Acute Care at Home During the COVID-19 Pandemic Surge in Boston

J Gen Intern Med
DOI: 10.1007/s11606-021-07052-5

INTRODUCTION

The COVID-19 pandemic has severely strained hospital systems, particularly in hotspot regions. The predominant national response has been to build tent hospitals in parking lots and parks, to convert large conference centers to field hospitals, or to bring floating hospitals to aide overwhelmed infrastructure. Sadly, most of these high-cost interventions have remained vastly underutilized.[1]

A different approach to optimizing hospital capacity is to provide acute care at home as a substitute for traditional hospitalization.[2] "Home hospital" care includes a physician, nurse, and paramedic team that delivers advanced infusion, respiratory therapies, lab and imaging diagnostics, and continuous monitoring at home. A patient receives twice daily nurse or paramedic visits and a daily physician visit, coupled with 24/7 response capability. Conditions include those typical of a general medicine ward: infections and exacerbations of heart failure, asthma, and chronic obstructive pulmonary disease. In several randomized controlled trials, it has better or similar quality, safety, and experience outcomes compared to traditional hospital care.[3]

Whether during an infectious pandemic a home hospital would continue to provide a high level of care while creating inpatient capacity was unknown.

METHODS

We performed a retrospective analysis of our home hospital program operating within 5 miles of 2 sites in Boston, Massachusetts: Brigham and Women's Hospital and Brigham and Women's Faulkner Hospital. Detailed operations have been described previously.[3] During COVID-19, home hospital programs chose to continue treating their standard diagnoses or to add COVID-19 to their inclusion criteria. Due to severe personal protective equipment availability constraints, our program chose the former.

Received March 27, 2021
Accepted July 20, 2021

To evaluate home hospital's capacity creation, we included patients home hospitalized during pandemic surge conditions, beginning March 15, 2020 (when Massachusetts state of emergency restrictions took effect) until the surge ended on June 18, 2020 (defined as < 30 patients hospitalized with COVID-19). We analyzed patient characteristics and outcomes through medical record abstraction. The Mass General Brigham IRB approved this study.

RESULTS

Over 95 days, we cared for 65 acutely ill patients at home, amounting to 419 bed-days, or 5% of all medicine patients without COVID-19 and 15.4% of all patients with COVID-19 admitted in our catchment area (Fig. 1). During this time, our program was staffed clinically each day by 1 physician, 1–2 nurses, and 1 mobile integrated health paramedic and had a mean midnight census of 3.7.

Patients were 57% female, 37% White, and 39% partnered (Table 1). Median age was 66 (interquartile range, 34) and 75% primarily spoke English. We most commonly cared for infection (59%) and heart failure exacerbation (22%). Length of stay was 5.0 days (interquartile range, 4.1); escalation rate was 3.1%. Most (65%) were discharged without services, 12.3% were readmitted within 30 days, and 13.8% presented to the emergency department within 30 days.

DISCUSSION

We found that despite a COVID-19 pandemic surge, a small home hospital team created substantial inpatient capacity while delivering high-quality acute care at home. To put this in context, the field hospital established to create capacity for Boston's acute care infrastructure served 394 patients (mean 57 years old, 29% female, 19% White, mean of 6 outpatient medications; length of stay 8.3 days, 6.6% escalation rate), required onboarding 124 providers and 331 nurses, and cost $29.8 million over a similar time period—more than $75,000 per patient.[4,5] Traditional hospitalization typically costs about $15,000 per patient, and home hospital care is about 38% less expensive than hospital care.[3]

Our work builds on others who demonstrated successful surge capacity creation with home hospital programs that took care of patients *with* COVID-19.[6] Our work demonstrates that home hospital serves an important function whether or not it

