The Impact of a Hospital Liaison Officer Pilot Program on E.D. Turn Around Time in the District of Columbia

Author:

Marshall Washick, M.S., NRP, IA

CQI Division

Office of the Medical Director

D.C. Fire and EMS

Executive Summary:

The Hospital Liaison Officer pilot program is an effort by D.C. Fire and EMS to address prolonged hospital drop times in the District of Columbia by placing staff in hospital ED's to facilitate the triage process and provide medical observation for low-acuity patients or determine providers can bring patients directly to ED triage, bypassing the ED. The program started on April 6th, 2023, at Howard University Hospital. Shortly after implementation there was a 10.1% decline in hospital drop times in the overall system and an 23.6% decline at Howard University. Due to the success of the program at Howard, the HLO pilot was expanded to United Medical Center (UMC) on May 23rd, 2023. Again, there were notable improvement in drop times across the system, which improved an additional 1.3% for the system, and at 22.8% improvement at UMC. To better understand the effects of the HLO, a log-linear regression model was developed to assess the Departments capacity to respond to EMS calls. The findings from the model show an increase in capacity of 6.4% and 8.5% as the result of the HUH, and HUH plus UMC HLOs – effectively gaining capacity for approximately 30 additional runs for the equivalent amount of total committed time in hours.

Background:

Prolonged hospital drop-times have deleterious effects on EMS systems and patients who experience them. EMS providers often wait several hours in an ED with a patient on their stretcher waiting for a bed to become available to transfer the patient on to, and hand over care to hospital staff. In the District of Columbia, this has been an ongoing issue for years despite efforts to reduce hospital drop times across the system. To address the issue, the D.C. Fire and EMS Department developed the Hospital Liaison Officer pilot program as an intervention to tackle the problem of prolonged hospital drop times. The HLO is a DC Fire and EMS officer of any rank along with two EMTs (one from AMR and one from FEMS) to provide medical observation for low-acuity patients while they wait for an ED bed to become available. This pilot effectively adds hospital capacity to manage patients brought in by EMS.

Methods:

To evaluate the impact of the HLO pilot program, three types of Shewhart Charts were used for time series data: $\bar{X}$ charts, S charts, and Individuals charts. Aggregated time data used for $\bar{X}$ charts (see Appendix for $\bar{X}$ charts) and S charts were transformed using the square root of seconds to adjust for skewness and maintain characteristics of a normal distribution. Individual's charts were used to evaluate individual data points. Reported averages (including center lines of Shewhart Charts) are represent by squared average of the square root of time in seconds whereby the mean is reported as the following:

$$Center\ Line\ or\ Mean = \left(\sum_{i=1}^{n} \frac{1}{n} \sqrt{time}\ in\ seconds\right)^2$$

Subgroup analysis was performed on the agency level (FEMS and AMR) and four individual hospitals, Howard University, United Medical Center, George Washington University Hospital, and MedStar Washington Hospital Center. These four hospitals were chosen for analysis because over 70% of patients transported are to these facilities.

Shewhart Charts use data derived from a system or process and graphically display the output, while also plotting the descriptive statistics of that output. They provide an insight into how a system is performing (within control, or not), and identifies individual or runs of data points that indicate a potential problem or change in the system or process – intended or not.

In an effort to assess the impact of the HLO on the overall EMS system, a log-linear regression model was developed to understand the changes in the Departments capacity to respond to EMS related calls.

Data:

Data used in the analysis were extracted from FirstWatch and SafetyPad and include the date range of March 1, 2023 through June 19, 2023.

Analysis:

Overall, the HLO program has had a positive effect on hospital drop times in the District of Columbia. Table 1 shows how the HLO at Howard Univ. Hospital (HUH), then with the addition of United Medical Center improved hospital drop times.

Table 1. System Drop Time Improvement

	System Table		
	Avg. Drop Time in minutes	% Change	% Change from No HLO
No HLO	59.2	-	-
HUH HLO	53.2	10.1%	10.1%
HUH+UMC HLO	52.5	1.3%	11.3%

The effects of adding the HLO at Howard had dramatic improvements on the overall hospital drop time for the system, with over a 10% improvement in average drop time. Adding in UMC had a much smaller effect on the system, but none the less, has still improved the overall system drop time.

