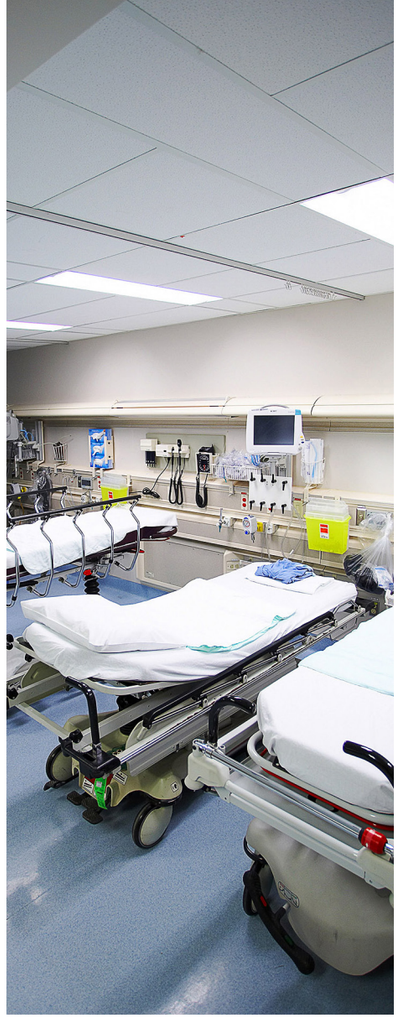


CBRE

HOME HOSPITAL IMPACTS ON EMERGENCY DEPARTMENT CROWDING

John Fard, PhD, Project Manager

Hospital emergency departments (EDs) play a critical role in the United States healthcare system, providing a gateway to care for many people. However, EDs throughout the United States are experiencing crowding (Hing and Bhuiya, 2012, Bair et al., 2010), and research has determined ED patient boarding is a major source of ED crowding (Solberg et al., 2003, Hoot and Aronsky, 2008, Viccellio, 2008, Powell et al., 2012). ED patient boarding is when an ED patient remains in the facility after the decision to admit or transfer the individual is made by a physician. Boarding often occurs when an inpatient bed elsewhere in the hospital is not available for the ED patient. Therefore, the ED becomes a bottleneck for patient flow as patients are delayed in being admitted to inpatient beds.

Home hospital programs, in which select patients receive hospital-level care at home, are linked with the potential to free inpatient beds and extend hospital facility capacity. The research in this study sets out to explore the relationship between home hospital care and emergency department boarding. Simulation modeling is used to compare various home hospital models to better understand which ones are likely to reduce ED crowding and at what rates reductions can be expected. Further insights from this research identify which hospitals are suited to implement home hospital programs, the key indicators to evaluate a program to implement, and potential adjustments to improve program performance. In turn, the reduction of ED crowding results in improved access to care,

CBRE HEALTHCARE

PERSPECTIVES

patient outcomes, financial health of the organization, and long-term strategic planning.

Background

ED Crowding

Research has shown crowding can adversely effect access to care for individuals. ED crowding causes longer wait times for people to obtain care and disrupts the operation of emergency medical services (Hoot and Aronsky, 2006). Similarly, there are consequences for access to care when ED crowding causes ambulance diversion. Diversion can delay patient transport to a treatment facility, which prolongs the time it takes to reach a care provider (Hoot and Aronsky, 2008). Crowding can also lead to patient elopement, in which individuals leave hospitals without receiving treatment due to long wait times (McNaughton et al., 2012).

Crowding can have strategic impacts on an organization by constraining long-term planning and decision-making for the facility as well as organization-wide goals and responsibilities. These conditions challenge hospital goals to meet the capacity needs of their communities. If ED crowding is a continuous problem at a hospital facility, the challenges may trigger and impact boardroom-level discussions concerning occupancy rates, capacity, and potential capital projects to expand the facility. Crowding has also been shown to adversely impact the financial health of hospital organizations through opportunity costs and inefficient use of resources (Hoot and Aronsky, 2008).