Published online: 06 August 2021

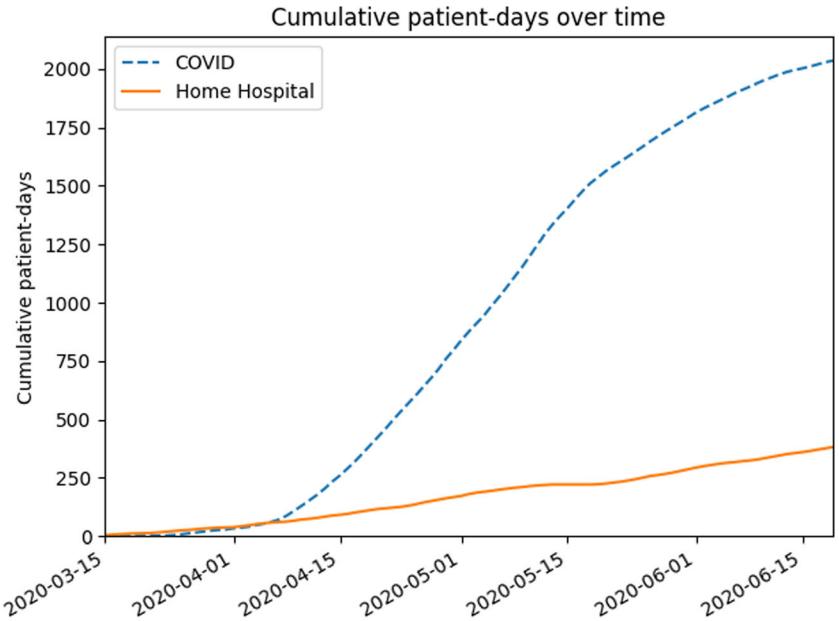

Figure 1 Bed requirements for patients with COVID-19 and home hospital bed capacity creation.

Table 1 Patient Characteristics and Outcomes

	Home hospital patients (*n* = 65)
	***n* (%)**
Baseline characteristics	
Median age (IQR), *years*	66 (34)
Female sex	37 (56.9)
Race/ethnicity	
White	24 (36.9)
Black	15 (23.1)
Hispanic or Latino	12 (18.5)
Other	7 (10.7)
Unknown	4 (6.2)
Partner status	
Partnered	25 (38.5)
Single	21 (32.3)
Separated	17 (26.2)
Unavailable	2 (3.1)
Primary language	
English	49 (75.4)
Spanish	12 (18.5)
Other	4 (6.2)
Insurance	
Medicare	30 (46.2)
Private	27 (41.5)
Medicaid	7 (10.8)
None	1 (1.5)
Education	
Less than high school	18 (27.7)
Graduated high school	16 (24.6)
< 4-year college	15 (23.1)
4-year college	15 (23.1)
> 4-year college	1 (1.5)
Unknown	9 (13.8)
Employment	
Retired	29 (44.6)
Employed	16 (24.5)
Not employed	12 (18.5)
Disabled	7 (10.8)
Unknown	1 (1.5)
Cigarette smoking	
Never smoker	32 (49.2)
Former smoker	27 (41.5)
Current smoker	4 (6.2)
Unknown	3 (4.6)
Admitting diagnoses	
Skin/soft tissue infection	15 (23.1)
Heart failure	14 (21.5)
Other infection	13 (20.0)
Complicated urinary tract infection	10 (15.4)
Other	7 (10.8)
Diabetes	3 (4.6)
Chronic obstructive pulmonary disease	3 (4.6)
Code status	
Full code (confirmed or presumed)	46 (70.8)
Do not resuscitate/do not intubate	19 (29.2)
Admitted to hospital in past 6 months	38 (58.5)
Visited emergency department in past 6 months	37 (56.9)
Mean outpatient medications (95% CI)	8.2 (6.9–9.4)
Comorbidities	
Asthma	14 (21.5)
Coronary artery disease	8 (12.3)
Heart failure	14 (21.5)
Cancer	7 (10.8)
Chronic kidney disease	15 (23.1)
Diabetes	22 (33.8)
Hypertension	43 (66.2)
Chronic obstructive pulmonary disease	6 (9.2)
Patient outcomes during the acute episode	
Median length of stay (IQR), *days*	5.0 (4.1)
IV medications	51 (78.5)
Patients with PT/OT visits	7 (10.8)
Patients with specialist consults	7 (10.8)
Patients with imaging orders	3 (4.6)
Median laboratory orders (IQR)	3 (8)
Escalation[a]	2 (3.1)
Discharge disposition	
Routine	42 (64.6)
Home health	22 (33.8)
Home hospice	1 (1.5)
Patient outcomes 30 days after the acute episode	
30-day readmission	8 (12.3)
30-day emergency department presentation	9 (13.8)
Primary care visit ≤ 14 days after discharge	10 (15.4)

CI confidence interval, IQR interquartile range
[a]*Return to the hospital for continued acute care*

(*continued on next page*)

treats patients with COVID-19. In addition, a home hospital program may enable care delivery for patients who would otherwise defer care during a pandemic.

