

12-21-2021

The “Ebb and Flow” of Documentation: Does the Transition Between Two Electronic Medical Records Systems Affect Emergency Department Efficiency?

Michelle Angeline MD

West Virginia University, michelle.angeline1@hsc.wvu.edu

Erica B. Shaver MD

West Virginia University, eshaver@hsc.wvu.edu

Christopher Kiefer MD

West Virginia University, ckiefer@hsc.wvu.edu

Kimberly D. Quedado PhD

kimberly.quedado@hsc.wvu.edu

Melinda Sharon

Marshall University

See next page for additional authors

Follow this and additional works at: https://researchrepository.wvu.edu/faculty_publications



Part of the [Health and Medical Administration Commons](#)

Digital Commons Citation

Angeline, Michelle MD; Shaver, Erica B. MD; Kiefer, Christopher MD; Quedado, Kimberly D. PhD; Sharon, Melinda; Davis, Stephen PhD; Hurst, Kyle MD; Goode, Christopher S. MD; and Marshall, Thomas C. MD, "The “Ebb and Flow” of Documentation: Does the Transition Between Two Electronic Medical Records Systems Affect Emergency Department Efficiency?" (2021). *Faculty & Staff Scholarship*. 3068.
https://researchrepository.wvu.edu/faculty_publications/3068

This Article is brought to you for free and open access by The Research Repository @ WVU. It has been accepted for inclusion in Faculty & Staff Scholarship by an authorized administrator of The Research Repository @ WVU. For more information, please contact beau.smith@mail.wvu.edu.

Authors

Michelle Angeline MD, Erica B. Shaver MD, Christopher Kiefer MD, Kimberly D. Quedado PhD, Melinda Sharon, Stephen Davis PhD, Kyle Hurst MD, Christopher S. Goode MD, and Thomas C. Marshall MD

1 **The “Ebb and Flow” of Documentation: Does the Transition Between Two Electronic**
2 **Medical Records Systems Affect Emergency Department Efficiency?**

3 **ABSTRACT**

4 **Background:** Electronic Medical Record (EMR) systems are electronic databases for compiling
5 patient records. As healthcare networks expand, it is critical for providers to have access to
6 patient data more broadly. As a result individual healthcare facilities must adjust to enterprise
7 wide EMRs.

8 **Objective:** This study examined the operational effects of transitioning from an Emergency
9 Department (ED) specific EMR to an enterprise wide EMR by evaluating throughput metrics in a
10 community ED.

11 **Methods:** During a 6-month transition period (July-December 2017) in a community-based,
12 academic ED located in North Central West Virginia, length of stay (LOS) and the following
13 operational metrics were analyzed: door-to-provider times, door to disposition time, average
14 LOS, left without treatment (LWOT) rates, and total ED volumes. These metrics were compared
15 with the prior year’s same 6-month period to account for seasonal variability in patient pathology
16 or ED volumes.

17 **Results:** Overall, there was a statistically significant increase in the LOS measures, including
18 door-to-provider time ($p=0.0003$), door to disposition time ($p<0.0001$), average LOS ($p<0.0001$),
19 and LWOT ($p=0.0008$) rates in the post-implementation period. Of note, the overall ED volumes
20 post-implementation were significantly lower than pre-implementation ($p<0.0001$), further
21 supporting that EMR transition negatively impacted ED efficiency despite lower patient
22 volumes.

23

24 **Conclusion:** An ED-specific EMR to enterprise wide EMR transition in a community ED had a
25 negative effect on the overall efficiency of the emergency department.

26

27 **Key Words:** Electronic Medical Record (EMR), Emergency Medicine, Healthcare
28 Administration

29

30 **INTRODUCTION**

31 **Background**

32 An effective emergency department (ED) triages, assesses, resuscitates, diagnoses, and
33 dispositions the most vulnerable and undifferentiated patients the most efficient manner possible.
34 Time management is a critical element in this process. As a result, the Emergency Medicine
35 (EM) physician is faced with the competing interests of providing effective and compassionate
36 patient care, and dealing with inevitable distractions and interruptions, all while being challenged
37 to master timely and complete documentation in the electronic medical record (EMR).

