

Using the NYU ED Algorithm and Admission-Hour Patterns to Reduce Avoidable ED Visits: A Primary-Care Perspective

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ABSTRACT

Overutilization in the Emergency Department (ED) presents a substantial barrier to cost-efficient, coordinated care, especially with Medicare populations. This study examined claims and visit data for 2024 Aetna Medicare Advantage members associated with Mendez Medical Center in Broward County, Florida with the aim of identifying and decreasing potentially avoidable ED visits. Using the NYU Emergency Department Algorithm (NYU-EDA), and physician review, 40.2% of 15,253 claims were avoidable. The diagnostic analysis found non-cardiac chest pain, spinal stenosis, and urinary tract infections to be the top contributors. A chronological analysis of 1,011 unique visits revealed that just over half occurred after business hours; while also indicating that many of the avoidable visits occurred during regular business hours of the clinic indicating missed opportunities for access. The facility-level analysis found avoidable claim rates to range from 32.5% to upwards of 85%. The results informed a targeted intervention and the interventions included a “Mendez Guarantee” for same-day access, clinical protocols for the most common avoidable diagnoses, and enhanced follow-up workflows. If these findings are generalizable to the broader Medicare panel, projected annual cost avoidance associated with the intervention may range between \$2.03 and \$2.71 million. Overall, we offer a model for primary care clinics to utilize claims data that could ultimately reduce avoidable emergency department use offering a scalable primary care model that benefits all stakeholders, including providers, payers, and the healthcare system at large.

CCS Concepts

- **Applied computing** → **Health care information systems**;
- **Information systems** → **Data analytics**;
- **Computing methodologies** → **Supervised learning by classification**;

Keywords

Avoidable ED visits; primary care; NYU ED Algorithm; Medicare Advantage; healthcare utilization; time-based triage; hospital claims data; clinical protocols; patient engagement; value-based care.

1. INTRODUCTION

Emergency department (ED) overuse is a prominent issue in the U.S. healthcare system with ramifications on costs, resources, and continuity of care. Although EDs play a vital role in dealing with acute and life-threatening illness, many ED patients utilize those services for complaints that are better suited for primary care and could have been treated without having to utilize an ED. This misalignment creates inefficiencies, worse care coordination, and higher costs.

In efforts to quantify that misalignment, researchers from New York University came up with the NYU Emergency Department Algorithm (NYU-EDA), a robustly validated, decision algorithm which classifies an ED visit on a continuum of complex urgency, non-emergent, emergent but preventable or treatable in primary care (Billings et al., 2000; Ballard et al., 2010). Since then, the NYU-EDA has been used for health services research to

quantify the impact of avoidable ED utilization.

Non-emergent visits might comprise 20–40% of ED utilization (Ballard et al., 2010), but when we include visits classified as emergent but treatable in primary care, we may have upwards of 45–70% percent of ED visits that are avoidable (Gandhi & Sabik, 2014; Raven et al., 2013; Uscher-Pines et al., 2013). This discrepancy emphasizes the need for proactive measures, especially in primary care which can redirect avoidable use by improving access, expanding education, and facilitating timely and preferred delivery of care.

At Mendez Medical Center, a primary care clinic located in Broward County, Florida, reducing unnecessary ED use has been prioritized at the institutional-level. Among the many challenges we face, one of the most significant involves changing patient behavior to understand that they should use our services first before they default to ED. This is especially important for our Medicare population because many due to real or perceived barriers to access or familiarity with other points of care.

In this study, we utilized the NYU Emergency Department Algorithm (NYU-EDA) to assess Aetna Medicare ED claims and visits from 2024 associated with our clinic. Then, through the unique diagnostic classification and temporal dimensions, we looked at admission timestamps and ED visit frequencies by day and hour to determine avoidable visits, specifically during usual business hours that could have been care provided in an office-based practice.

These findings guided the development of a robust intervention that leveraged standardized clinical protocols for the fifteen ED avoidable diagnoses, a patient-centered outreach campaign named the “Mendez Guarantee” where we marketed patients to be aware about available same-day care, and new management workflows replicating avoidable ED utilization in real time. By unifying clinical standards, operational workflows, and patient engagement strategies we hope to achieve an improved continuity of care, reduction of unnecessary ED visits, and a greater overall care delivery model for our Medicare population.