Our analysis has limitations, all limiting generalizability: our patients were recruited at only 2 sites, a small rotating cohort of clinicians cared for the patients (4 doctors, 7 nurses, and 3 paramedics), and the pandemic conditions in Boston may not have occurred elsewhere.

On November 25, 2020, the Centers for Medicare and Medicaid Services (CMS) issued the Acute Hospital Care at Home waiver that creates a payment mechanism for home hospital. Since then, over 130 hospitals have taken up this care model, demonstrating significant scalability. This model could have an important impact on the ongoing response to the pandemic and future capacity creation for US acute care. Large multisite studies will help to further delineate home hospital's role.

David Michael Levine, MD MPH MA[1,2]
Henry Mitchell[1]
Nicole Rosario, MS[1]
Robert B. Boxer, MD PhD[1,2]
Charles A. Morris, MD MPH[1,2]
Kathryn A. Britton, MD MPH[2,3]
Jeffrey L. Schnipper, MD MPH[1,2]

[1]Division of General Internal Medicine and Primary Care, Brigham and Women's Hospital, Boston, MA, USA
[2]Harvard Medical School, Boston, MA, USA
[3]Division of Cardiovascular Medicine, Brigham and Women's Hospital, Boston, MA, USA

Corresponding Author: *David Michael Levine, MD MPH MA; Harvard Medical School, Boston, MA, USA (e-mail: dmlevine@bwh.harvard.edu).*

Author Contribution • *Levine had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.*

- *Study concept and design: Levine.*
- *Acquisition, analysis, or interpretation of data: all authors.*
- *Drafting of the manuscript: Levine.*
- *Critical revision of the manuscript for important intellectual content: all authors.*
- *Statistical analysis: Mitchell.*
- *Administrative, technical, or material support: Mitchell, Rosario.*
- *Study supervision: Schnipper.*

Declarations:

Conflict of Interest: *David Levine: Dr. Levine receives funding from Biofourmis for an investigator-initiated artificial intelligence study on deterioration of home hospital patients and home hospital software, separate from the present work. He also receives funding from IBM, separate from the present work.*
Jeffrey Schnipper: Dr. Schnipper is the recipient of funding from Mallinckrodt Pharmaceuticals for an investigator-initiated study of opioid–related adverse drug events in post-operative hospitalized patients.
All other authors: None.

REFERENCES

1. **Nelson B**. Too little or too much? Missing the Goldilocks zone of hospital capacity during covid-19. BMJ. 2020;369. https://doi.org/10.1136/bmj.m2332
2. **Leff B, Burton L, Mader SL, et al.** Hospital at home: feasibility and outcomes of a program to provide hospital-level care at home for acutely ill older patients. Ann Intern Med 2005;143(11):798-808. Accessed 15 Feb 2016. http://www.ncbi.nlm.nih.gov/pubmed/16330791
3. **Levine DM, Ouchi K, Blanchfield B, et al.** Hospital-level care at home for acutely ill adults a randomized controlled trial. Ann Intern Med 2020;172(2):77-85. https://doi.org/10.7326/M19-0600
4. **Baughman AW, Hirschberg RE, Lucas LJ, et al.** Pandemic care through collaboration: lessons from a COVID-19 field hospital. J Am Med Dir Assoc 2020;21(11):1563-1567. https://doi.org/10.1016/j.jamda.2020.09.003
5. **Kavanaugh K.** Field hospitals to return to Mass.; the cost and how they were utilized in the spring. Boston 25 News. Published 2020. https://www.boston25news.com/news/25-investigates/25-investigates-field-hospitals-return-mass-cost-how-they-were-utilized-spring/VVFKFN7QFBFKNOYWF57TQMO2GQ/
6. **Sitammagari K, Murphy S, Kowalkowski M, Chou SH, Sullivan M, Taylor S, Kearns J, Batchelor T, Rivet C, Hole C, Hinson T, McCreary P, Brown R, Dunn T, Neuwirth Z MA**. Insights from rapid deployment of a "virtual hospital" as standard care during the COVID-19 pandemic. Ann Intern Med. 2020;0(0):null. https://doi.org/10.7326/M20-4076