Home Hospital

The motivation for home hospital research and growth is driven by five major forces (Landers, 2010):

- Aging U.S. population
- Chronic disease epidemics
- Technological advances in equipment and information technologies
- Healthcare consumerism
- Increased healthcare costs

Clinical research has shown home hospital care to be effective for select illnesses presenting frequently to EDs. Five of the most common illnesses include(Leff et al., 1997, Cryer et al., 2012):

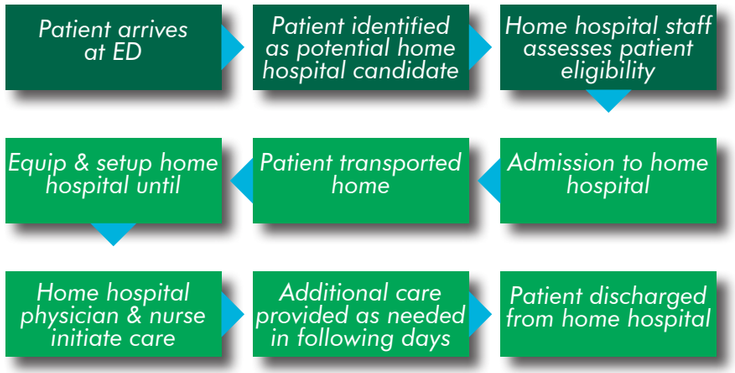
- Cellulitis
- Chronic Obstructive Pulmonary Disease (COPD)
- Community Acquired Pneumonia (CAP)
- Congestive Heart Failure (CHF)
- Deep Vein Thrombosis (DVT)

Certain clinical and social criteria are required for an individual to be deemed suitable for home hospital care. The clinical criterion is a combination of an individual having a particular illness suitable for home hospital care while also not possessing exclusionary medical

characteristics. Currently, home hospital programs are running in over 10 Veterans Affairs sites and in hospitals in Albuquerque, NM, and Los Angeles, with plans to expand to Danville, PA.

Patients are referred to home hospital care by physicians from a variety of sources, including from an ED visit, during an inpatient stay, or from a community site such as an urgent care clinic. The ED referral model begins with an individual requiring care arriving to an ED. If ED staff identifies the patient as a home hospital candidate, home hospital staff will assess the patient's eligibility for hospital care at home. Once the patient is deemed eligible and consents to home hospital care, they are transported home and cared for by a team of nurses and/or physicians for the remainder of required inpatient-level care. See Figure 1 for a summary of the home hospital ED referral model.

Figure 1:



Methods

This study examines the relationship between home hospital care and ED boarding performance at a large, urban, teaching hospital facility. A methodology for identifying potential home hospital patients was used through clinical and social criteria, and a scale for the range of expected clinical eligibility rates were established for five suitable illnesses. The eligibility rates were instrumental in determining what portion of a hospital's patient population is affected by remote care. The range fell on a spectrum of Low, Most Likely, and High rates or percentages of patients deemed medically eligible for a home hospital suitable illness.

The study modeled patient flow and bed demand, using computer simulation modeling to assess the impact of home hospital care on ED boarding performance. Five simulation models were investigated to quantify the impact that home hospital has on ED boarding in the existing system. As discussed, the models incorporated home hospital through an ED Referral program, Inpatient-Transfer Referral program, Community Referral program, and a fully integrated home hospital program, which incorporated referrals from the ED, Inpatient-Transfer, and Community. The models simulated for the

case hospital are titled as follows in Table 1. The simulations are programmed in such a way that when an ED patient is admitted to home hospital care, the freed inpatient bed is available for the next ED, elective, urgent, or transfer patient requesting a bed in the floor unit. This study assumes that home hospital staffing and equipment is adequate during operational hours. The models employ home hospital operational hours on weekdays between 8 a.m. and 6 p.m.