2. METHODS

2.1 Data Source

For this study, we analyzed two complementary datasets capturing 2024 emergency department (ED) utilization among Aetna Medicare Advantage members attributed to Mendez Medical Center, a primary-care practice in Broward County, Florida. The first dataset included 1,011 unique ED visits (out of a total roughly 1,200 active patients) and also contained adequate date-and-hour timestamps for our time-based analyses, however, the dataset was missing primary diagnosis information on about 90% of these encounters. To fill this sensor gap, we examined a second dataset of 15,253 ED claims from the same patient population and year that provided full information on ICD-10 diagnosis codes, payer information and facility identifiers, but only a date-level timestamp resolution. All personal identifiers were removed in accordance with HIPAA and institutional privacy policies.

2.2 NYU-EDA Classification

We categorized every ED visit using the New York University Emergency Department Algorithm (NYU-EDA), a validated probabilistic algorithm developed, and first published, in 2000 based on ICD-9 discharge codes (Billings et al., 2000). The original authors classified visits into four mutually exclusive groups: non-emergent; emergent but primary-care treatable; emergent and preventable if treated in the ED with timely care; and emergent and unavoidable. We followed the authors' methods and mapped emergency visits as potentially avoidable if their cumulative probabilities, of being mapped as non-emergent or primary-care treatable, equaled or exceeded 50% and flagged visits as avoidable (avoidable_flag = 1) if they were both primary-care treatable (or non-emergent) and flagged as avoidable (avoidable_flag = 0) if they were mapped as emergent.

2.2.1 Handling of Unclassified Codes

As the foundation of the original NYU-EDA depended on ICD-9, the algorithm did not capture some of the ICD-10 codes introduced in later years, leading to 11.4% of ED visits remaining unclassifiable. To overcome this limitation, we implemented an approach consistent with established practice (Johnston et al., 2017) and performed physician-led manual reviews to categorize the avoidability of these visits, which facilitated comprehensive coverage and consistency in subsequent analyses.

2.3 Temporal Analysis

To analyze time-based trends in avoidable ED utilization, admission time stamps were obtained and analyzed in two ways. First, we carried out an hourly examination using visit time data linked to clinic hours of operation (Monday to Friday, 8:30 am to 5:30 pm; Saturday, 8:30 am to 12:30 pm) to assess if visits were made during hours of operation at the site or outside of these business hours. Second, we completed a monthly-level i.e., calendar-level, assessment to examine fluctuations in the amount of ED visits, which reflects potential seasonal or event-related patterns in ill-advised care-seeking behavior.

2.4 Facility-Level Analysis

Facility names were standardized to address naming inconsistencies and maintain analytical rigor. We then computed the percentage of avoidable claims overall per facility and identified the top facilities with at least 50 claims. To assess if avoidability rates varied statistically across facilities, we conducted a Chi-square test of independence (McHugh, 2013). The level of significance was set at $p < 0.05$.

2.5 Statistical Analysis

All quantitative analyses and visualizations were generated in Python using the Pandas and Matplotlib libraries, respectively. Proportions of avoidable claims were summarized descriptively and corresponding 95% confidence intervals were generated using the Wilson Score method, which generates more accurate interval estimates than the traditional normal approximations (Brown et al., 2001). The Chi-square statistical test was used to evaluate if the distribution of avoidable claims significantly varied across facilities. Future analyses could include stratified comparisons by age-group, gender, or insurance subtype; however, we did not explore any of these in this work due to demographic characteristics of our sample, which is primarily of Medicare beneficiaries aged 65 and older, minimizing opportunity for substantial variation among these subgroup comparisons.

2.6 Operational Review and Intervention Design

Facility The quantitative findings were presented to Mendez Medical Center leadership, clinical staff, and administrative leaders during group working meetings. The multidisciplinary teams provided input to co-design a comprehensive intervention approach for reducing avoidable

utilization of the ED. To facilitate standardized implementation of the intervention, we developed an operational script for distribution to the providers, clinical members, and administrative leaders at Mendez. The operational script articulated standardized ways of communicating, triage escalation guidelines, and primary talking points to reinforce office-first care pathways. The key components of the intervention included a standardized clinical protocol for the fifteen most common avoidable diagnoses, the “Mendez Guarantee” campaign to provide same-day access; deployment of visual outreach materials in all patient-facing spaces; and newly designed workflows to follow-up with patients, prioritize urgent complaints, and monitor high utilizers on a real time basis.