38 **Importance**

39 Historical data has shown that EMR implementation generally has a positive financial
40 return on investment (ROI) and leads to improved quality of patient care and safety.(1, 2)
41 However, despite the many known benefits of the EMR, a recent study has called to question the
42 impact of the EMR on ED workflow, efficiency, and accuracy of documentation.(2)
43 Additionally, this research has started to objectively evaluate length of stay measures and
44 operational characteristics, both prior to and after implementation of an EMR to assess for
45 impact. Ward et. al published one of the largest studies to assess the effect of EMR
46 implementation on the operational metrics of a diverse group of community EDs.(2) While the

47 study showed no meaningful difference in eight measures of operational performance, there were
48 some variations and negative impact on efficiency and operational metrics of some of the
49 individual EDs, sparking future work to assess which specific variables account for decreased
50 efficiency related to EMR implementation.

51 Recently, the transition from paper documentation to the use of an EMR has posed new
52 challenges for physicians when it comes to performing their duties in an efficient manner. This
53 has specifically had a profound effect on EM physicians, as they adapt to new routines while
54 maintaining optimal patient care as emergency department volumes increase.(3-6) The
55 introduction of the EMR as a means for more robust health information documentation processes
56 has posed frequent discussions regarding the benefits and risks of this transition. Prior literature,
57 as it applies specifically to ED operations and efficiency, has debated whether the advent of the
58 EMR helps or hinders EDs that have embraced the practice of electronic documentation.(2, 4-8)
59 While the referenced studies do not focus on a transition between EMR systems, most studies
60 have demonstrated a largely negative effect on ED performance in the time period following
61 initial EMR introduction from paper documentation. These studies specifically reference
62 negative trends in the length of stay (LOS) and operational metrics, with one study
63 demonstrating an overall LOS increase of nearly 40 minutes within the first 4 weeks of EMR
64 implementation.(2, 4-6, 8)

65 As the healthcare system becomes increasingly complex, and accurate communication
66 and medical documentation across all specialties and services within a hospital system becomes
67 inevitably more vital, enterprise wide EMR's are gaining traction as a vehicle for improving the
68 overall quality and safety of patient care.

69

70 **Goals of this Investigation**

71 While most previous studies have analyzed the transition from paper documentation to
72 initial ED implementation of an EMR, this study is the first, to our knowledge, to evaluate the
73 effect of the transition from an ED-specific EMR to an enterprise-wide EMR, and the subsequent
74 effects on length of stay and operational metrics in a community ED. We hypothesized that the
75 transition between EMRs would likely increase length of stay and other operational metrics
76 including door-to-provider times and left without treatment rates (LWOTs). The purpose of this
77 study was to measure the change in efficiency pre- and post – EMR deployment.

78

79 **METHODS**

80 **Study Design and Setting**

81 We conducted a longitudinal analysis of data from a single, community-based, university
82 affiliated ED located in North-Central West Virginia, with an annual volume of 58,000 patients
83 per year. The ED contains 36 acute treatment rooms and 292 licensed inpatient hospital beds.
84 The ED is staffed by board-certified and/or board-eligible Emergency Physicians. EM and
85 family medicine residents, nurse practitioners, and physician assistants serve as additional
86 providers at variably scheduled times. The study site utilized an ED-specific EMR for seven
87 years before transitioning to an enterprise-wide EMR in July 2017. During the two months prior
88 to full implementation of the new EMR, healthcare providers underwent 8 hours of standardized
89 EMR training that was uniformly implemented across the health system. For the first two weeks
90 of deployment in July 2017, specially certified users were on site and available to local
91 providers. After this immediate post implementation period EMR support was available via
92 phone.