Subgroup analysis comparing average hospital drop time by agency is shown in Table 2.

Table 2. Agency Drop Time Improvement

	AMR			FEMS		
	Avg. Drop Time in minutes	% Change	% Change from No HLO	Avg. Drop Time in minutes	% Change	% Change from No HLO
No HLO	77.9	-	-	52	-	-
HUH HLO	67.7	13.1%	13.1%	47.9	7.9%	7.9%
HUH+UMC HLO	60.1	11.2%	22.8%	49.1	-2.5%	5.6%

The HLO had a positive effect on both AMR and FEMS as agencies. AMR experienced the largest improvement, and collectively, has improved their agency average drop time by approximately 23%. As for FEMS, while there was moderate improvement overall, there appears to be a small amount of regression.

Subgroup analysis of individual hospitals drop times is shown in Table 3. HLOs have only been approved at Howard and United Medical Center.

Table 3. Hospital Drop Time Improvement

	United Medical Center			Howard Univ. Hospital		
	Avg. Drop Time in minutes	% Change	% Change from No HLO	Avg. Drop Time in minutes	% Change	% Change from No HLO
No HLO	65.4	-	-	64	-	-
HUH HLO	60.8	7.0%	7.0%	48.9	23.6%	23.6%
HUH+UMC HLO	47.3	22.2%	27.7%	50.1	-2.5%	21.7%
	George Washington Univ. Hospital			**MedStar Washington Hospital Center**		
	Avg. Drop Time in minutes	% Change	% Change from No HLO	Avg. Drop Time in minutes	% Change	% Change from No HLO
No HLO	62.6	-	-	56.3	-	-
HUH HLO	60.3	3.7%	3.7%	53.5	5.0%	5.0%
HUH+UMC HLO	60.1	0.3%	4.0%	55.9	-4.5%	0.7%

Overall, improvement was demonstrated across all four hospitals, with the largest and most notable changes occurring at both Howard University Hospital and United Medical Center – achieving more than a 20% improvement in hospital drop time with an HLO at these facilities. There also appear to be general improvement overall. Prior to the implementation of the HLO pilot project, average hospital drop times were already in decline. What is possibly being demonstrated here is a synergistic effect of gradual improvement at hospitals in conjunction with HLOs.

Log-Linear Regression Model:

To assess the impact of the HLO pilot on the Departments capacity to respond to EMS related calls, a log-linear regression model was developed to understand changes to the system. The final model is presented as Figure 1.

Figure. 1 Regression Model of HLO Impact on Total Commit Time, controlling for call volume

$$\mathbf{log}(\boldsymbol{Total\ Commit\ Time, Hours}) = \mathbf{5.07}(\boldsymbol{No\ HLO}) - \mathbf{0.07}(\boldsymbol{HUH\ HLO}) - \mathbf{0.09}(\boldsymbol{HUH + UMC\ HLO}) + \mathbf{0.003}(\boldsymbol{Total\ Daily\ Call\ Volume})$$

Where the 'Total Commit Time, Hours' is defined as aggregated total amount of time from dispatch of a run to when the unit is available. For example, if Unit X responds to 10 runs and commits 60 minutes to each run – the total commit time of that unit is 10 hours. If Unit Y responds to 5 runs and commits 120 minutes to each run, the total commit time of that unit is also 10 hours. The aggregate total commit time would be 20 hours for 15 runs.

To start, overall call volume and total commit time in hours were plotted to visually assess correlation between each variable. The Spearman's Rank Correlation was used to assess dependence between each variable and found to be r_s=0.77, suggesting a strong positive relationship. Values equal to +1 suggest a perfect positive correlation. Next, because the HLO was the only known change to the process of responding to, treating, and dispositioning patients – three different periods were incorporated into the model: period without an HLO, period with an HLO at Howard, and period with and HLO at Howard and UMC. This in effect is able to control for each period of time, and assess the impact of the HLO on the system.

The table output for the model is shown below, in Table 4.