3. RESULTS

3.1 Overall Avoidable ED Visit Rate

In 2024, we analyzed ED claims data and found a total of 15,253 emergency department claims made for patients attributed to Mendez Medical Center; of those, 6,136 claims (40.2%) were deemed avoidable using the NYU Emergency Department Algorithm along with physician review, and 9,117 claims (59.8%) were deemed not avoidable. The avoidable rate was analyzed using the Wilson Score interval and yielded an avoidable rate of 95% (39.5% - 41.0%). This finding reflects a consistently high rate of emergency department utilization that could likely have been managed through outpatient resources.

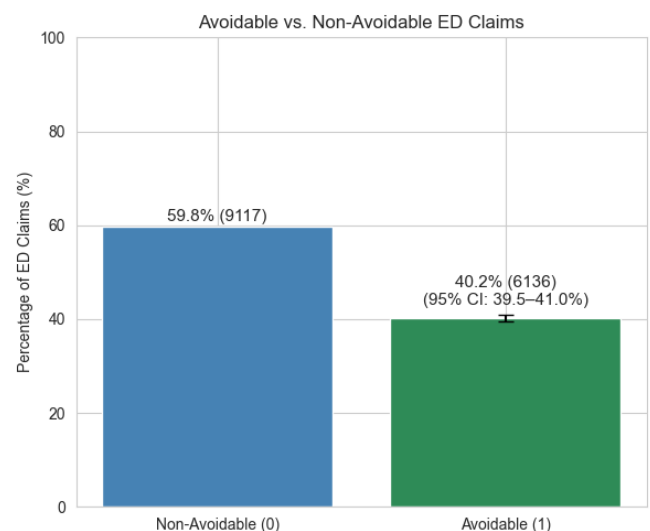


Figure 1. Distribution of ED claims by avoidable classification with 95% confidence intervals.

3.2 Key Contributors to Avoidable Claims from ED Visits

To better understand the types of clinical conditions driving avoidable emergency department (ED) utilization, we analyzed the primary diagnosis codes from the claims that were flagged as avoidable. The analysis indicated that avoidable ED utilization was clustered around a limited number of ICD-10 diagnosis codes. The avoidable diagnosis that led the way in terms of claims was non-cardiac chest pain (R07.89), representing 13.0% of all avoidable claims from ED visits. This followed by lumbar spinal stenosis (M47.812, 10.8%), urinary tract infection (N39.0, 9.0%), joint pain (M25.551, 8.9%), and generalized weakness (R53.1, 8.5%), as illustrated in Figure 2. These conditions can usually be managed by a primary care physician with appropriate orientation and prompt access, highlighting the importance of enhancing clinical triage processes, access policies and patient education programs.

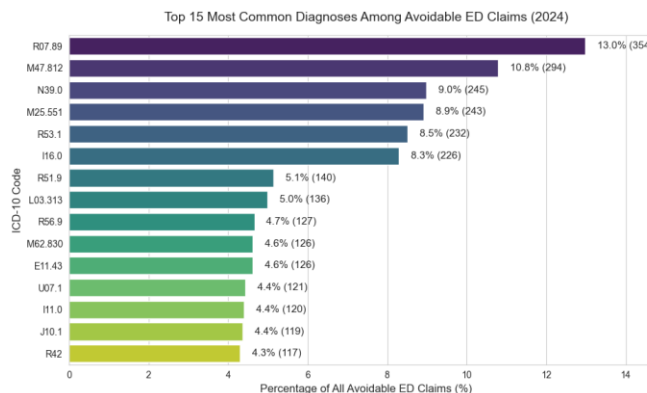


Figure 2. Top 15 avoidable diagnoses by percentage of total avoidable claims in emergency department visits.

