

Developing an Electronic Health Record Derived Health Equity Dashboard to Improve Learner Access to Data and Metrics

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Abstract

Objectives

It is essential to engage learners in efforts aimed at dismantling racism and other contributors to health care disparities. Barriers to their involvement include limited access to data. The objective of our study was to create a data dashboard using an existing quality improvement infrastructure and provide resident access to data to facilitate exploratory analysis on disparities in emergency department (ED) patient care.

Methods

Focusing on patient populations that have previously been shown in the literature to suffer significant disparities in the ED, we extracted outcomes across a variety of metrics already collected as part of routine ED operations. Using data visualization software, we developed an interactive dashboard for visual exploratory analyses.

Results

We designed a dashboard for our resident learners with views that are flexible and allow user selected filters to view clinical outcomes by patient age, treatment area, and chief complaint.

32 Learners were also allowed to select grouping and outcomes of interest to investigate questions
33 and form new hypotheses of their choosing. Available dashboard views included summary
34 counts view to assess ED visits over time by selectable group, a rooming and triage acuity view,
35 time-to-event survival curve view, histogram and box plot views for continuous variables, a view
36 to assess outcome variables by time of day of ED arrival, customizable contingency table views,
37 and correspondence analysis.

38

39 **Conclusions**

40

41 Utilizing an existing quality improvement infrastructure, we developed a dashboard that provides
42 a new perspective into commonly collected ED operations data to allow for the exploration of
43 disparities in ED care that is accessible to learners. Future directions include using these data to
44 refine hypotheses on ED disparities, understand root causes, develop interventions, and measure
45 their impact.

46

47 **Introduction**

48

49 Learners play a critical role in patient care yet their opportunities to engage in eliminating health
50 care disparities remains limited¹. The Accreditation Council for Graduate Medical Education
51 (ACGME) has formed a working group, the Quality Improvement in Health Care Disparities
52 Collaborative², to guide development of programs to empower learners to systematically engage
53 in reducing health care disparities. Racism, in the form of health care disparities in emergency
54 department (ED) care, exist in outcomes related to administration of pain medications³,
55 management of acute coronary syndrome⁴, and access to specialists⁵. These studies have drawn
56 much needed attention to examining differences in health care delivery, but implementation of
57 interventions based on these findings remains limited⁶. The effectiveness of implicit bias training
58 and other educational interventions to reduce systemic racism in physician behavior have mixed
59 efficacy⁷. Incorporating novel approaches to allow assessment of provider actions in real-time
60 will be essential to informing interventions to eliminate these disparities⁸.

61

62 While it is common for EDs to provide individual or departmental feedback regarding metrics on
63 disposition, length of stay, patient satisfaction, and other aspects of care, these data are rarely
64 stratified by groups that have the potential to be marginalized in their care. These patient
65 groupings include race, ethnicity, sexual orientation, gender identity, language, religion, age and
66 weight. Dashboards have emerged within healthcare as a visual tool to monitor data for
67 continuous quality improvement (QI) and to detect variations in care. However, this data is
68 generally unavailable to learners and audiences are limited to hospital staff in clinical and
69 financial operations. The COVID-19 pandemic has driven a dramatic expansion in the number of
70 dashboards presented to healthcare workers outside of operations⁹. We sought to adapt this
71 philosophy of data transparency and real-time monitoring to improve the equity of care delivered
72 in our ED. Thus, we developed a data dashboard utilizing variables selected from existing quality
73 metrics and applied exploratory analyses to these data to identify health care disparities that are
74 specific to our institution and patient population. The goal was to develop a learner accessible
75 dashboard and facilitate a collection of relevant variables that would allow for data exploration,
76 generation of new hypotheses and evaluation of interventions.

77

78 **Methods**

79

80 **Group selection**

81

82 We identified groups previously shown to suffer disparities in outcomes of their care in the ED.
83 Groups included patients of varying race, ethnicity, sexual orientation, gender identity, language,
84 religion, age and weight. These data were collected routinely at registration either during the ED
85 encounter or prior encounters and stored in the electronic health record (EHR).

