Clinical Operations Research: A New Frontier for Inquiry in Academic Health Systems

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Patient throughput in healthcare systems is increasingly important to policymakers, hospital leaders, clinicians, and patients alike. In 1983, Congress passed legislation instructing the Centers for Medicare and Medicaid Services (CMS) to implement the "prospective payment system," which sets reimbursement for CMS hospitalizations to a fixed rate, regardless of the length of stay (LOS). Policy changes such as this coupled with increased market consolidation (ie, fewer hospitals for more patients) and increased patient acuity have created significant challenges for hospital leaders to manage patient throughput and reduce or maintain LOS.[1] Additionally, emergency department (ED) overcrowding and intensive care unit (ICU) capacity strain studies have demonstrated associations with adverse patient outcomes and quality of care.[2-5] Finally, and perhaps most importantly, the impact of these forces on clinicians and patients has compromised the patient-clinician relationship and patient experience. As patient throughput is important to multiple stakeholders, novel approaches to understanding and mitigating bottlenecks are imperative.

The article by Mishra and colleagues in this month's issue of the *Journal of Hospital Medicine* (JHM) describes one such novel methodology to evaluate patient throughput at a major academic hospital.[6] The authors utilized process mapping, time and motion study, and hospital data to simulate four discrete future states for internal medicine patients that were under consideration for implementation at their institution: (1) localizing housestaff teams and patients to specific wards; (2) adding an additional 26-bed ward; (3) adding an additional hospitalist team; and (4) adding an additional ward and team and allowing for four additional patient admissions per day. Each of these approaches improved certain metrics with the tradeoff of worsening other metrics. Interestingly, geographic localization of housestaff teams and patients alone (Future State 1) resulted in decreased rounding time and patient dispersion but increased LOS and ED boarding time. Adding an additional ward (Future State 2) had the opposite effect (ie,

decreased LOS and ED boarding time but increased rounding time and patient dispersion). Adding an additional hospitalist team (Future State 3) did not change LOS or ED boarding time but reduced patient dispersion and team census. Finally, adding both a ward and hospitalist team (Future State 4) reduced LOS and ED boarding time but increased rounding time and patient dispersion. These results provide a compelling case for modeling changes in clinical operations to weigh the risks and benefits of each approach with hospital priorities prior to implementation of one strategy versus another.

This study is an important step forward in bringing a rigorous scientific approach to clinical operations. If every academic center, or potentially every hospital, were to implement the approach described in this study, the potential for improvement in patient outcomes, quality metrics, and cost reduction that have been the intents of policymakers for over 30 years could be dramatic. But even if this approach were implemented (or possibly as a result of implementation), additional aspects of hospital operations might be uncovered given the infancy of this critical field. Indeed, we can think of at least five additional factors and approaches to consider as next steps to move this field forward. First, as the authors noted, multiple additional simulation inputs could be considered, including multidisciplinary workflow (eg, housestaff, hospitalists, nurses, clinical pharmacists, respiratory therapists, social workers, case managers, physical and occupational therapists, speech and language pathologists, etc.) and allowing for patients to transfer wards and teams during their hospitalizations. Second, qualitative investigation regarding clinician burnout, multidisciplinary cohesiveness, and patient satisfaction are crucial to implementation success. Third, repeat time and motion studies would aid in assessing for changes in time spent with patients and for educational purposes under the new care models. Fourth, medicine wards and teams do not operate in isolation within a hospital. It would be important to evaluate the impact of such changes on other wards and services, as all hospital wards and services are interdependent. And finally, determining costs associated with these models is critical for hospital leadership, resource allocation, implementation, and sustainability. For example, Future State 4 would increase admissions by 1,080 per year, but would that offset the cost of opening a new ward and hiring additional clinicians?

In addition, the authors feature the profoundly important concept of "geographic localization." This construct has been investigated primarily among critically ill patients. Geographic

dispersion has been shown to be associated with adverse clinical outcomes and quality metrics.[7] Although this has begun to be studied among ward patients,[8] the authors take this a step further by modeling future states incorporating geographic localization. Future State 4 resulted in the best overall outcomes but increased rounding time and patient dispersion, although these differences were not statistically significant. This piques our curiosity about the possibility of a fifth future state: adding geographic localization to Future State 4. Adding a new ward and new clinician team might provide a unique opportunity to geographically localize patients and to study the collective impact. Additionally, it is possible that geographic localization only improves outcomes if all teams (ie, house-staff and hospitalist teams) have geographically localized patients rather than exclusively housestaff having geographically localized patients.

Indeed, these results raise much broader and interesting questions surrounding ward capacity strain, that is, when patients' demand for clinical resources exceeds availability.[9] At our institution, we conducted a study to define the construct of ward capacity strain and demonstrated that among patients admitted to wards from EDs and ICUs in three University of Pennsylvania Health System hospitals, selected measures of patient volume, staff workload, and overall acuity were associated with longer ED and ICU boarding times. These same factors accounted for decreased patient throughput to varying, but sometimes large, degrees.[10] We subsequently used this same definition of ward capacity strain to evaluate the association with 30-day hospital readmissions. We demonstrated that ward capacity strain metrics improved prediction of 30-day hospital readmission risk in nearly one out of three hospital wards, with medications administered, hospital discharges, and census being three of the five strongest predictors of 30-day hospital readmissions.[11] These findings from our own institution further underscore the importance of the work by Mishra et al. and suggest future directions that could combine different measures of hospital throughput and patient outcomes into a more data-driven process for optimizing hospital resources, supporting the efforts of clinicians, and providing high-quality patient care.

This study is a breakthrough in the scientific rigor of hospital operations. It will lay the groundwork for a multitude of subsequent questions and studies that will move clinical operations into evidence-based practices. We find this work exciting and inspiring. We look forward to additional work from Mishra et al. and look forward to applying similar approaches to clinical operations at our institution.

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