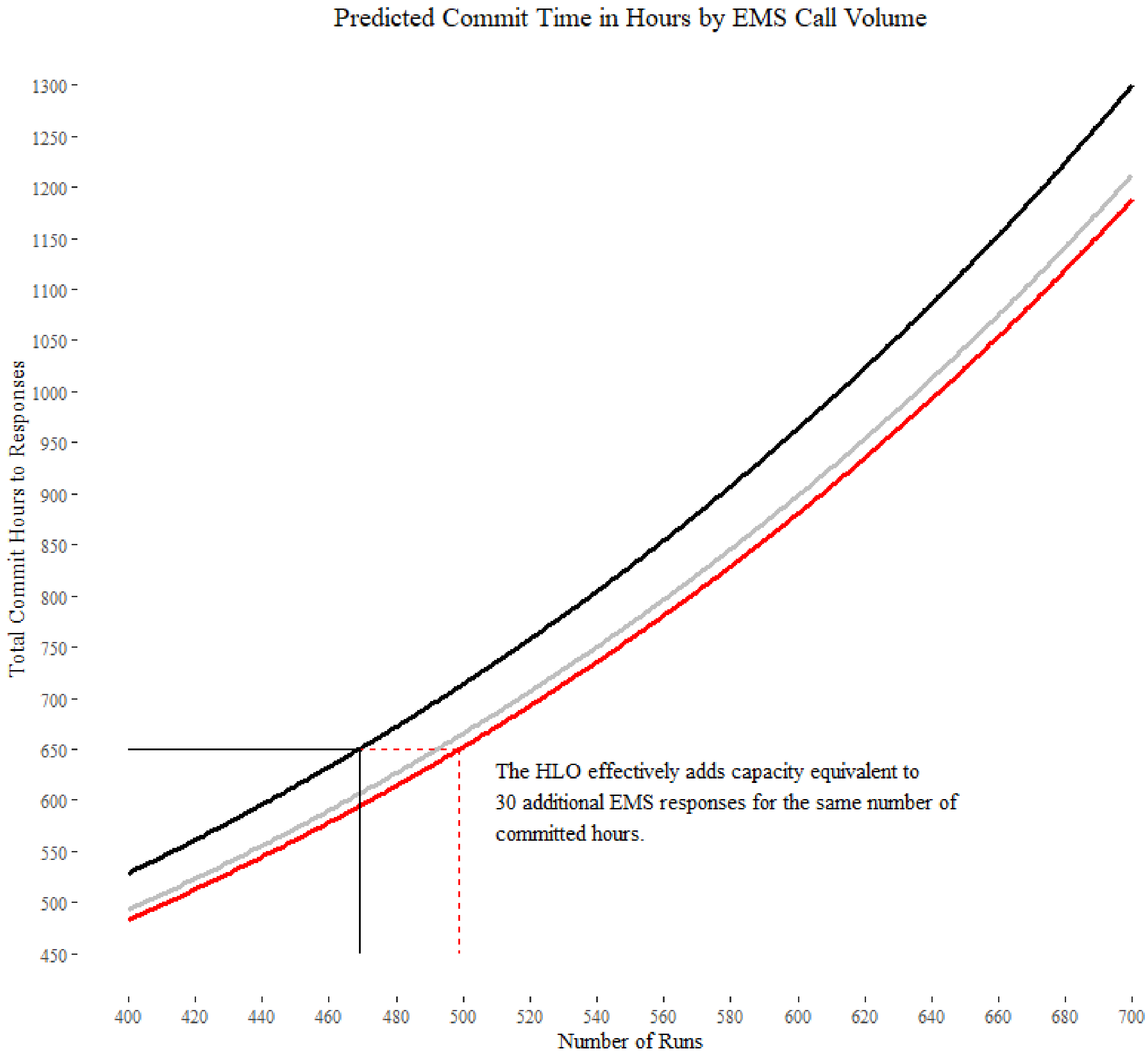
Table 4. Regression Model Output Table

Term	Estimate (log)	Std. Error	Statistic	p-value
No HLO	5.07	0.0761	66.6	>0.0001
HUH HLO	-0.07	0.0124	-5.33	>0.0001
HUH+UMC HLO	-0.09	0.0151	-5.88	>0.0001
Daily Call Volume	0.003	0.000168	15.9	>0.0001

Statistics		
Residual Std. Error	0.055	107 degrees of freedom
Multiple R-squared	0.71	
Adj. R-squared	0.70	
F-statistic	88.09	3 and 107 degrees of freedom
p-value	>0.0001	

To demonstrate the change in capacity, the following graph (Graph 1.) demonstrates the predicted impact of daily call volume on total commit time in hours.

