Evaluation of Hospitalizations Preventable with Idealized Outpatient Care and Continuity of Care

Shawn X. Li · Marcela G. del Carmen · Ryan W. Thompson · Elizabeth T. Cañiero-Fonseca · Helaine Rockett · Timothy G. Ferris · Della F. Terry · Ana Sofia Warner · Amy Yu · Jason H. Wasfy

ABSTRACT
Background: Unnecessary hospitalizations may pose the risk of iatrogenic complications, suboptimal patient experience, and increased cost. Administrative data lack granularity to understand the proportion and causes of hospitalizations preventable through optimizing care continuum (HPOCC). We aim to identify the incidence and causes of HPOCC through clinician-adjudicated chart review.

Methods: A retrospective review was performed for inpatient admissions from the emergency department (ED) over 1 week. Each admission was reviewed by a clinician to determine whether it is an HPOCC defined as not requiring inpatient care with the assumption of idealized outpatient care and social support.

Results: Of the 515 patients admitted from the ED, 31 (6.0%) patients were judged to have had an HPOCC. Causes of HPOCC include urgent diagnostics (9, 29.0%), unnecessary transfer from a long-term facility (7, 23.0%), needing IV therapy (5, 16.0%), benign incidental finding (5, 16.0%), diagnostic uncertainty in complex chronic illness (3, 10.0%), and lack of access to care for disposition (2, 6.0%).

Conclusion: Hospitalizations preventable through optimizing care continuum account for about 1 in every 15 hospitalizations in an urban academic medical center. The need for urgent diagnostics accounts for a plurality of HPOCC and could be an important target for quality improvement.

Keywords: preventable hospitalization, continuity of care, healthcare utilization, urgent diagnostics

Introduction
Value-oriented payment mechanisms, including accountable care organizations, have created incentives for healthcare providers and provider organizations to shift inpatient care to other settings. As such, the care continuum has expanded to services outside the hospital and primary care clinics to include visiting nurses, ancillary services at home, and even home hospitals. To this end, increasing after-hours care, intensifying monitoring of high-risk patients, and improving medication adherence all have been shown to reduce avoidable hospital admissions.

Hospitalizations preventable through optimizing the care continuum (HPOCC) is a novel concept that looks at in detail, in a holistic fashion, the clinical and social events that led up to a potentially preventable admission. Reducing HPOCC may be a promising target for improving quality and value. Hospitalizations preventable through optimizing care continuum can expose patients to iatrogenic complications, a suboptimal patient experience, and increased costs. Identifying the scope and causes of HPOCC is a first step into understanding how to improve the care continuum to deliver higher value care to patients.

Previous studies from administrative databases have shown that more than a quarter of admissions from the emergency department (ED) are potentially avoidable. Minority race, lack of insurance, comorbid mental health problems, or substance use disorders (SUDs) were identified as independent predictors of preventable admissions. Patients were often admitted for conditions that could be managed in the ambulatory setting, including congestive heart failure, bacterial pneumonia, and urinary tract infections. Furthermore, administrative level data have shown that a plurality of the Medicare Coordinated Care Demonstration programs that leverage outpatient management reduced hospitalizations by 8–33%. Similarly, review of the
Evidence suggest that there is a lower rate of hospitalization rate for ambulatory care sensitive conditions in areas with greater access to primary care. Although administrative data provide some assessment of the scope of the problem, they may miss important granular clinical details that affect preventability and provide an inadequate understanding of clinical causes of preventability. As such, clinical data are required to understand both the scope of HPOCC and causes that may provide insight into evidence-based solutions. We conducted a clinical, physician-adjudicated chart review to determine the proportion of HPOCC. We then used this information to identify specific resources in the outpatient setting that may have prevented them.

Methods

Data Sources and Patient Selection

The study was performed in an urban, nonprofit, academic medical center, with nearly a 1,000-bed capacity. IRB approval was obtained from the study institution for the collection and analysis of data outlined below (IRB protocol number 2018P002397). All inpatient admissions from the ED were identified from September 17, 2017 to September 23, 2017. Enterprise Data Warehouse was queried for patient baseline variables including: age, gender, insurance status, length of stay (LOS), home distance from hospital, hypertension, diabetes, congestive heart failure, diabetes mellitus, chronic obstructive pulmonary disease, and whether the patient has seen the primary care physician (PCP) within the last year. The above comorbidities were extracted from the International Classification of Disease (ICD) codes within the last year with similar diagnosis congegregated into a SNOMED concept. SNOMED is a suite of designated standards accepted by the U.S. federal government for the electronic exchange of clinical information and as a standard in interoperability. Using SNOMED concepts allow grouping of multiple similar ICD codes for analysis. Distance from the hospital was calculated by the average driving distance between home zip code and the zip code of the study site.