93 In order to quantify the impact of EMR transition, this study analyzed length of stay and
94 operational characteristics, with the primary outcome being average ED LOS. Secondary
95 outcomes for analysis included door-to-provider times and left without treatment (LWOT) rates.

96

97 **Measurements & Analysis**

98 Data from two discrete 6-month time periods was analyzed: the first representing a 6-
99 month period (July 1-December 31, 2016) preceding implementation of the enterprise EMR by
100 exactly one year, and the second representing the same time period post-EMR transition (July 1-
101 December 31, 2017). The same 6-month time frame of each year was chosen to control for
102 seasonal variations in ED volumes and patient pathology.

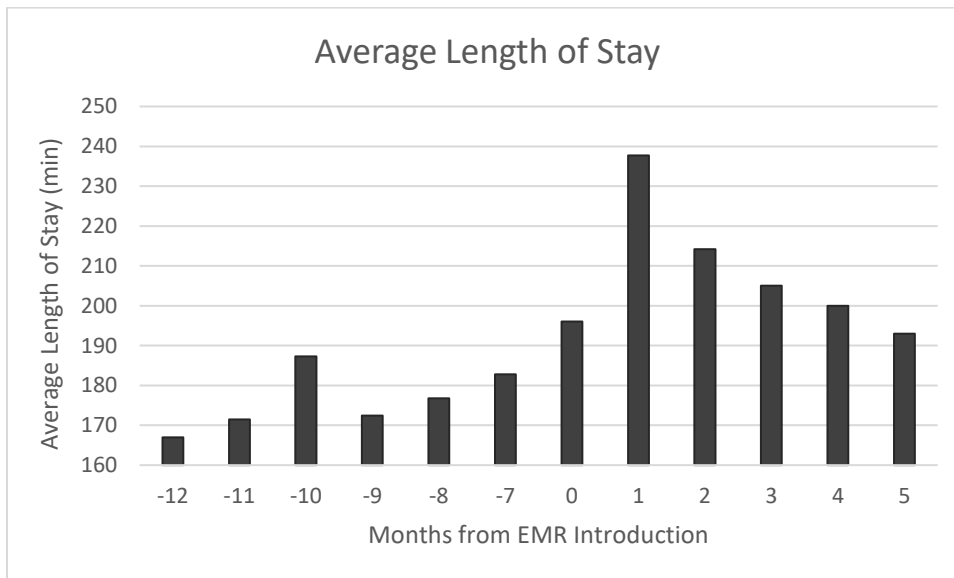
103 The primary outcome of the study was total LOS. The extent to which the primary
104 outcome departed from normality was assessed via the Shapiro-Wilk test. A One-way Analysis
105 of Variance (ANOVA), or the nonparametric Kruskal-Wallis test in cases of non-normal
106 outcomes, was used to test whether or not average LOS differed after the EMR change.
107 Secondary outcomes of our study included door-to-provider times and left without treatment
108 (LWOT) rates during the two study periods. An alpha of 0.05 was selected as the threshold for
109 statistical significance. All analyses were conducted using JMP® 13.2.1 (SAS Institute, Inc).

110 **RESULTS**

111 From July 1 to December 31, 2016, there were a total of 29,480 patients (1,095 average
112 per week) who presented to the ED. During this initial time period under the ED-specific EMR,
113 the average total LOS was 176 minutes (Figure 1). Average door-to-provider time was 41.2
114 minutes, with a LWOT rate of 1.97%. Following implementation of the enterprise-wide EMR,
115 from July 1 to December 31, 2017, there were a total of 27,711 patients (1,026 average per

116 week) who presented to the ED, a statistically significant decrease in patient volume compared to
117 the prior similar time period ($p < 0.0001$). Post-EMR transition, data showed a significant increase
118 in the average LOS to 207 minutes, an overall increase of 31 minutes ($p < 0.0001$; Figure 1).
119 Door-to-provider time and LWOT rates both significantly increased to 53.2 minutes and 3.81%,
120 respectively ($p < 0.0001$; Figure 2).