Graph 1.



The black solid curve represents the predicted total commit time in hours without HLOs in the system; whereas the solid grey and red curves represent HLOs at HUH and HUH+UMC respectively. This model effectively shows improvement in capacity for the Department to respond to EMS related calls. On average, the system has gained the capacity for 30 additional EMS responses for the equivalent amount of total commit time. Prior to the HLO, 469 EMS related runs equated to 650 total committed hours. With the HLO at Howard, that is equivalent to 492 runs and with HUH plus UMC, that increases to 499 runs.

To calculate the average percent of capacity gained as a result of the HLO, we can use the following formula:

$$\%\ Change\ in\ Capacity = 1 - e^{coef(HUH\ HLO)} \times 100$$

$$\%\ Change\ in\ Capacity = 1 - e^{coef(HUH+UMC\ HLO)} \times 100$$

As a result, on average the Department gained 6.4% additional capacity with the HLO at HUH and 8.5% additional capacity with the HLO at both HUH and UMC.

The evaluate the effect of call volume on total commit time in hours, we use the following formula:

$$\% \; change \; in \; Total \; Commit \; Time, Hours = e^{coef(Daily \; Call \; Volume)} - 1 \; \times 100$$

The result of this formula is a 0.3% change in Total Commit Time in Hours for every one unit increase call volume. Because of the multiplicative effects of this, increases in call volume also increase the Total Committed Time in Hours more so. To demonstrate this, the difference between a call volume of 400 and 401 is approximately 7 additional minutes of Total Commit Time. The difference between 680 and 681 is approximately 32 additional minutes of Total Commit Time.

This shows the effect of call volume regardless of the HLO is quite profound. As units become busier there become less units available to respond to calls, particularly transport units. Non-transport units must then wait longer with patients on scene until a unit arrives to transport. Furthermore, there may be additional delays throughout the system – such as overcrowded EDs, units arriving from neighboring jurisdictions, mass casualty incidents, among other reasons that add additional pressure on the system, resulting in delays.

Discussion:

The effect of the HLO has been surprisingly positive and demonstrates that EMS systems can improve hospital drop times by facilitating the triage the process at hospital ED and adding hospital capacity to medically monitor low-acuity patients until an ED bed becomes available. This may serve as a key finding for hospital administrators as they continue their efforts to collaborate with the Department to improve the Districts emergency medical system.

We believe what has made this pilot program successful is a stepwise and systematic approach to expanding the HLO pilot program as opposed to implementing the pilot at all hospitals simultaneously. In doing so the Department has been able to learn what works with the program and what does not – which in turn makes expansion easier to execute and effective, while avoiding mistakes and missteps. Furthermore, it has provided insight on the cumulative effects of slowly expanding the HLO pilot. Additionally, this pilot program has allowed us to monitor for any additional changes in the system that may have unintended consequences. For which there have been none.

