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The trade-off between inpatient bed overflow and A&E admission wait time

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Background: Our issue in 2009 (1) discussed variation management with a focus on partitioning and pooling. We used Queueing Theory to illustrate that with the same total workload and service provision, a service system with less partitioning will have lower waiting time at the same utilisation level. In this issue, we will discuss the determinants of bed overflow using concepts from Operations Research.

What is bed overflow?

Inpatient beds are organised by clinical specialties for patient care, e.g. General Medicine, Orthopaedic Surgery. Ideally a patient should be assigned to the ward of the designated specialty. However sometimes the right bed of the specialty is not available and the patient has to be given a bed from another specialty, resulting in 'bed overflow' and transfer back after that. This has implications for clinical care and workflow, but it does ensure that patients will have a faster access to inpatient beds.

Why does bed overflow occur?

A common question is: why is there a 'bed shortfall' when the hospital is not operating near 100%, even after discounting beds that have been reserved for specialised purposes, such as intensive care units and isolation beds? To answer this, we first examine the demand and supply at specialty level. While the bed occupancy rate (BOR) at hospital level may be healthy, individual specialty may see much higher or lower BOR. Another reason is a result of mismatch between demand and supply at the point of demand, both at the daily and hourly level. Figure 1 shows generic admission and discharge volume by day of the week, and Figure 2 shows the hourly pattern within a typical day. In Figure 1, we see a hospital will typically, for a few successive days, have more admissions than discharges. This will cause a steady rise in bed occupancy and therefore increase the chances of having a 'bed tight' situation. We see in Figure 2 that during a typical day, requests of beds occur throughout the day while discharges are possible only during some hours, resulting in variation in patients waiting throughout the day.

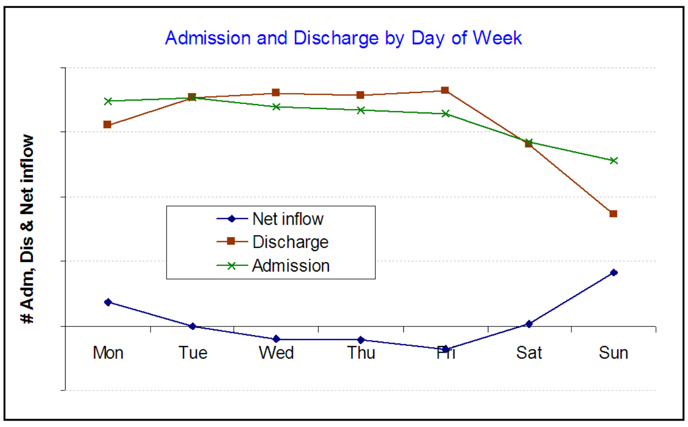

Figure 1: Day of week pattern

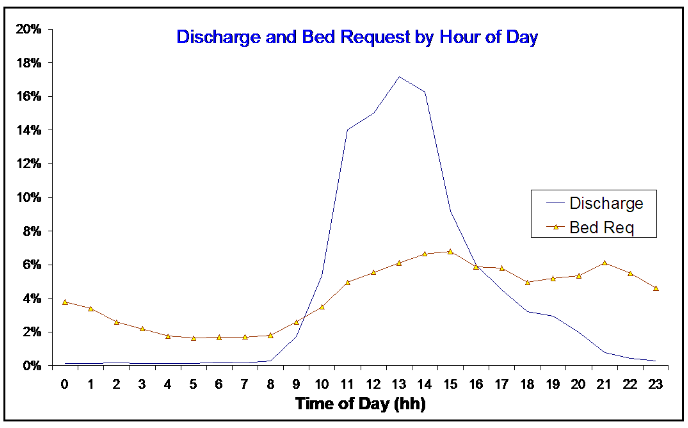

Figure 2: Hour of day pattern

Under such circumstances, either the hospital needs to cater for excessive bed buffer, or the patients need to wait for a bed to be available. This is what we observe as "wait" at the Accident & Emergency Department (A&E). The need to partition the patients by specialty makes the situation more intricate as we will need to operate with a smaller pool of supply. This point was discussed in our earlier issue 2009 (1).

Possible actions and trade-offs

What then can one do with the current resources? Is ring-fencing of wards a possible solution?

The fundamental solution lies in matching the demand and supply in a timely manner — however, this is easier said than done. At a tactical level, overflow reduces the problem of long waiting time for a bed. This can be viewed as a trade-off between providing inpatient care as soon as possible (waiting in A&E), versus having the designated ward for optimal clinical care. As illustrated in Figure 3, by accepting a higher threshold of A&E bed wait time, the likelihood of overflow will reduce.

In comparison, strict ring-fencing means that each specialty will only admit its own patients and therefore no overflow is allowed. From a queueing perspective, this is a form of partitioning and the downside is excessive waiting at the A&E. Due to the random nature of demand in healthcare, this will potentially lead to high wait time and low utilisation. Figure 4 illustrates the benefits of economies of scale of having a bigger bed pool on bed wait time.

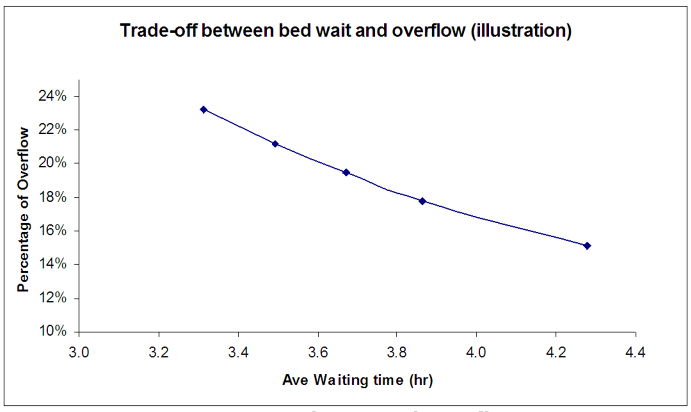

Figure 3: Bed wait and overflow

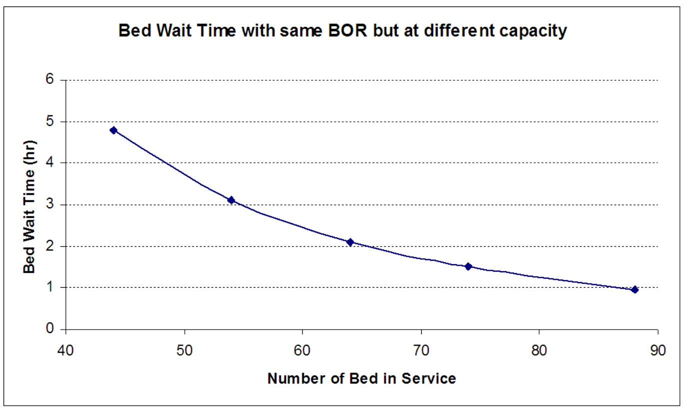

Figure 4: Economies of scale on bed wait time

Another possible area for exploration is reduction of patients' scatter for each specialty. The idea is that given the same amount of overflow, could we find a way to 'consolidate' the overflow? This may involve finding some 'groupings' or 'chaining'.

Patients need to be right-sited and admitted quickly as both overflow and excessive patient wait time impact patient safety. We must understand the trade-off between them and know that the impact is at inpatient and A&E respectively. Decision makers have to make a judgment call for a suitable operating point for their own hospitals knowing that the common denominator is patient safety.

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