Chart Review

Chart review was performed by a physician to determine whether a hospitalization was an HPOCC or not, along with the reason for HPOCC. A subset of reasons for HPOCC was defined a priori which included: the need for urgent diagnostics, need for IV therapy, and lack of access to care for disposition. Additional categories were designated following chart review, which included unnecessary transfer from a long-term facility, benign incidental finding, and diagnostic uncertainty in complex chronic illness. Urgent diagnostics refers to patients with acute presentations that need timely diagnostics and thus are admitted to coordinate the logistics of an urgent workup. Unnecessary transfer from a long-term facility refers to patients with longitudinal care (e.g., rehabilitation, partial hospitalization program) who were transferred to the ED for reasons other than needing inpatient level of care. Patients needing IV therapy refers to patients who were diagnosed and clinically stable, but admitted because IV therapy could not be administered as an outpatient (i.e., in cases where oral medications do not act as an adequate substitute such as the need for IV diuresis). Benign incidental finding refers to asymptomatic patients with a finding on laboratory or imaging test unrelated to the original presentation and admitted for nonurgent inpatient work-up of the incidental finding. Diagnostic uncertainty in complex chronic illness refers to benign presentations and unrevealing work-up in a chronically ill, and medically complex patient who was admitted given diagnostic uncertainty. Lack of access to care for disposition refers to patients who were ready to be discharged from the ED, but could not find a safe disposition plan and were thus admitted. Causes of HPOCC are intended to be mutually exclusive, but if there are multiple causes, the clinician reviewer identified the most important cause. Reasons for HPOCC and fictional example cases are tabulated in Table 1. A second physician reviewed a random sample of 100 cases while blinded to the first reviewer’s determination and categorized in the same fashion described above, if the admissions were HPOCC.

Within each patient chart encounter, data used to evaluate whether the admission was HPOCC included all relevant information at the time of presentation including, but not limited to: patient notes, vitals, lab values, radiographic reports, cardiology reports (including but not limited to consult notes, interpretation of echocardiograms, coronary angiograms, and pacemaker/defibrillator interrogations), electrocardiograms, and microbiology data. Patient data were reviewed in chronological order to determine the necessity of admission at the time of patient presentation to minimize retrospective bias from knowing the clinical course.
Endpoints and Statistical Methods

Hospitalizations preventable through optimizing care continuum was defined as not requiring an inpatient level of medical care with the assumption of idealized outpatient support to overcome the outlined causes of HPOCC. This definition looks at the events surrounding the admission and assessing how better outpatient support could have prevented the admission. Importantly, this definition is agnostic to ambulatory sensitive conditions (i.e., being admitted for an ambulatory sensitive condition does not necessarily define HPOCC). Furthermore, this pragmatic definition focuses on optimizing care continuum in the near term (i.e., an admission for a complication of diabetes is not categorized as an HPOCC because lifestyle modifications starting in childhood could have prevented the current admission). Between HPOCC and non-HPOCC patients, categorical variables were reported as frequency and percentage, and continuous variables were reported as mean and SD. Distance data had a significant rightward skew with a skew coefficient of 5.9. Thus, the median rather than the mean and SD of distances were reported. Sample size was not calculated ex ante given the analytical aim of the primary outcome was exploratory and subset of the HPOCC categories were not prespecified. Of the 100 random cases reviewed by two physicians, congruence between the

