Reducing Emergency Department Utilization With an After Visit Summary Nudge Toward Alternative Care Options

Study Protocol with Statistical Analysis Plan

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Study Protocol

Background

Decreasing inappropriate utilization of the Emergency Department (ED) is a priority for the Geisinger health system. ED visits may be avoided if patients first call the system to get appropriate guidance for their concerns or are otherwise better informed about reasons to visit the ED vs. other, potentially more appropriate resources such as urgent care and primary care facilities. The study team is working to reduce ED utilization by including additional information in adult outpatient After Visit Summaries (AVSs).

Objectives

The study will involve A/B testing different AVS versions, including a version that encourages patients to contact Geisinger via different contact methods, a version that includes a map to the patient's closest urgent care location and accompanying information about urgent care, and a version that includes a self-triage guide. A standard-practice control group will receive the current standard AVS. Analysis results will be assessed to determine which version is most effective at reducing ED use.

Design

This study is a randomized controlled trial with 4 study arms. Patients will be randomized to receive or not receive a modified AVS after outpatient in-person or telehealth visits.

Methods

At the time of a patient's first qualifying appointment during the study period, patients will be randomized into the following study arms:

1. **Standard practice:** Patients in this arm will receive the current standard practice AVS.
2. **Contact us first:** Patients in this arm will receive the standard AVS, plus information on how to contact Geisinger if they need medical attention.
3. **Contact us first + urgent care map:** Patients in this arm will receive the standard AVS, plus information on how to contact Geisinger if they need medical attention, plus a map of their nearest Geisinger urgent care location and additional information about urgent care.
4. **Contact us first + urgent care map + self-triage:** Patients in this arm will receive the standard AVS, plus information on how to contact Geisinger if they need medical attention, plus a map of their nearest Geisinger urgent care location and additional information about urgent care. This arm will also receive a self-triage chart, with common reasons patients go to the ED and situations where seeking alternative care might be appropriate.

Sequential Design

We will use a group sequential design with O'Brien-Flemming alpha spending and beta spending (Lakens et al., 2021), with optional stopping for futility. We will perform one interim look after collecting data from 109,346 patients (50% of the sample) and the final look after

completing data collection with 218,692 patients. We will stop after the interim look if $p <$ .005575 (i.e., a much larger effect than expected) for the contrast between *any* of the 3 experimental arms and control in *Analysis 1* below. We may also stop for futility if $z > -0.192$ (i.e., an effect in the opposite direction to our expectations) for *all 3* contrasts between experimental arms and control in *Analysis 1* below. All tests will be 1-sided tests with an overall alpha of .05.

Power Analysis

With a traditional RCT design and 215,000 patients, we would have 95% power to detect a reduction in avoidable ED use in the 30 days following the appointment from 3.88% to 3.50% (9.80% relative reduction) with one-tailed alpha of .05. The target effect size and number of patients are largely informed by practical considerations regarding the acceptable duration of the intervention (approximately 6 months), with an effect deemed useful if achieved.

We next determined that the inflation factor based on the sequential design described above was 1.01717. We multiplied the inflation factor by the fixed design sample size (215,000 * 1.01717) for a sample size of 218,692.

Project Status

The intervention has not yet begun.

Process for Determining a Patient's Nearest Urgent Care

A patient's nearest urgent care will be determined by their zip code in Geisinger's Electronic Health Record. Zip code locations will be defined as population-weighted centroids (obtained from https://hudgis-hud.opendata.arcgis.com/datasets/HUD::zip-code-population-weighted-centroids/) where available. For some zip codes (P.O. Box zip codes in particular), population-weighted centroids are not available. In those cases, we will use the zip code's approximate centroid obtained from the USPS Zip Code Database (https://www.unitedstateszipcodes.org/zip-code-database/).

Distance to the nearest Geisinger urgent care location for each zip code will be calculated using the following process:

1. For each zip code in PA, NY, and NJ (states that are within or sufficiently close to the Geisinger service area), we will compute the Haversine distance to each urgent care location
2. For each zip code, we will determine if at least one urgent care location is within 40 miles of the zip code centroid
3. If more than one location is within 40 miles and under a 10 mile difference in distance between zip code centroid and each of those two clinic locations (e.g., if one clinic is 10 miles away and another is 15 miles away, a 5 mile difference), we will use the Google Maps API to determine which clinic is the closest driving distance in minutes

For patients assigned to one of the arms that includes an urgent care map, we will show a map to the closest clinic if the Haversine distance is under 40 miles from the centroid of the patient's zip code. For patients with zip codes farther than 40 miles from a Geisinger urgent care location, we will show a map that includes all urgent care locations with information on how to find their nearest urgent care.