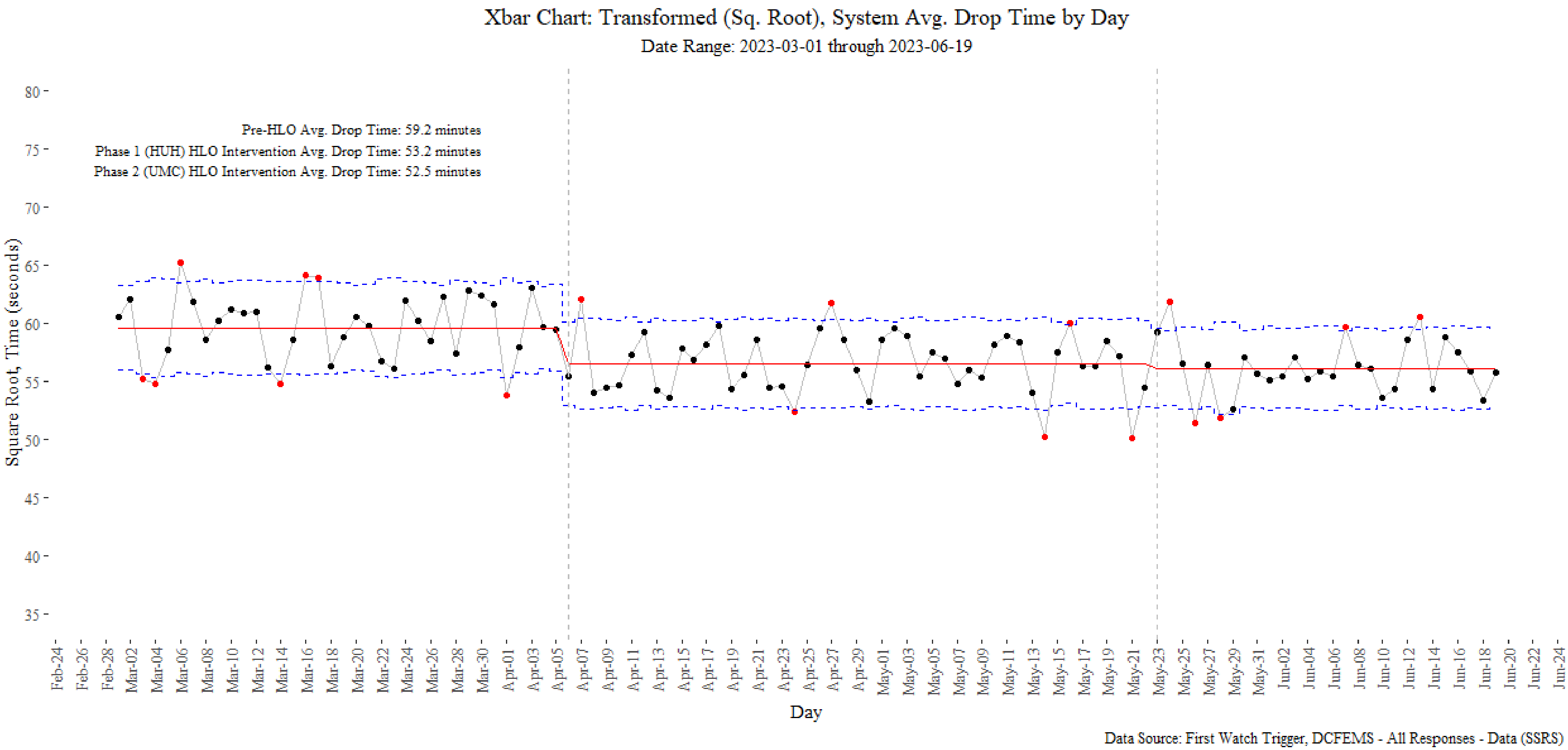
The largest impact on overall drop time in the system has been a result of substantial AMR improvements. Because AMR makes up a sizeable portion of EMS transports, and almost exclusively all low-acuity transports – it should be expected that overall drop times should decline. Furthermore, the added benefit of improving AMR drop times is increased capacity to respond to calls. Thus, reducing wait times on scene for FEMS units.

What is not factored into this analysis is the cost associated with the program. This includes the additional equipment, unforeseen overtime across officer and member ranks, and additional costs billed by AMR for staff. Furthermore, because there are no metrics available at this time that represent unit costs, it us unclear what the potential savings are to the Department as result of increased capacity to respond to EMS related calls. Future projects that focus on system improvement should incorporate cost and savings factors in the future.