121 **Figure 1.** Average length of stay, pre- and post-implementation.
122

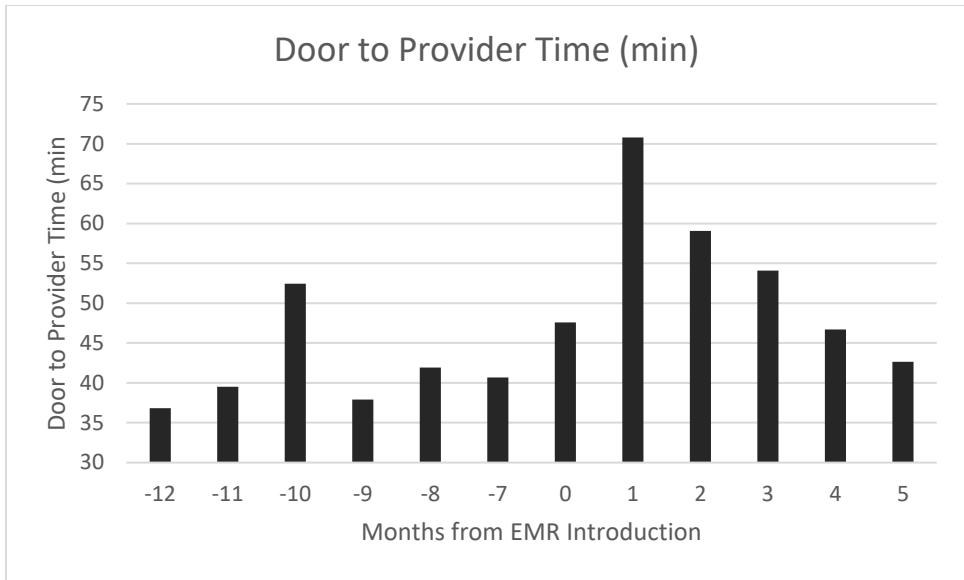


123
124

125 Note: Scale provides month (July 2016 to December 2016) to month (July 2017 to December
126 2017) comparison of pre and post EMR implementation to correct for seasonal variation. Data
127 points are expressed as weekly averages during the entirety of the study.

128

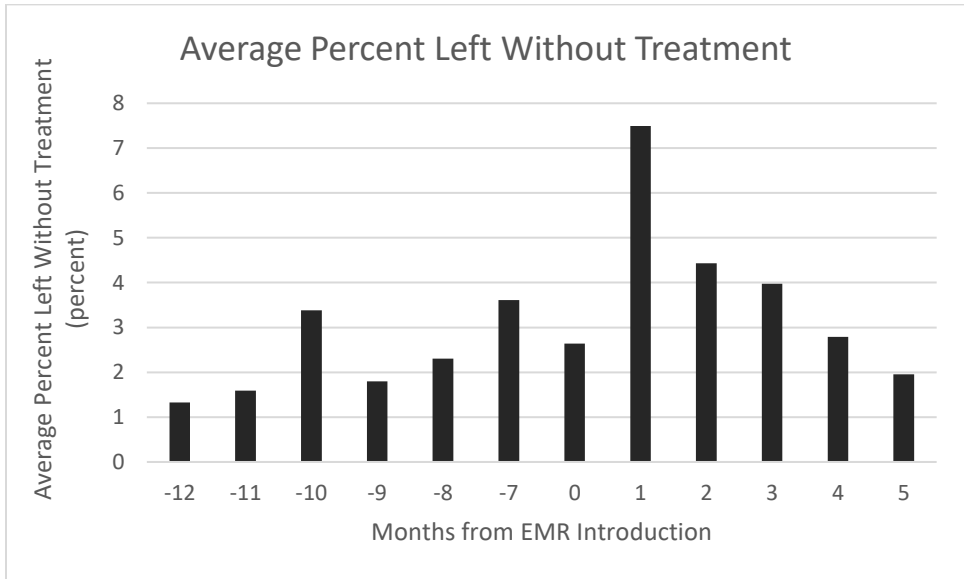
129 **Figure 2.** Average door-to-provider times, pre- and post-implementation.
130



