average of 56 ORs each weekday and performed over 36,000 procedures. The hospital began experiencing significant delays in its perioperative environment: patients and teams were waiting in the OR for a bed in the PACU with increasing frequency; approximately 20 per cent of all cases were delayed by more than 30 minutes. The impact on access to care became real as surgeons decreased the numbers of cases they were scheduling per day. Morale across all teams was low, and overtime expense for OR services was high as elective cases stretched further into the evening and night-time hours. An initial encounter with an external consulting group at the time yielded no assistance in finding a solution. Having just started the MGH-MIT collaboration on a small scale, the institution increased its support for this new team to apply operations research tools and methodologies to help find a sustainable solution. An initial study of the patient flow of the perioperative units revealed that the inpatient beds were the main bottleneck as the PACU was congested with patients who could not move to their next phase of care in the inpatient units. Analysis revealed that this was a manifestation of suboptimal elective-surgery scheduling practices that resulted in uneven bed occupancy throughout the week.

A large-scale optimisation model was created to find a rearrangement of the

elective block schedule with the goal of smoothing the average inpatient bed occupancy throughout the week.[23] The model was revised iteratively as the team devised an implementable schedule with the surgical services over a six-month period. Further, supported by both hospital and departmental leadership, the central team was given the authority to make the proposed changes to the surgical block schedule.

Approximately 14 per cent of the OR blocks were rearranged to achieve smoother inpatient bed occupancy across the week. The peak average weekly census decreased by 3.2 per cent ($p < 0.05$) and the average weekday census decreased by 2.8 per cent ($p < 0.001$) for the patient group most similar to the circumstances under which the model was built. During this period, the census peak increased 1.6 per cent ($p < 0.05$) and the average weekday census increased by 2 per cent ($p < 0.001$) for all surgical patients. In addition, the surgical volume increased by 9 per cent during the period of analysis, with one fewer bed assigned to the surgical services compared with the number of beds assigned in 2008. Finally, PACU delays reduced to less than 5 per cent of all cases with delay times of less than 15 minutes when they occurred.

CONCLUSION

Historically, capacity has been 'undermanaged' in health systems. Traditional mechanisms that rely on single departments to solve these problems are inadequate. Reliance on existing departmental leadership and resources also risks creating solutions that are perceived as advantageous to one department over another. In the current environment of ever-increasing financial and throughput pressures, hospitals need newer tools to manage capacity efficiently. On the basis of our collective experience at two large academic medical centres, we identified four important elements to effective capacity management: dedicated leadership with a hospital-level view, centralised analytics defining universal metrics, aligning incentives across the institution and engaging the front line in capacity optimisation. Ultimately, these structural components support a transition to a more sophisticated, systems engineering-based approach to capacity optimisation that is applicable to both community and academic health systems.

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