Conclusion:

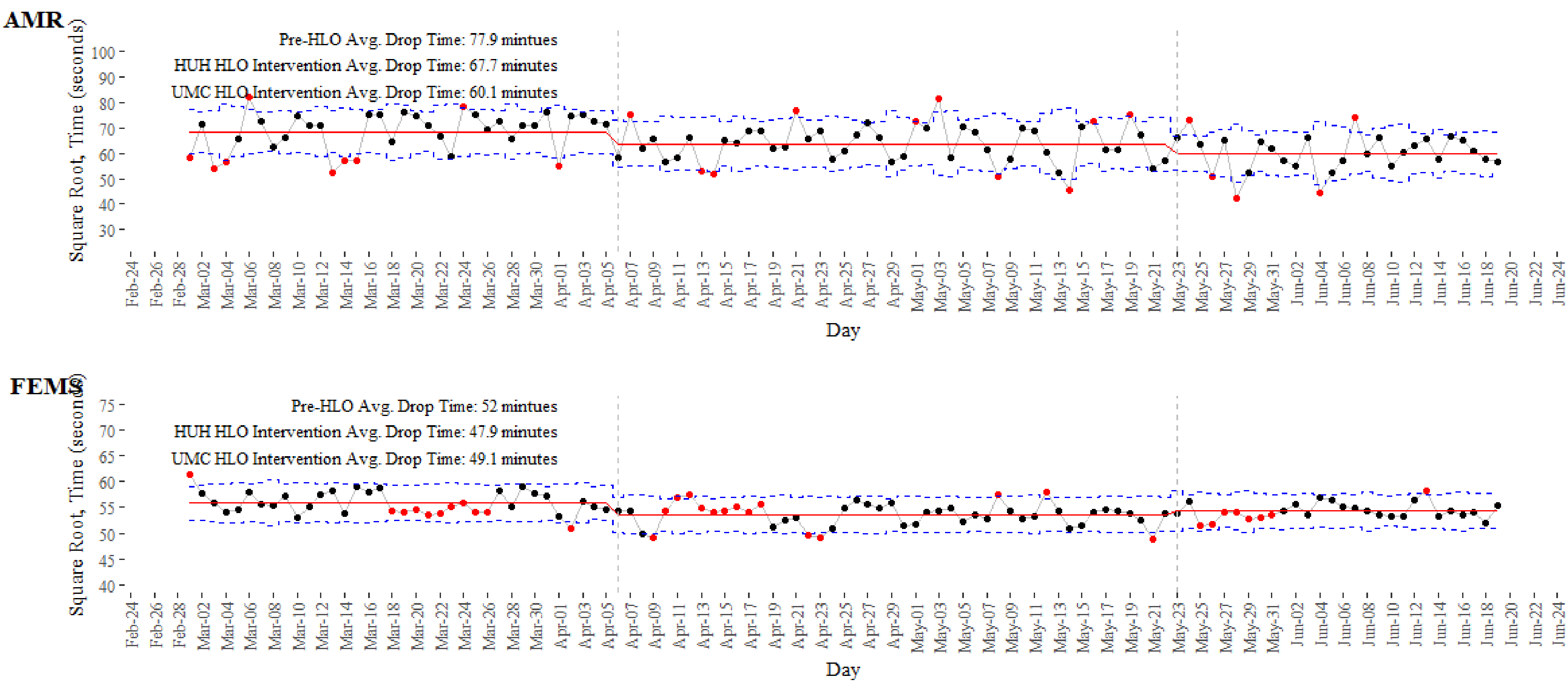
The Hospital Liaison Officer pilot program has demonstrated success at improving hospital drop times in the District of Columbia and improving capacity to respond to EMS related calls. Achieving this was the result of a stepwise, systematic approach that uncovered lessons learned throughout the first two and half months of the pilot. Additional analysis should be undertaken to assess the cost and potential savings of this program. The most striking finding of this analysis is the dire need to improve ED capacity to handle low-acuity patient volume in the short term and work to reduce an over reliance on the emergency medical system in the District of Columbia to provide primary care services in the medium- to long-term.

Appendix: Shewhart Charts



Xbar Chart: Transformed (Square Root) Avg. Drop Time by Day and Agency

Date Range: 2023-03-01 through 2023-06-19



Data Source: First Watch Trigger, DCFEMS - All Responses - Data (SSRS)

Xbar Chart: Transformed (Square Root) Avg. Drop Time by Day and Hospital

Date Range: 2023-03-01 through 2023-06-19