<table>
<thead>
<tr>
<th>Reason for HPOCC</th>
<th>Description of reason</th>
<th>Fictional example cases</th>
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<tbody>
<tr>
<td>Urgent diagnostics</td>
<td>Patients with acute presentations that need timely diagnostics and thus admitted to coordinate the logistics of an urgent workup</td>
<td>78M with a history of hypertension, hyperlipidemia, congestive heart failure and atrial fibrillation, presenting with epigastric discomfort. Admitted for serial troponins to rule out myocardial infarction</td>
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<td>Unnecessary transfer from a long term facility</td>
<td>Patients with outpatient or longitudinal care (e.g., rehabilitation, partial hospitalization program, hospice) who were transferred to the ED for reasons other than needing inpatient care</td>
<td>57M with a history of ALS status post-PEG placement who presents from rehab with difficulty clearing secretions admitted to optimize respiratory care</td>
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<td>Needing IV therapy</td>
<td>Patients who had rapid diagnosis of a condition in the ED and were clinically stable but admitted for IV therapy.</td>
<td>76F with history of CAD, HFpEF, CKD, presenting with orthopnea and weight gain, admitted for IV diuresis for heart failure exacerbation</td>
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<td>Benign incidental finding</td>
<td>Patients with a finding on laboratory or imaging test unrelated to the original presentation and admitted for nonurgent inpatient workup of the incidental finding.</td>
<td>38M with no significant past medical history who underwent CT A/P for concern of nephrolithiasis was admitted for workup of an incidentally found 0.5-cm adrenal mass</td>
</tr>
<tr>
<td>Diagnostic uncertainty in complex chronic illness</td>
<td>Benign presentations and unrevealing work-up in a chronically ill, and medically complex patient who was admitted given diagnostic uncertainty</td>
<td>72F with a past medical history of protein losing enteropathy, multiple bowel surgeries including bowel resection with chronic abdominal pain presenting with acute on chronic lower abdominal pain. Pain improved after bowel movement in the ED. CT A/P in ED suggested enteritis, but MRI A/P was negative. Admitted for further workup</td>
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<tr>
<td>Lack of access to care for disposition</td>
<td>Patients were ready to leave the ED after assessment of presenting problem, but could not find a safe disposition plan.</td>
<td>31F with a history of polysubstance use disorder presenting for detox. Patient was evaluated by the addiction team with plan for disposition to crisis stabilization center, but there were no beds, thus admitted</td>
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ALS = amyotrophic lateral sclerosis; A/P = abdominal/pelvic; CAD = coronary artery disease; CKD = chronic kidney disease; CT = computed tomography; HFpEF = heart failure with preserved ejection fraction; MRI = magnetic resonance imaging; HPOCC = hospitalizations preventable through optimizing care continuum; PEG = percutaneous endoscopic gastrostomy.
two reviewers was determined by calculating the kappa statistic using Stata 13.19 (StataCorp, College Station, TX).

Results
Of the 515 patients admitted from the ED between September 17, 2017 and September 23, 2017, 31 (6.0%) patients were judged to have had an HPOCC by clinical review (Table 2). On average, HPOCC patients were older (68 vs. 55), more likely to be female (61.3% vs. 41.5%), and had shorter LOS (4.1 ± 2.5 days vs. 7.4 ± 7.7 days) compared with those who were not. The distribution of insurance status between HPOCC and non-HPOCC was different with HPOCC patients more likely to have Medicare (48.4% vs. 21.1%) and less likely to have Medicaid (16.1% vs. 21.9%) and private insurance (35.5% vs. 57.0%). The median distance from the hospital for HPOCC patients is 6.7 miles and 11.6 miles for non-HPOCC patients.

Patient comorbidities were similar between the two groups, with HPOCC patients having a higher rate of diabetes (35.5% vs. 15.9%). Other variables are demonstrated in Table 2. The frequency of seeing PCPs within the last year was similar between the two groups (9.7% for HPOCC and 4.7% for non-HPOCC).

Of the 31 patients who were judged to have HPOCC, the reasons were: urgent diagnostics (9, 29.0%), unnecessary transfer from a long-term facility (7, 23.0%), needing intravenous (IV) therapy (5, 16.0%), benign incidental finding (5, 16.0%), diagnostic uncertainty in complex chronic illness (3, 10.0%), and lack of access to care for disposition (2, 6.0%) (Figure 1). Kappa statistic for the 100 randomly reviewed cases by two physicians was 0.81 which suggest their separate analysis to be in almost perfect agreement.19