131
 132
 133
 134
 135
 136
 137
 138
 139

Note: Scale provides month (July 2016 to December 2016) to month (July 2017 to December 2017) comparison of pre and post EMR implementation to correct for seasonal variation. Data points are expressed as weekly averages during the entirety of the study.

Figure 3. Average percentage left without treatment rates, pre- and post-implementation.



140
 141
 142
 143
 144
 145
 146

Note: Scale provides month (July 2016 to December 2016) to month (July 2017 to December 2017) comparison of pre and post EMR implementation to correct for seasonal variation. Data points are expressed as weekly averages during the entirety of the study.

DISCUSSION

147 To our knowledge, this is the first study to analyze specific length of stay and operational
148 metrics following a transition between EMR systems. Most of the prior literature has analyzed
149 the transition from paper medical records to an EMR. Our results from an ED specific EMR
150 system to enterprise wide EMR transition were consistent with prior paper to EMR transition
151 studies that have demonstrated a negative impact on ED efficiency metrics immediately after
152 implementation of a new EMR.(2-6). We found significant increases in average length of stay,
153 door to provider times, and left without treatment rates. We did attempt to control for
154 confounding factors such as annual seasonal variability by studying the same time periods per
155 and post EMR implementation. Our results indicated an increase of 31 minutes to total length of
156 stay post-implementation of the enterprise-wide EMR. The fact that the total patient volumes
157 were incidentally lower immediately post implementation makes these increases in length of stay
158 even more striking, as patient length of stay times likely would have been further increased had
159 patient volumes been similar to the same time period pre-enterprise-wide EMR implementation.

160 Our results differed from one of the largest prior studies analyzing the paper to EMR
161 transitions and the effect upon ED efficiency. Ward et al. found no difference in length of stay
162 measures and operational characteristics in the overall analysis of 23 community EDs after these
163 EMR implementations.(2) We believe our results may have differed for multiple reasons. First,
164 our study evaluates a single clinical site with a fully encompassing EMR, including registration,
165 provider documentation, order entry, diagnostic processing and resulting, as well as integration
166 of bed requests and admission orders while the prior work evaluated a variety of sites, with
167 variable EMR penetration across the clinical setting.(8)

168 With more independent community hospitals being incorporated into larger health
169 systems, we anticipate these enterprise-wide EMR transitions to become extremely common.

170 Over the past decade, health systems having increasingly adopted EMR systems, citing potential
171 cost savings, with prior estimates revealing a potential nationwide savings of \$162 billion
172 through increased safety and system efficiency.(9) Given this, system-wide EMR consolidation
173 to a single platform is increasingly favored by the leadership of these health systems, as they
174 believe it establishes a secure way to share HIPAA-sensitive data, thereby improving
175 communication, decreasing duplicate testing within the same system, and increasing patient
176 safety.(10) Unfortunately, current EMR models vary widely in their interface, content, and
177 operability, which can make it difficult for clinicians to seamlessly transition from one EMR
178 system to another.(11) This likely helps to explain the negative operational effects observed in
179 our study following the transition from one EMR system to another.(11)

180 Limitations of this study include that data was obtained from a single site, community
181 ED. In addition, the post-implementation time period used in the analysis was the six months
182 immediately following the change in EMR, which differed somewhat from the data presented by
183 Ward et al which utilized a “steady state” period following EMR implementation as the post
184 intervention comparison period. We were unable to evaluate a “steady state” period, as the
185 negative effects on patient throughput necessitated a significant workflow change that involved
186 implementation of a new “split-flow” process. Thus, we are lacking the data to evaluate whether
187 or not our location had a return to baseline in levels of efficiency after a time period directly after
188 implementation had passed and steady state had returned.