86

87 **Outcome variable selection**

88

89 Our department's data analytics group collects a variety of metrics concerning clinical
90 operations. These quality metrics are similar to those commonly monitored other EDs and
91 include information on wait and rooming times, provider action times, dispositions,

92 administration of pain medications, use of laboratory testing, use of imaging and triage
93 information¹⁰. A subset of these variables were selected for use in the dashboard.

94

95 Dashboard design

96

97 All selected variables were collected and stored securely in our institution's health information
98 data warehouse. We utilized Tableau data visualization software (Tableau Software, Seattle,
99 WA) to develop the interactive dashboard. Learners were provided the ability to select groups
100 and outcomes to explore trends over time, by chief complaint, primary diagnosis, and a variety of
101 other factors. Dashboard creation and data collection were deemed exempt QA activities by our
102 hospital's institutional review board and access is via secure login similar to the EHR.

103

104 **Results**

105

106 Selected outcome variables

107

108 Outcome variables were a subset of commonly available ED operations metrics and broadly
109 grouped into four domains. First, we identified triage related variables including time to events
110 such as time to room and first provider contact, triage note text, and triage acuity level. We also
111 identified outcomes in diagnostic testing such as utilization of specific and total laboratory tests,
112 type and number of imaging studies, and use of specialist consultants. Pain and antiemetic
113 medication usage was also identified as a domain of interest and variables included type, route,
114 and timing of administration for a predefined list of pain and antiemetic medications. Finally,
115 disposition related metrics including ED and hospital length of stay, disposition type, time to
116 disposition decision, ED return and unplanned ICU transfers were collected.

117

118 Dashboard based exploratory analyses

119

120 We designed the dashboard views to be flexible and allow user selection of filters to narrow
121 analysis to a specific population of interest by date of presentation, age, treatment area (adult or
122 pediatric ED), and chief complaint. Learners were allowed to select grouping and outcomes of

123 interest to investigate questions of their choosing in a variety of dashboard views that included:
124 total ED visits over time by selectable group; rooming and triage acuity trends; time-to-event
125 survival curves, histogram and box plot views for continuous variables; assessment of outcome
126 variables by time of day of ED arrival; contingency tables; and correspondence analysis¹¹. Figure
127 1 presents an example dashboard based, exploratory analysis of pain medication administration
128 in patients presenting with abdominal pain stratified by race and ethnicity as White, Non-
129 Hispanic, Non-White or Hispanic, and unknown race/ethnicity patients. Summary counts and
130 percentage data indicate relatively stable ED census and percentage of patients who are non-
131 white or Hispanic (Figure 1A). Time-to-event analysis demonstrated that within the population
132 of abdominal pain patients, there was generally a longer time to administration of the first pain
133 medication in non-white or Hispanic patients (Figure 1B). Final pain score was also assessed
134 and higher final pain scores were found in Non-White or Hispanic patients (Figure 1C).
135 Correspondence analysis demonstrated association between non-opioid medications and Non-
136 White or Hispanic patients (Figure 1D). These analyses were considered example exploratory
137 analyses and formal statistical testing was not performed.

138

139 **Discussion**

140

141 We have developed a dashboard for the exploration of common ED metrics stratified by groups
142 historically known to have disparities in care. By utilizing our own department's data, we hope
143 to increase awareness and empower learners to pursue QI interventions that seek to reduce
144 inequality and bias in the care of our patients. Potential interventions could include personalized
145 and aggregate data derived from the dashboard. For example, use of individual provider data to
146 facilitate personal coaching sessions regarding implicit bias could mitigate identity threat as a
147 barrier to meaningful behavior change. Specifically, this data could be used to provide trainees
148 with iterative and formative feedback congruent with the ACGME's Milestones 2.0 under
149 System Based Practice, Practice-Based Learning and Improvement and Interpersonal and
150 Communication Skills. Alternatively, dashboard monitoring could be used to support an ongoing
151 dialogue regarding local issues of health care disparities and support active change management
152 when resistance to continued action is encountered. Based on our experience with a resident-
153 initiated lecture series on health care disparities, example topics amenable to such analysis

154 include differences in care due to primary language, race and pain medication delivery, and rural
155 health disparities.