Table 1:

HOSPITAL MODELS SIMULATED FOR COMPARISON	
Model 1	Baseline Model: no home hospital incorporated
Model 2	ED Referral Model: admission to home hospital from ED
Model 3	Inpatient-Transfer Referral Model: admission to home hospital after initial stay in hospital inpatient bed
Model 4	Community Referral Model: admission to home hospital from physician office or clinic
Model 5	Fully Integrated Model: incorporation of ED Referral, Inpatient-Transfer Referral, and Community Referral models

Results

These five models were simulated and the models that resulted in a statistically significant reduction of ED boarding rates when compared to the baseline model were:

- ED Referral with High Eligibility
- Inpatient-Transfer Referral with High Eligibility
- Fully Integrated Models with Most Likely and High Eligibilities

The models' resulting parameter values are presented in Table 2.

Table 2: Weekly ED boarding performance for simulated models

	CLINICAL ELIGIBILITY RATES USED	*AVG. BOARDING HRS. PER WEEK*	*REDUCTION IN BOARDING HOURS DUE TO HOME HOSPITAL*	*AVG. PATIENTS TO HOME HOSPITAL*
Model 1: Baseline	--	479.54	--	N/A
Model 2: ED Referral	Low	478.59	Not statistically significant	0.29
	Most Likely	479.73	Not statistically significant	0.43
	High	473.05	1.4%	0.67
Model 3: Inpatient-Transfer Referral	Low	476.22	Not statistically significant	1.09
	Most Likely	475.01	Not statistically significant	1.61
	High	471.08	1.8%	2.43
Model 4: Community Referral	Low	479.37	Not statistically significant	0.08
	Most Likely	477.49	Not statistically significant	0.13
	High	477.63	Not statistically significant	0.21
Model 5: Fully Integrated	Low	476.83	Not statistically significant	1.22
	Most Likely	473.01	1.4%	1.66
	High	465.37	3.0%	2.54

Findings

ED Boarding Impact Results

From the simulation tests, the Fully Integrated home hospital model (Model 5) was the most impactful type of home hospital program on ED boarding. Incorporating all methods of home hospital referral (ED, Inpatient-Transfer, and Community), the Fully Integrated model resulted in statistically significant boarding tallies that were less than the baseline model, resulting in up to a 14 hour per week reduction in boarding hours, or about a 3% decrease. This is the equivalent of saving almost 125 inpatient bed-hours per week; these freed bed-hours could be used to improve patient flow for additional patients. The average weekly boarding hours for the ED Referral and the Inpatient-Transfer models with High Eligibility were also statistically less than the baseline boarding rates.

The results of the simulation model tests give a range of boarding hours among the different models and clinical eligibility rates. The large, urban, academic hospital setting in this study is a highly specialized care provider and serves a high acuity patient mix. The rate of home hospital suitable illnesses and patients presenting to this hospital would presumably be less than alternate hospital settings, such as non-specialty hospitals with low acuity patients, less ICU bed requests, and low length of stay averages. Therefore, while a 3% decrease in boarding rates may not make a practical difference in how hospital leaders operate and run the emergency department system, there are indications for more significant reductions under alternate hospital settings.

Admission to Home Hospital

In this study's simulation tests, it became apparent the Inpatient-Transfer referral model allowed the greatest flexibility and opportunities for patients to admit to home hospital care, featuring an admission rate of almost four times higher than the competing models. The high admission rate to home hospital care is a key indicator for reducing crowding, and is a key insight for decision-makers to evaluate when choosing between the competing home hospital programs.