189 Additionally, during the study period, all aspects of the hospital in the study, including
190 inpatient wards, pharmacy, operating rooms, laboratory services, and radiology were
191 transitioning from various forms of documentation to the enterprise-wide EMR. Although these
192 changes can also significantly affect ED operational efficiency, we did not quantify the impact of

193 these individual units or the differing levels of EMR experience of the providers. As a result of
194 these variables, it is difficult to distinguish exactly where delays occurred.

195 This study illustrates the need for EDs to adequately prepare for an EMR transition. By
196 working with institutional Information Technology in order to ensure adequate training for
197 providers, potentially increasing provider staffing during the transition, and making on-site
198 technical support available during the transition for issues that arise during clinical care, this can
199 hopefully mitigate an anticipated decline in operational efficiency and performance metrics.

200

201

202

203 **References**

- 204 1. Wang SJ; Middleton B; Prosser LA; Bardon CG; Spurr CD; Carchidi PJ, et al. A cost-benefit
205 analysis of electronic medical records in primary care. *Am J Med.* 2003;114(5):397-403.
- 206 2. Ward MJ; Landman AB; Case K; Berthelot J; Pilgrim RL; Pines JM. The effect of electronic
207 health record implementation on community emergency department operational
208 measures of performance. *Ann Emerg Med.* 2014;63(6):723-30.
- 209 3. Feblowitz J; Takhar SS; Ward MJ; Ribeira R; Landman AB. A Custom-Developed
210 Emergency Department Provider Electronic Documentation System Reduces
211 Operational Efficiency. *Ann Emerg Med.* 2017;70(5):674-82.e1.
- 212 4. Perry JJ; Sutherland J; Symington C; Dorland K; Mansour M; Stiell IG. Assessment of the
213 impact on time to complete medical record using an electronic medical record versus a
214 paper record on emergency department patients: a study. *Emerg Med J.*
215 2014;31(12):980-5.
- 216 5. Mohan MK; Bishop RO; Mallows JL. Effect of an electronic medical record information
217 system on emergency department performance. *Med J Aust.* 2013;198(4):201-4.
- 218 6. Park SY; Lee SY; Chen Y. The effects of EMR deployment on doctors' work practices: a
219 qualitative study in the emergency department of a teaching hospital. *Int J Med Inform.*
220 2012;81(3):204-17.
- 221 7. Farley HL; Baumlin KM; Hamedani AG; Cheung DS; Edwards MR; Fuller DC, et al. Quality
222 and safety implications of emergency department information systems. *Ann Emerg
223 Med.* 2013;62(4):399-407.
- 224 8. Ward MJ; Froehle CM; Hart KW; Collins SP; Lindsell CJ. Transient and sustained changes
225 in operational performance, patient evaluation, and medication administration during

226 electronic health record implementation in the emergency department. *Ann Emerg*
227 *Med.* 2014;63(3):320-8.

228 9. Hillestad R. Health care IT adoption could save USD162 billion. *World Hosp Health Serv.*
229 2006;42(2):36, 8-40.

230 10. Arndt; Z. R. M&A drives health systems' EHR consolidation. *Modern Healthcare* [serial
231 on the Internet]. 2018 January 28, 2019: Available from:
232 [https://www.modernhealthcare.com/article/20180403/NEWS/180409973/m-a-drives-](https://www.modernhealthcare.com/article/20180403/NEWS/180409973/m-a-drives-health-systems-ehr-consolidation)
233 [health-systems-ehr-consolidation.](https://www.modernhealthcare.com/article/20180403/NEWS/180409973/m-a-drives-health-systems-ehr-consolidation)

234 11. Kellermann AL; Jones SS. What it will take to achieve the as-yet-unfulfilled promises of
235 health information technology. *Health Aff (Millwood).* 2013;32(1):63-8.

236

237