3.3 Facility-Level Variation in Avoidable Use

Alongside examination of diagnosis-dependent trends, we examined avoidable ED utilization at the facility-level based on claims data. Facilities with a minimum of 50 claims exhibited broad variability in the proportion of avoidable claims. The avoidable claim rates were the highest through HCA Florida University Hospital and Cleveland Clinic Weston (87.9% and 87.8%, respectively; see Figure 3). Conversely, Holy Cross Hospital and Broward Health Coral Springs, at 32.5%, reported the lowest rates of avoidable claims. A Chi-square test of independence demonstrated statistical association ($\chi^2 = 2178.91$, $df = 41$, $p < 0.0001$), providing evidence that the associated variability in facility-level avoidable ED claims does not occur by random chance. Therefore, facility-level conditions such as geographic location, triage protocols, admission practices, and institutional reputation may shape patient decision-making and utilization of avoidable ED care settings.

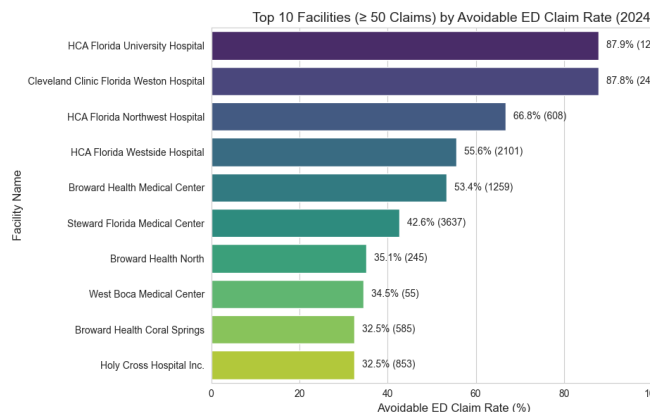


Figure 3. Top 10 facilities (≥ 50 claims) by avoidable ED claim rate. Chi-square test confirms significant variation across hospitals ($p < 0.001$).

3.4 Time-Based Patterns in ED Utilization

Next, we examined temporal patterns to assess how visit timing may influence avoidable ED utilization.

3.4.1 Monthly Trends

Monthly trends in ED usage displayed cyclic variation throughout the year. As shown on Figure 4, visit volume peaked in December (138 visits) and March (120 visits), which may represent seasonal illness syndromes or cessation of outpatient care over holiday periods. ED usage appeared to remain relatively stable during the summer months, indicating that access issues related to weather or vacations may not have been prominent factors.

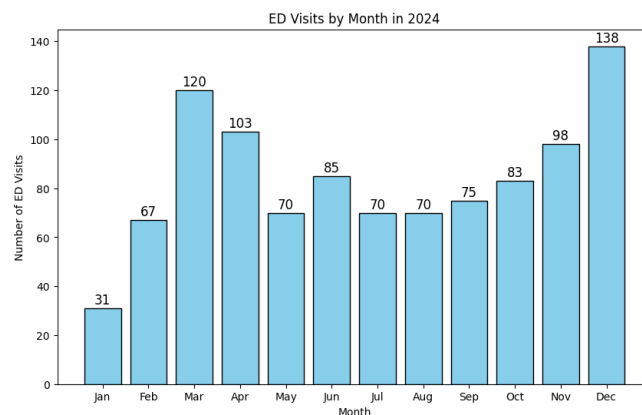


Figure 4. Monthly distribution of ED visits in 2024.

3.4.2 Hourly Distribution

An hourly analysis of weekday ED admissions showed that a substantial number of visits clustered between 6:00 PM and midnight. The after-hours visit accumulation indicates that there are either patients who are unaware of office resources or some limitation on extended hour coverage for urgent, but non-emergency care.

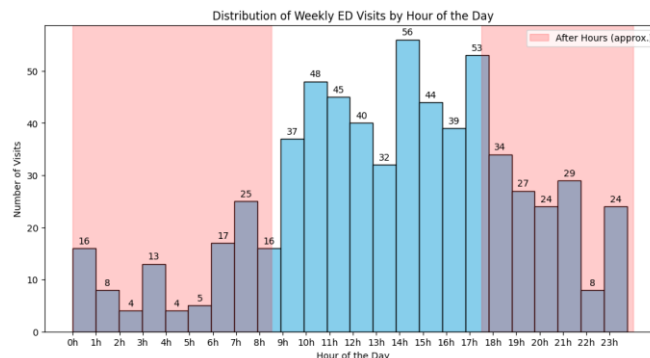


Figure 5. Distribution of weekday ED visits by hour of day. Shaded regions denote after-hours.