Home Hospital Implementation Timing

As opposed to the Inpatient-Transfer referral model, the ED referral often had very low admission numbers per week. This was due to ED patients requesting admission to the hospital outside typical hours of operation for a home hospital program. There are seemingly clear reasons why manageable hours of operation have been employed in past and current home hospital programs, such as staffing concerns, safety of caregivers, and difficulty in procuring and delivering equipment and medical supplies. However, in a crowded, urban hospital facility, demand for bed requests from ED patients can occur later into the evenings and nighttime hours. For

example, the peak times for bed requests from the ED at the case hospital occurred well after the 6 pm close of a typical home hospital program. In order to identify how the ED referral model could potentially be improved, a simulation model for a program operating 24 hours per day was tested. This model's admission rate increased by a factor of 3.5, almost matching that of the Inpatient-Transfer referral model. Further, 93.49 inpatient bed hours per week are expected to be saved without the operating hours limitation, versus only 22.25 hours for the initial ED Referral simulation. Table 3 presents the simulation results for an ED Referral home hospital program operating during normal business hours versus a 24 hour per day program. This insight around the impact hours of operation has on crowding performance can help hospital leaders determine which home hospital program is the best option for their organization.

Table 3: Simulation test evaluating various hours of operation for an ED Referral program utilizing Most Likely clinical eligibility rates

HOURS OF OPERATION	AVG. WEEKLY BOARDING HOURS	REDUCTION IN BOARDING HOURS	AVG. ADMITS / WEEK
8 a.m. - 6 p.m.	479.73	Not Statistically Significant	0.43
24 hours / day	469.51	2.1%	1.48

Hospital Crowding Levels

In this study's simulation experiments, home hospital's impact on ED boarding is tested based on various crowding levels experienced in the hospital system. The case hospital is typically a high occupancy inpatient facility, but to understand the difference between average and high occupancy facilities, a sensitivity analysis was conducted. The national average occupancy rate for hospitals of similar bed size to the case hospital in this study is about 74%. Therefore, the simulation was ran to compare hospitals with average and high occupancy rates of 74% and 93%, respectively. The Average Occupancy Model achieved a 1.3% decrease in boarding hours per week, while the High Occupancy Model averaged a 3.3% decrease. These results analytically present an expected rate for the impact that home hospital programs may have on average occupancy facilities versus those with tighter bed constraints. See Table 4 for results from the crowding level tests.

Table 4: Mean weekly ED boarding hours for crowding level simulation tests

	CLINICAL ELIGIBILITY RATES USED	*AVG. OCCUPANCY AT MIDNIGHT*	*AVG. BOARDING HOURS PER WEEK*	*REDUCTION IN BOARDING HOURS*
Baseline, Average Occupancy Model	N/A	74.4%	238.26	N/A
Model 5 , Average Occupancy Model	Most Likely	74.6%	235.19	1.3%
Baseline, High Occupancy Model	N/A	93.4%	1476.99	N/A
Model 5, High Occupancy Model	Most Likely	93.8%	1427.98	3.3%

Extended Insights - Facility Management Implications

While home hospital's impact on ED boarding was the focus of this study, the evaluation of patient throughput extends beyond the emergency department and into other areas of the hospital. One of the key input variables to simulating patient flow in the case hospital model was bed cleaning turnaround times. Bed cleaning has a critical impact on the ability to move patients from the ED into hospital rooms, which directly affects ED boarding. In order for a bed assignment to take place at the case hospital, a clean and ready bed must be available in the requested floor unit. When a 25% slower bed clean turnaround time is tested in the simulation model, ED boarding hours increased by 16.5%. When a 25% faster bed clean turnaround time is tested, ED boarding hours decreased, and thus improved, by 14%. If bed cleans lag and cannot keep up with patient discharges and admissions, patient admissions are forced to be delayed. Further challenging bed cleaning tasks is the uncertain nature of timing when patients will be

discharged from beds. Staff schedules need to be adjusted to meet critical bed-cleaning demand. Through this research, it was discovered that the facility managers at the case hospital addressed these challenges by employing a fluid and flexible staffing system to readily address the varying volume of discharges that can happen at peak durations throughout an afternoon.