Limitations
There are limitations to this study. First, it was a retrospective review of a limited sample of patients who were admitted from the ED at a single institution over the course of 1 week. Although the week was chosen to avoid major weather events or holidays, it is possible that the results reported here do not reflect the general pattern of admissions from the ED. Furthermore, sample-size calculations were not performed given the exploratory nature of the analytical aim; however, we hope that our work could be the basis of future quantitative work. Second, although a subset of charts was subject to double review, individual reviewer biases could confound the result. Third, the determination of HPOCC was meant to faithfully recreate the decision making of the clinician at the time of

Table 2. Patient Baseline Characteristics

<table>
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<th>HPOCC, n = 31</th>
<th>Non-HPOCC, n = 484</th>
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<tbody>
<tr>
<td>Age</td>
<td>68.0 (19.0)</td>
<td>55.7 (22.6)</td>
</tr>
<tr>
<td>Gender (female)</td>
<td>19 (61.3%)</td>
<td>201 (41.5%)</td>
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<tr>
<td>Payer</td>
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<tr>
<td>Medicare</td>
<td>15 (48.4%)</td>
<td>102 (21.1%)</td>
</tr>
<tr>
<td>Medicaid</td>
<td>5 (16.1%)</td>
<td>106 (21.9%)</td>
</tr>
<tr>
<td>Private</td>
<td>11 (35.5%)</td>
<td>276 (57.0%)</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td>4.1 (2.5)</td>
<td>7.4 (7.9)</td>
</tr>
<tr>
<td>Distance from hospital (mi)</td>
<td>6.7</td>
<td>11.6</td>
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<tr>
<td>Hypertension</td>
<td>18 (58.1%)</td>
<td>196 (40.5%)</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>8 (25.8%)</td>
<td>65 (13.4%)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>11 (35.5%)</td>
<td>77 (15.9%)</td>
</tr>
<tr>
<td>COPD</td>
<td>2 (6.5%)</td>
<td>43 (8.9%)</td>
</tr>
<tr>
<td>Seen PCP within last year</td>
<td>3 (9.7%)</td>
<td>23 (4.7%)</td>
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COPD = chronic obstructive pulmonary disease; HPOCC = hospitalizations preventable through optimizing the care continuum; PCP = primary care physician.

Figure 1. Causes of HPOCC reported as percentages of all HPOCC. HPOCC, hospitalizations preventable through optimizing the care continuum.
admission, more objective methods of determining 
HPOCC such as a scoring system would increase the 
reproducibility of these results. Fourth, there are 
likely factors contributing to the decision of 
admission independent of the medical condition 
(i.e., anxiety around illness) that is not accounted 
for in this analysis. A prospective study with real time 
patient/family interview would complement un-
derstanding the admission decision. Differences in 
patient comorbidities and insurance status are likely 
confounded by differences in age. Future pro-
spective studies are necessary with multiple physi-
cian adjudicators to confirm our findings.

Discussion
In this study, we report that about 1 of every 15 
admissions were preventable by idealized outpatient 
systems of care. Previously reported rate of prevent-
able admissions ranges from 9 to 38%, which is 
higher than what we have found in this study of 
6%.9,10 Differing definition of a preventable admis-
sion and differing data sources (administrative vs. 
chart review) could be drivers of the observed 
difference. In our study, HPOCC patients were more 
likely to be older and have diabetes—both of which 
are associated with prolonged LOS.20,21 Despite this 
fact, we found that HPOCC patients had a signifi-
cantly shorter LOS compared with non-HPOCC 
patients. This finding likely reflects the preventable 
nature of the admission for patients who did not need 
extensive inpatient level of medical care.

By identifying the causes of HPOCC, we can begin 
thinking about strategies to overcome these barriers 
(Figure 2). This study identified three logistical 
shortcomings that result in preventable admissions 
that make up 61% of the HPOCC: lack of access to 
urgent diagnostics, need for IV medications, and 
nonstandardized processes for benign incidental 
findings. First, the lack of access to urgent diagnostics 
reflects a mismatch between diagnostic demand and 
capacity. It has been shown that computed tomogra-
phy and magnetic resonance imaging (MRI) are often 
less available at peak hours.22 Different operating 
models regarding imaging can be considered, such as 
increasing staffing of MRI scanners and pooled 
diagnostics resources across multiple hospitals to even 
demand.23 Furthermore, dedicated observation units 
for common, time-sensitive complaints such as chest 
pain can be feasible and previously shown to reduce 
costs while providing equal quality of care compared 
to inpatient admission.24 Second, regarding admis-
sions for IV medications, outpatient IV infusion suites 
are likely a safe and accessible alternative but are in 
short supply.25,26 For patients who choose not to use 
an infusion center, home infusions can be a viable 
alternative. Specifically for heart failure, a home-based 
IV diuresis algorithm can be feasible, effective, and 
safe.27 Third, benign incidental findings as a reason 
for admission have been shown to increase cost and 
subject undue burden on the patient and medical