3.5 Office Hours vs. After Hours

To evaluate the after-hours effect on frequency more precisely, we examined the frequency of visits during versus outside of posted hours. The visit distribution was broken down by hours through stratification of visit time. It was determined that 59.1% or the majority of ED visits, took place outside of Mendez Medical Center's posted business hours. Conversely, only 40.9% of ED visits occurred during business hours. The findings demonstrate not only the degree to which there is opportunity for increased patient engagement and deployment of real-time triage solutions during business hours, but also the higher share of avoidable visits that occurred during available in-office time. In summary, these findings reiterate the importance of same-day access guarantees and strong, clear messaging about office and in-person care first.

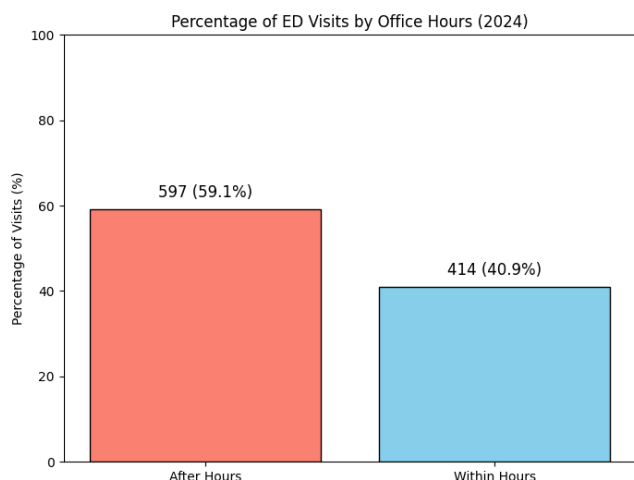


Figure 6. Proportion of ED visits occurring during vs. outside of posted business hours at Mendez Medical Center in 2024.

4. DISCUSSION

The findings of this study offer a meaningful opportunity to reverse the overutilization of the emergency department (ED) by Medicare Advantage beneficiaries traced to Mendez Medical Center. In 2024, 40.2% of our ED claims were classified as avoidable with the use of the NYU Emergency Department Algorithm (NYU-EDA) and a physician review. This was consistent with other research suggesting that between 20-45% of ED visits in the U.S. are for a non-emergent or primary care treatable condition (Ballard, et al., 2010; Gandhi & Sabik, 2014).

Although the NYU-EDA classification and diagnosis-level breakdown was performed on a fully-inclusive claims dataset ($n = 15,253$), the timing analysis of encounters, such as visit hour and month, was conducted on a separate dataset of 1,011 unique ED visits comprising the same population. This dataset contained dates and times, for potential time series adoptions upon observations. Notably, the majority of our avoidable ED visits occurred during clinic posted hours, indicating both a behavior and operational gap in primary care access.

Our facility-level studies provided additional context for this variance in avoidable ED use when the facility had 50 or more claims. HCA Florida University Hospital and Cleveland Clinic Weston had avoidable ED claim rates of 85% or greater, while Holy Cross Hospital and Broward Health Coral Springs had rates of 32.5%. Any causes of decreased claims will be multifactorial; areas to discuss and compare could involve the design of their triage protocols, the complexity of patients utilizing the facility, ability to recruit from their local reputation, or ease of access to the facility. The Chi-square test confirmed the variation existed and was significant indicating the result is unlikely due to chance. Few studies have confirmed that ED utilization is more than urgency; it is also a product of social, geographic and access-related factors (Uscher-Pines, et al., 2013; Raven, et al., 2013).

Time-series derived from visit-level showed that avoidable ED use was concentrated in the evenings and in months such as December and March. These observations suggest that proposed seasonal increases in ED utilization have the potential for targeted interventions, such as later-hour after-hours appointments or virtual triage options (Weinick, et al., 2010). Additionally, 40.9% of our total ED visits occurred during operating hours of a clinic visit indicating that patients were either unaware of same-day access or perceived the ED as more convenient than the clinic for comprehensive care.

