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Improving handoff efficiency for admitted patients: A multidisciplinary, lean-based approach

Although Emergency Department (ED) crowding remains a national problem, efforts to improve ED process efficiency and optimize throughput can potentially increase functional ED capacity [1,2]. As a frequently occurring process with potential for significant waste and complexity, handoffs between the ED and inpatient teams represent an opportunity to apply systems improvement science and reduce delays [3,4]. In addition, the inpatient handoff process represents the final bottleneck in patient progression through many EDs and thus is a particularly important area of focus given the theory of constraints and potential effects on ED and hospital capacity utilization [5-7]. Systems engineering methodologies have demonstrated success in other areas of ED process flow [8-10]. Therefore, we hypothesized that a multidisciplinary, Lean-based effort involving different stakeholder groups could achieve improved handoff process efficiency and reduced turnaround times.

We performed a retrospective, before-and-after analysis at an urban, tertiary-care academic medical center with >112,000 annual visits. Patient ED flow follows a relatively standard course of diagnosis and disposition, with an inpatient admission rate of ~25% overall. All adults admitted to the medicine service between 8/1/16–8/1/2018 were included; the intervention occurred 7/10/17. The primary outcome was median overall turnaround time between "bed ready" and patient arrival on the inpatient unit. Secondary outcomes included median provider and nursing handoff times, and patient transport time. Data were collected from a computerized tracking system (EPIC, Verona, WI) and a run chart created to track progress (Tableau, Seattle, WA).

The intervention consisted of multiple, Lean-based process improvement and parallel processing optimizations developed by a multidepartmental team including leadership from Emergency Medicine, Medicine, Nursing, Admitting, and Patient Transport. Four workgroups focused on: (1) communicating expected discharges to Admitting earlier, (2) nursing handoff optimization, (3) provider handoff optimization, and (4) transport process optimization. Process optimization components included improved communication efficiency, utilizing planned discharge patient lead time to start the new patient handoff process, and performing provider handoff when the patient was assigned to a bed, even if the bed remained 'dirty' (not yet ready to accept the patient in transfer). Median turnaround times were compared using Mann-Whitney *U* Test for significance.

Post-intervention, improvement was noted in all metrics. Overall median time from "bed ready" to patient on-unit arrival decreased by 30 min (101 to 71 min, $p < 0.01$). Median provider handoff time decreased 33 min (52 to 18 min, $p < 0.01$). Nursing handoff and transport times decreased 9 min (35 to 26 min, $p < 0.01$) and 5 min (32 to 27 min, $p < 0.01$), respectively (Fig. 1). This represented a cumulative gain of ~10 ED bed hours daily.

In this pilot study, a multidisciplinary group utilizing Lean methodologies and parallel processing techniques successfully and sustainably decreased the overall median time from bed ready to patient arrival on an inpatient unit. Given the significant inpatient capacity constraints