156

157

158 Our dashboard leverages the existing data infrastructure in our ED and similar techniques could
159 be applied easily scaled both within and across at other institutions to minimize the costs to
160 training programs or EDs that seek to implement similar dashboards. Partnership with
161 departmental leadership facilitates a meaningful cross-disciplinary conversation with clinical
162 operations staff. While we utilized Tableau software to create our dashboard, similar, less costly
163 tools are available. Preconfigured reporting tools may also be available directly in the EHR. For
164 example, Epic (Epic Systems, Madison, WI) includes the SlicerDicer reporting tool that can be
165 applied to the analysis of health care disparities.

166

167 Dashboard monitoring promotes continuous QI and can facilitate access to data for learners and
168 educators. The ability to interact with departmental data, particularly one's own data, may
169 provide learners the opportunity to further investigate their observational hypotheses. Congruent
170 with the ACGME's Quality Improvement in Health Care Disparities Collaborative, access to
171 departmental health disparities data is an important foundational resource for learners to engage
172 in projects aimed at eliminating health care disparities. We anticipate that this will help
173 overcome one of the barriers that limit learners' participation in QI projects. By reducing these
174 barriers, learners can more easily identify potential interventions within their clinical
175 environment.

176

177 **Limitations**

178

179 While our dashboard allows for data monitoring and exploratory visual analysis, statistical
180 testing that adjusts for confounding variables is necessary before drawing inferences; especially
181 prior to designing new interventions. The dashboard is limited by the completeness and accuracy
182 of the underlying EHR data. Demographic information, from which the categorical groupings
183 are derived, is entered at registration by department registrars and can be edited by patients
184 online. This process may introduce errors or selection bias in the underlying data. Finally,

185 outcome variables we selected to present to dashboard users were already collected by our
186 quality monitoring. While this approach is pragmatic, it may introduce a reporting bias. Other
187 outcomes that we do not collect may better reflect health care disparities of interest.

188

189 **Conclusion**

190

191 We utilized existing QI infrastructure to build a dashboard that allows for the exploration of
192 disparities in ED care that is accessible to learners. Future directions include using these data to
193 drive novel educational interventions, refine explanatory hypotheses on ED disparities,
194 understand root causes, and measure both the impact of educational interventions on learners and
195 overall program evaluation.

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236 **Figure Legends**

237

238 **Figure 1.** Example exploratory analyses using the dashboard for first pain medication by race
239 and ethnicity in patients presenting with abdominal pain. REAL = Race, Ethnicity and Language.
240 All panels are filtered to adult emergency department (ED) visits for abdominal pain and
241 stratified by the following groups: White and Non-Hispanic; Non-White or Hispanic; and
242 unknown race/ethnicity. Other selectable filters are at the right of each panel. **A)** Total and
243 quarterly distribution of ED visits by race with disposition. Counts and percentages are displayed
244 for each of total visits, quarterly visits and dispositions. **B)** Descriptive statistics and box plots
245 regarding final pain score documented by race. **C)** Time-to-first pain medication by race. Most

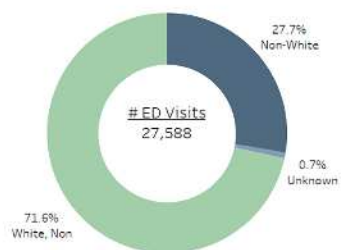
Health Equity Dashboard for Learners

246 commonly administered pain medications were identified a priori. Documented administration
247 time is plotted as a survival curve where administration of pain medication is the event of
248 interest. Lower curves indicate higher likelihood of receiving pain medication. **D)**
249 Correspondence analysis of first pain medication name (blue X's) by race (orange O's). Distance
250 and direction from the origin indicates similarity between selected group and pain medications.
251 White, Non-Hispanic patients more associated with receiving opiate pain medications and Non-
252 White or Hispanic patients more associated with receiving no pain medication or non-steroidal
253 anti-inflammatory medications.