When we conducted a comprehensive analysis of the diagnostic content of avoidable ED claims, we noticed some recurrent themes. The most prevalent conditions which includes, non-cardiac chest pain, joint pain, urinary tract infections, generalized weakness, are conditions that can typically be managed

in the primary care setting when given the timely diagnostic tool and clinical workflow. These patterns formed the basis of a Standard-of-Care Protocol designed for the 15 most frequent avoidable diagnoses. The protocol framed various diagnostic steps, expected treatment protocols and follow up/on-going treatment plans to mitigate unnecessary ED triage.

Sequentially we used our findings to design a multi-pronged intervention, which was collaboratively and informally facilitated to shift patient behavior and enhance care coordination. Key tenets included: the “Mendez Guarantee” for same day access to acute concerns; education at multiple patient touchpoints (triage, discharge and follow-up); and an easy method for all care team members to flag repeat utilizers of ED for proactive care planning. The execution of this strategy has demonstrated early success with preventive engagement with providers and reduced disjointed care for un-familiar or un-coordinated care.

It should be noted that classification of diagnosis was established using claims data with some limitations related to the NYU-EDA's original design was based on ICD-9 codes, and there are other limitations to highlight in the next section.

This study provides a real-world example of how a primary care clinic may leverage claims and encounter data to identify avoidable ED utilization and develop actionable interventions. Although causation has not been formally established, our findings signal the next steps for investigation including: impact analysis of our intervention; developing cost avoidance modelling on avoidable ED claims; exploring social determinants of health in much broader engagement with our stakeholders.

From a financial standpoint, avoidable ED utilization represents a significant cost burden. We reviewed our dataset of 1,011 unique ED visits, each having timestamps. We found that about 40.2% of visits, about 406 encounters were deemed avoidable. If we apply a conservative estimate of \$1,500 to \$2,000 per ED visit from national sources (HCUP, 2021; BetterCare, 2024) and working from the perspective of only the sample we reviewed, this alone could reflect potential total cost burden from avoidable ED use of \$609,000 to \$812,000 annually.

Essentially, this estimate shows savings potential for one subset of the Aetna Medicare population attributed to Mendez Medical Center. Our intervention strategy is being implemented across our full Medicare panel that currently has over 4,000 patients actively managed. If the phenomenon of avoidable ED utilization exists in the larger population, we could estimate avoidable ED visits occurring in the range of up to 1,350 visits annually, which might represent cost avoidance of \$2.03 to \$2.71 million annually.

These savings are not only meaningful for the medical office in terms of improving care coordination and reducing fragmentation, but have significant implications for CMS and insurance payers that ultimately pay for emergency services. This intervention model represents a viable, leveraged intervention toward reducing unnecessary healthcare spending on the system side of healthcare by redirecting non-emergent ED visits to more appropriate primary care venues and provides a scalable pathway to help improve the efficiency of the U.S. healthcare system.

5. LIMITATIONS

This study's findings have limitations that merit consideration when interpreting results. First, avoidable ED visits were identified using the NYU Emergency Department Algorithm (NYU-EDA) which is an algorithm that was developed originally using ICD-9 codes. While our data were structured using ICD-10 codes, we were able to use ICD-10 diagnoses in NYU-EDA categories, mapping unclassified ICD-10 codes using physician review. Approximately 11.4% of claims for the ED visits in our sample required manual classification of the ICD-10 diagnosis. This inherently subjective classification process can result in bias and inconsistency across patients.

Second, structural data limitations required us to have two datasets in order to complete the different parts of the analysis,

which restricted the ability to analyze patient level and diagnosis timing as a single integrated analysis. First, we used a dataset of 1,011 unique ED visits, which included detailed timestamp information by hour and date, to analyze temporal and time-series analyses; however, more than 90% of unique primary diagnosis codes were not available. Therefore, diagnosis classification was highly incomplete using this dataset. We also used a second dataset of ED claims ($n = 15,253$), which included full ICD 10 diagnoses associated with the claims as well as payer information, but did not have time-series detail beyond the service date. While we were able to conduct the analyses we proposed, separating datasets limited our ability to analyze ED claims by diagnosis and a facility level variable, and timing all in one data set.