Statistical Analysis Plan

Planned Analyses

Primary Outcome: Inappropriate ED visits (y/n) [Time Frame: In the 30 days following the appointment]

We will apply the NYU algorithm (Ballard et al., 2010) to determine whether an ED visit is inappropriate.

We will use one of the following two methods:

1. Epic tool: Geisinger is working to implement a tool in Epic that can automatically run the NYU algorithm and identify inappropriate (or "non-emergent") ED visits. If this tool is running prior to data analysis, we will use it to identify inappropriate ED visits for our primary outcome.
2. Custom code: If the Epic tool is not yet implemented prior to our data analysis, we will pull, for each ED visit, the primary ICD code for the visit and use custom code to determine whether the visit was inappropriate, following the methods described in Ballard et al. (2010) or the most up-to-date version of the algorithm we have access to at the time of data analysis.

Question 1: Do AVSs decrease inappropriate ED visits when including information about how to contact Geisinger if patients need care?

Analysis 1 (Confirmatory): We will test the hypothesis that each of the individual modified AVS versions decreases the likelihood patients will visit the ED in the 30 days following their visit. We will run an OLS regression including a categorical predictor variable coding for experimental arm (0 = standard practice arm, 1 = contact us first arm, 2 = contact us first + urgent care arm, 3 = contact us first + urgent care map + self-triage arm).

Question 2: Do AVSs decrease ED visits when including an urgent care map, beyond modified AVS version without an urgent care map?

Analysis 2 (Exploratory): We will run an OLS regression including only experimental arms with modified AVSs. We will include a predictor variable indicating whether each patient's AVS version includes a map (0 = no map, contact us first arm; 1 = map, contact us first + urgent care map arm and contact us first + urgent care map + self-triage arm).

Question 3: Do AVSs decrease ED visits when including a self-triage tool, beyond modified AVS versions without a self-triage tool?

Analysis 3 (Exploratory): We will run an OLS regression including only experimental arms with modified AVSs. We will include a predictor variable indicating whether each patient's AVS version includes a self-triage chart (0 = no self-triage chart – contact us first arm and contact us first + urgent care map arm; 1 = self-triage chart – contact us first + urgent care map + self-triage arm).

Covariates

Because the ultimate call to action (seeking care outside the ED) is likely to depend on proximity to the ED and alternate care options, all the regressions described above will include as covariates the driving distance in miles to the closest Geisinger ED and the driving distance in miles to the closest Geisinger urgent care location. Specifically, covariates will reflect the distance from the closest Geisinger ED and closest Geisinger urgent care location of the patient's zip code in the Geisinger electronic health records. Distances between each enrolled patient's zip code centroid and ED/urgent care locations will be computed using the same process described above in the section **Process for Determining a Patient's Nearest Urgent Care**, with the added step of computing the driving distance in miles for each zip code.

Primary Analysis Sample

Analysis will be limited to patients who, at the time of enrollment, lived close enough to an urgent care location to be shown a map to a specific Geisinger urgent care location (i.e., those who lived within 40 miles, using the Haversine method, of a Geisinger urgent care clinic). We estimate that over 98% of patients will be included in this primary analysis. We will also run a sensitivity analysis that includes all patients.

Other Pre-specified Outcomes

We will run the analyses described above on the following additional outcomes:

1. Urgent care visits

   Visited urgent care (y/n)

   [Time Frame: In the 30 days following the appointment]

2. Calls

   Called Geisinger (y/n)

   [Time Frame: In the 30 days following the appointment]

3. Patient portal messages

   Sent a patient portal message (y/n)

   [Time Frame: In the 30 days following the appointment]

Analysis Notes

Recent work suggests that OLS regressions are appropriate in randomized experiments with binary outcome variables such as ours (Gomila, 2021).

In addition to the analyses described above, we may run sensitivity analyses such as using count or continuous variables instead of dichotomized variables.

An exploratory analysis will test whether any of the experimental arms perform better than baseline, using a dichotomous predictor variable (0 = standard practice, 1 = any modified AVS).

Finally, we plan to run exploratory analyses to understand heterogeneity in observed effects (e.g., in covariates such as age, sex, race, or frequency of exposure to the AVS).