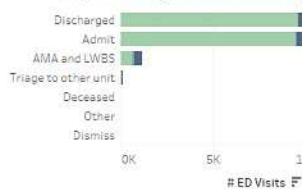
ED REAL Dashboard

Help

ED Visits by Non-White or Hispanic



Disposition by Non-White or Hispanic



ED Treatment Dept: AES-UH

ED Arrival Year: All

ED Arrival Date Range: Non-Null Values Only

Chief Complaint: Abdominal Pain

Group Selector: Age Group

- Group Filter
- 0-17
 - 18-24
 - 25-65
 - 65+

Grouping Selector: Non-White or Hispanic

- Grouping Filter
- Non-White or Hispanic
 - Unknown
 - White, Non-Hispanic

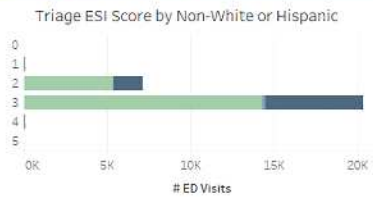
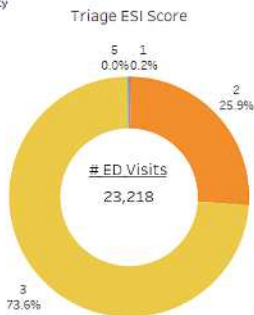
- Color Legend
- Non-White or Hispanic
 - Unknown
 - White, Non-Hispanic



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ED REAL Dashboard

Help



ED Treatment Dept: AES-UH

ED Arrival Year

- 2017
- 2018
- 2019
- 2020
- 2021

Chief Complaint: Abdominal Pain

Group Selector: Non-White or Hispanic

Filter Group

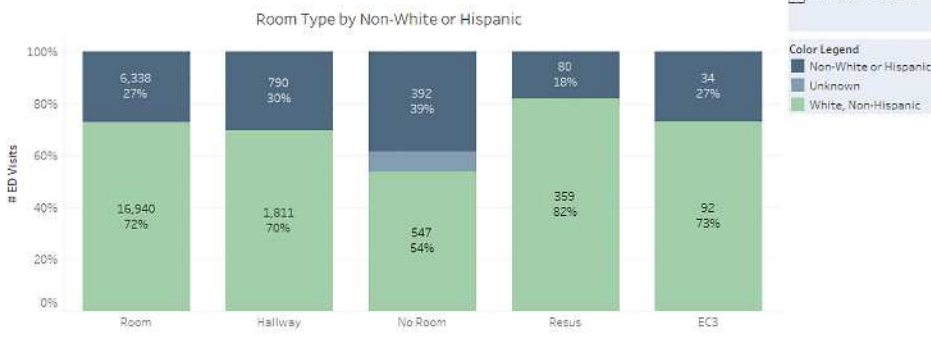
- Non-White or Hispanic
- Unknown
- White, Non-Hispanic