Third, this study was specific to Medicare Advantage patients attributed to a single primary care practice (Mendez Medical Center) located in Broward County, Florida. While it provided operational depth and specificity, it limited the ability to generalize our findings with other populations, payors, and geographies.

Fourth, while we conducted descriptive and facility level comparisons using Chi-square testing, our study used observational and retrospective data from the analyzing retrospective ED data. Therefore, we cannot make causal conclusions on why particular facilities had the highest low acuity claim reporting or if patients' behavior was changed following our interventions.

Fifth, the datasets did not include social determinants of health at the patient level (e.g. access to transportation, health literacy, language barriers) or behavioral factors (e.g. trust in primary care, prior experiences) that may have inadvertently influenced ED utilization. These variables are important to include in future research to understand patient decision-making and care outcomes at the broadest level.

Finally, our intervention strategies (e.g. same-day access guarantees, patient education workflows, and follow-up tracking) were implemented only months before the analysis. Therefore, although we captured post-implementation data on ED utilization rates, patient satisfaction and healthcare cost savings were not evaluated. In order to conclude if these innovations were effective and sustainable, longitudinal follow-up and outcome measures will need to be obtained in order to assess for continued effectiveness of these operable changes over time.

6. FUTURE WORK

Although the current intervention has centered on decreasing avoidable ED use through improved triage protocols, educating patients, and redesigning operations, there are more opportunities for impact. One of the more significant opportunities is the expansion of access to care beyond conventional office hours.

For the next stage of this project, Mendez Medical Center will establish structured after-hours care services, including evenings/weekends, to provide actual alternatives to the ED for care. On-call providers during extended Mendez Medical Center hours, particularly focused on when current avoidable visits occur, may be components of structured after-hours care.

In addition, as we continue to refine our predictive analytics models, we will have the ability to more accurately identify high-utilizer patients and repeat avoiders; allowing us more personalized outreach and care coordination. Future evaluations will also look at the longitudinal impact of these interventions on patient outcomes, satisfaction, and total cost of care.

Ultimately, this work represents one step in the development of a more responsive, data-driven and patient-centered model of primary care that acknowledges the promise of value-based healthcare. These efforts aim to not only reduce avoidable utilization but also improve patient satisfaction and engagement with primary care.

7. CONCLUSION

Emergency department (ED) overutilization remains a major problem in the U.S. healthcare system, especially for Medicare members with complex needs. When we examined ED claims from Mendez Medical Center in 2024, we found that 40.2% of ED visits were classified by the New York University Emergency Department Algorithm (NYU-EDA) as avoidable: these generally were conditions that could have been managed effectively as a primary care problem, with timely intervention. These studies are consistent with national data and reaffirm the integral role outpatient care models can have to mitigate ED utilization.

The application of the NYU-EDA classification combined with temporal, diagnostic, and facility-level analyses provided useful data that were applied to a targeted intervention process. The final protocol focused on clear processes on triage pathways; education of patients at discharge, during routine clinic visits; and improved follow-up workflows to reduce the aberration of timely access to office-based care from ED utilization. Furthermore, the "Mendez Guarantee" is a model for how promised same-day access can give patients an effective choice, and, if effectively communicated to patients, could change their behavior and divert non-emergent types to safer and cheaper places of care.

The study describes how, through operational change and data-backed collaborative practice, avoidable ED use can be alleviated in a manageable way. Even more important is the economic consideration; we made projected estimates of \$1,500 to \$2,000 per emergency visit, which suggests the avoidable ED use in the clinic's Medicare population could result in an annual cost avoidance of \$2.03 to \$2.71 million. These savings benefit the medical office through improved care coordination, delivery efficiency, and patient experience, but ultimately also positive impacts for CMS and insurers, who ultimately cover the costs of emergency care. Moreover, reduced avoidable ED use supports larger value-based care models, while providing an implementable framework for primary care to engage in clinical and financial sustainability.

8. ACKNOWLEDGMENTS

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