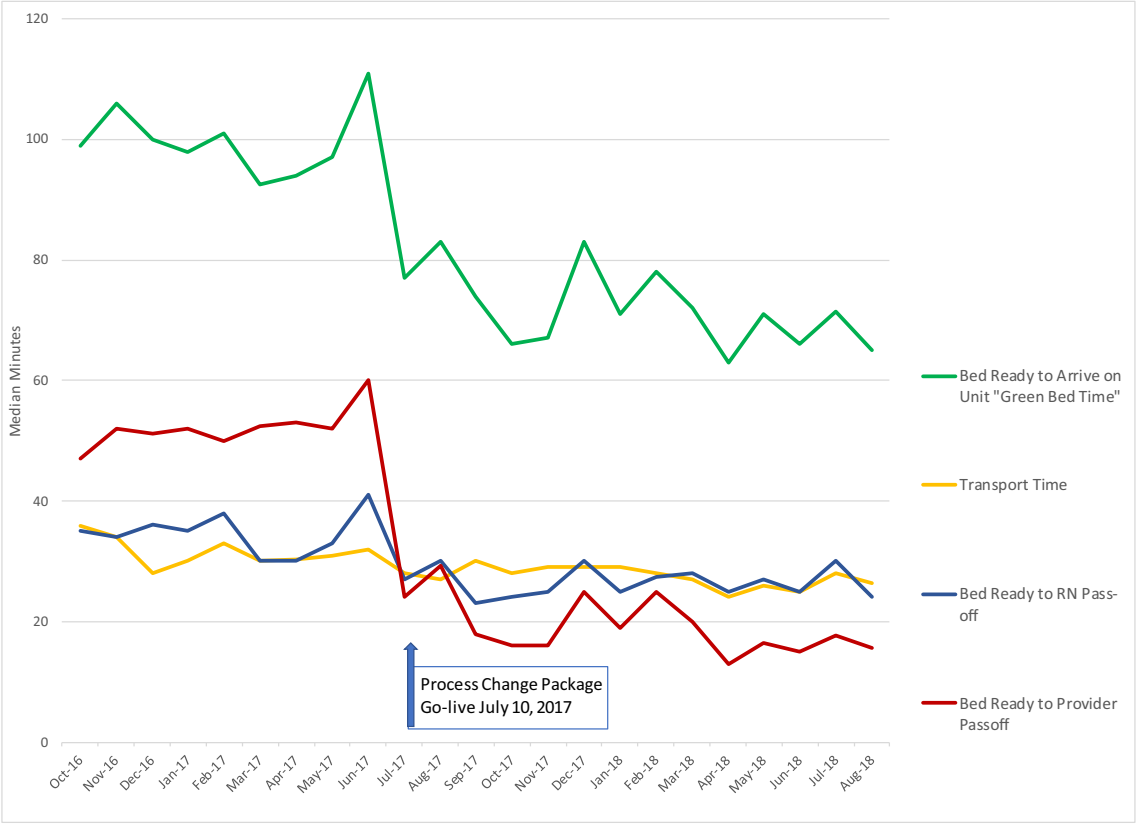

Fig. 1. Handoff process times.

faced by many hospitals, costs of wasted inpatient capacity, and negative upstream effects on ED capacity and length of stay [7], our findings have several potential important implications.

First, a multi-disciplinary group utilizing systems engineering techniques can sustainably and significantly improve capacity utilization in a complex academic hospital setting. Secondly, while this success was noted only with our Department of Medicine, such improvements might be generalizable to other services within our hospital. In addition, given the relatively standard process of patient handoff at most hospitals, it is likely these techniques are generalizable to other institutions who could realize similar gains. This pilot study also further underscores the value of using Lean methodologies (including focus on reducing waste in all forms, and decreasing process complexity) to optimize an unnecessarily complex process. We also found that mapping the process with "swim lanes" (a Lean technique in which role group specific actions are explicitly mapped [11]) allowed identification and leveraging of parallel processing opportunities.

Our study has several limitations. First, it is possible that the significant improvement in handoff times were due to other external factors. However, we were unable to identify any such factors and the sustainability of our results suggest otherwise. Second, as a single-center study, our findings may not generalize to hospitals with different handoff processes or underlying technological support systems (e.g. electronic medical records, telecommunication systems, etc.). However, given most handoff processes likely follow a relatively similar course, at least some "lessons learned" might be broadly applicable. Finally, our pilot did not estimate the cost savings associated with improved handoff efficiency and capacity utilization, but in a capacity-constrained system such as ours, a cumulative gain of ~10 bed hours daily is of significant value to the hospital and the ED.

In summary, in this single-center study, a multidisciplinary Lean-based reorganization of patient handoff practices improved performance measures and process efficiency. This represented a cumulative gain of ~10 ED bed hours daily. Broad, multi-centered application of systems engineering science might further improve ED throughput and capacity. Further study should quantify resource use implications.

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Effect of menstrual bleeding on the detection of anogenital injuries in sexual assault victims

The physical examination of sexual assault victims is performed to identify and treat injuries, as well as collect forensic evidence for prosecution. The combination of colposcopy with digital imaging and staining with contrast media such as toluidine blue, has led to reports of genital injury prevalence approaching 90% following nonconsensual sexual intercourse [1]. Such forensic evidence of anogenital injury influences decision making and legal outcomes throughout the criminal justice process. Because the examination is based on scientific evidence, it may influence victims to report their experiences to police, encourage police to file a complaint, and persuade prosecutors to file rape charges and pursue a conviction [2]. For example, McGregor et al. demonstrated that the presence of anogenital trauma was significantly related to filing of charges by the prosecutor as well as conviction [3].

Additional research is needed, however, to understand those factors that might influence the detection of anogenital trauma. For instance, previous investigators have suggested that individuals with darker skin may be at a disadvantage for injury identification with current examination strategies and color awareness may be an important component of the sexual assault forensic examination [4,5]. In addition, the presence of menstrual bleeding might also affect the identification of anogenital injury. Therefore, the purpose of this study was to determine the role of menstrual bleeding in the documentation of anogenital injury following sexual assault.

This was a retrospective, matched (1:4) cohort analysis set in a community-based nurse examiner program (NEP) over an eight-year study period. The study was designed to explore differences in frequency of identified anogenital injuries among menstruating and non-menstruating women. Most patients came from law enforcement dispatch and crisis line contacts. Those sexual assault victims presenting directly to the four city emergency departments were transferred to the NEP for evaluation after triage and initial assessment. The NEP was staffed by 9 forensic nurses trained to perform medical-legal examinations. Sexual assault victims were selected for inclusion in the study if they were currently menstruating and agreed to a forensic examination. This examination consisted of direct visual inspection, 1% toluidine blue contrast application, followed by colposcopy using a Cooper Surgical Leisegang© colposcope system with 30× magnification. After each technique, nurse examiners documented the types and number of anogenital injuries visualized using a standardized classification system [6].

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