![Figure 2. Summary of drivers of HPOCC and possible solutions. HPOCC, hospitalizations preventable through optimizing care continuum.](image-url)
team.\textsuperscript{28-30} Decision aids around incidental finding and standardized processes can be a way to mitigate the issue.\textsuperscript{31}

This study also identifies second order relationships at the intersection of patient comorbidities and barriers in the care continuum that lead to preventable admissions. Patients who receive around-the-clock care outside of the hospital are at times admitted because of inability to care for self rather than needing inpatient medical services.\textsuperscript{32,33} Bolstering communication tools such as advanced planning and telemedicine both have been shown to be effective in tackling this issue.\textsuperscript{34,35} For chronically ill patients with a complex medical history, inpatient admission can be perceived as a safe choice in the face of diagnostic uncertainty, but it can expose patients to unneeded risk. Alternatively, integrated care models that focus on the providing the right care at the right time rather than using inpatient care as a safety net can be better options for these patients. For example, the integrated care management program has been shown to reduce the cost of care for medically complex patients while providing high quality care in the outpatient setting.\textsuperscript{36} For medically complex patients, tools such as telemedicine and integrated care models could be synergistic to a close PCP relationship; however, we found that the number of patients who saw their PCP in the last year was low across the analysis cohort. Finally, the lack of a safe disposition plan highlights how shortcomings in the healthcare system affect some of our most vulnerable patients. Between HPOCC and non-HPOCC admission, living distance from the hospital was not significantly different. It would seem that considerations for disposition extend beyond convenience of transportation. Approximately 40% of US counties do not have an outpatient SUD treatment facility that accepts Medicaid.\textsuperscript{37} Along similar lines, rural communities have fewer SUD beds per capita compared with metropolitan areas.\textsuperscript{38} Safety of discharge is not only an issue for SUD treatment, because a sizable fraction of all comers to the ED who are discharged home do not seek follow-up care as instructed.\textsuperscript{39} Care bundles and implementing systematic follow-up after ED discharge to home can potentially mitigate some of these problems.\textsuperscript{40,41}

**Conclusion**

Hospitalizations preventable through optimizing care continuum makes up a small, but meaningful fraction of admissions through the ED. This study elucidated a few common mechanisms that lead to HPOCC as a way to begin designing system changes to reduce the cost of care. Common causes of HPOCC include logistical challenges such as the lack of access or urgent diagnostics and IV therapy which can be a tractable first step in reducing the number of HPOCC. However, complex secondary-order causes such as unnecessary transfer from a long-term facility were as common as logistical challenges, but likely require a broader scope of system redesign to address.

**Implications**

Prior administrative level data have identified areas of opportunity to reduce preventable admissions, but they may miss important granular clinical details that affect preventability and provide an inadequate understanding of clinical causes of preventability. We identified a small, but meaningful fraction of admissions that could have been prevented via optimizing the continuum of care by carefully analyzing the clinical details surrounding these admissions. Logistical challenges such as lack of access or urgent diagnostics and IV therapy are common and can be a tractable first step into reducing the number of HPOCC. At the same time, complex systems level issues resulting in unnecessary transfers in long-term facilities were similarly prevalent, but likely require effort from multiple stakeholders in the healthcare system to solve.

**Authors’ Biographies**

Shawn X. Li, MD, MBA, is a Resident Physician at the Massachusetts General Hospital (MGH). He is responsible for the day-to-day care of patients admitted to the MGH.

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Timothy G. Ferris, MD, is the Chief Executive Officer at the Massachusetts General Physician Organization (MGPO). In addition to his role as the CEO of the MGPO, Dr. Ferris is an practicing internist at the MGH.
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