Conclusion

This research provides insight regarding what types of hospitals are the best candidates for home hospital programs. Results indicate high occupancy hospitals (i.e. average midnight occupancy over 90%) reduce expected ED boarding performance 2.5 times better than average occupancy level hospitals (i.e. 75%). The results indicate hospitals with low acuity and short length of stay patient mixes are good candidates for home hospital implementation. Furthermore, when evaluating which type of home hospital program is best, organizations will want to look toward home hospital admission rate flexibility and how the organization's ED admission metrics compare to potential hours of operations for the home hospital program. Other practical implications of home hospital care include the potential to improve a host of health-related, access to care, and financial metrics for hospitals.

Home hospital and ED crowding have potential for strategic implications for a hospital organization. ED crowding can adversely impact the overall mission or goal of the hospital to adequately care for the general public, and may trigger boardroom-level discussions concerning occupancy rate concerns, capacity, and growth of the facility. These discussions can lead to potential strategic-level action. This research helps to better understand potential alternatives to costly and long-term capital expenditure projects. If crowding can be reduced through external impacts like home hospital referral or FM techniques like bed cleaning turnaround improvements, these impacts could be critical to hospital leaders and planners in making the most informed decisions.

ABOUT THE AUTHOR

John Fard is a Program Manager for CBRE, managing various types of healthcare related projects and providing healthcare organizations with capital program solutions. John has extensive experience in Collaborative Project Delivery, yielding improved efficiency and added value for his clients. He also has incorporated lean principles through Target Value Design to reduce waste and guide cost reductions. Prior to CBRE, John taught undergraduate and graduate courses in the School of Building Construction at Georgia Tech. His research interests include remote health care, capital program solutions, and integrated project delivery methods.

John holds a Doctor of Philosophy in Building Construction, a Masters of Science in Civil Engineering and a Bachelor of Science in Civil Engineering from Georgia Institute of Technology.

For more information on Home Hospital Care and it's impact on Emergency Department overcrowding, contact John.Fard@cbre.com.

WORKS CITED

CRYER, L., SHANNON, S. B., VAN AMSTERDAM, M. & LEFF, B. 2012. Costs For 'Hospital At Home' Patients Were 19 Percent Lower, With Equal Or Better Outcomes Compared To Similar Inpatients. Health Affairs, 31, 1237-1243.

HING, E. & BHUIYA, F. 2012. Wait time for treatment in hospital emergency departments: 2009. Hyattsville, MD: National Center for Health Statistics.

HOOT, N. & ARONSKY, D. An early warning system for overcrowding in the emergency department. AMIA Annual Symposium Proceedings, 2006. American Medical Informatics Association, 339.

HOOT, N. R. & ARONSKY, D. 2008. Systematic Review of Emergency Department Crowding: Causes, Effects, and Solutions. Annals of Emergency Medicine, 52, 126-136.e1.

LANDERS, S. 2010. Why health care is going home. The New England journal of medicine, 363,

LEFF, B., BURTON, L., BYNUM, J. W., HARPER, M., GREENOUGH, W. B., STEINWACHS, D. & BURTON, J. R. 1997. Prospective evaluation of clinical criteria to select older persons with acute medical illness for care in a hypothetical home hospital. Journal of the American Geriatrics Society, 45, 1066-1073.

MCNAUGHTON, C., SELF, W. H., JONES, I. D., ARBOGAST, P. G., CHEN, N., DITTUS, R. S. & RUSS, S. 2012. ED crowding and the use of nontraditional beds. American Journal of Emergency Medicine, 30, 1474-1480.

POWELL, E. S., KHARE, R. K., VENKATESH, A. K., VAN ROO, B. D., ADAMS, J. G. & REINHARDT, G. 2012. The Relationship between Inpatient Discharge Timing and Emergency Department Boarding. The Journal of Emergency Medicine, 42, 186-196.

SOLBERG, L. I., ASPLIN, B. R., WEINICK, R. M. & MAGID, D. J. 2003. Emergency department crowding: Consensus development of potential measures. Annals of Emergency Medicine, 42, 824-834.

VICCELLIO, P. 2008. Emergency department overcrowding: an action plan. Academic Emergency Medicine, 8, 185-187.