Color Legend

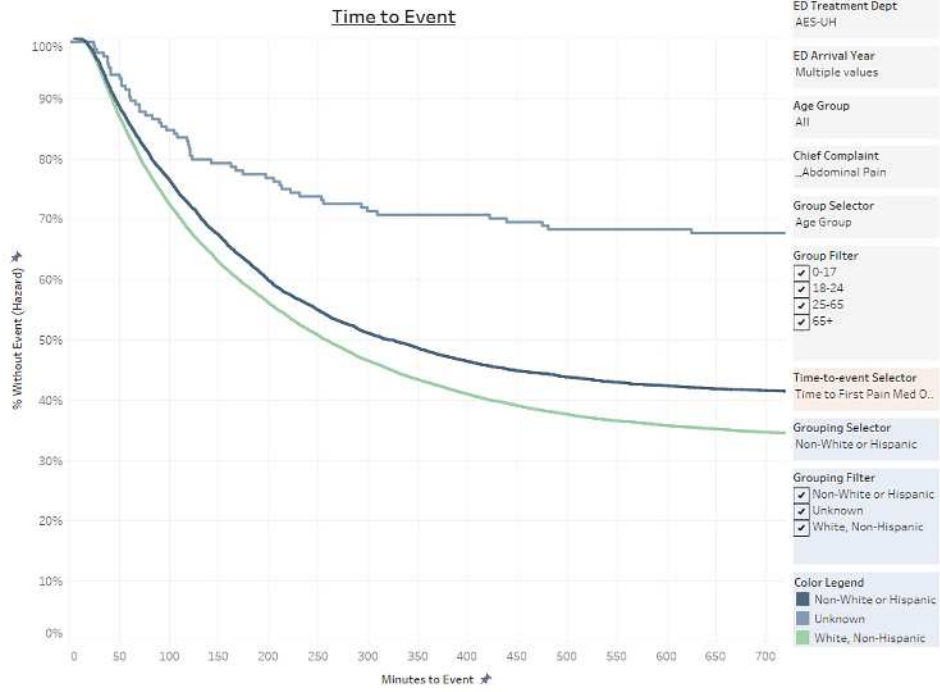
- Non-White or Hispanic
- Unknown
- White, Non-Hispanic

Non-Resus to Resus

	White, Non-Hispanic	Non-White or Hispanic	Unknown
No Resus	99.70%	99.76%	100.00%
Transfer	19,697	7,617	197
Non-Resus to Resus	0.30%	0.24%	
	59	18	



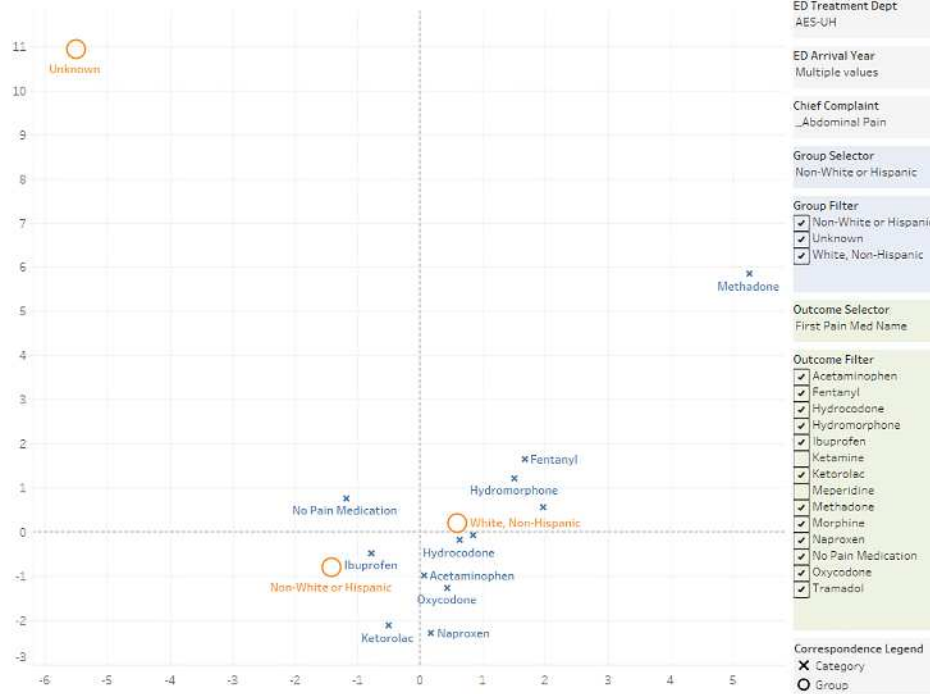
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ED REAL Dashboard

Help



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