

Accuracy of ECG Interpretations by Emergency Medicine Residents and the Efficacy of Immediate Feedback by EM Attendings

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Introduction

The American College of Cardiology/American Heart Association has published guidelines stating that patients presenting to the emergency department with a chief complaint of chest pain, should receive a 12-lead ECG within 10 minutes (2). While the speed in which an ECG is obtained is an important factor in determining further diagnostic evaluations and therapeutic plans, proper interpretation of the ECG is critical.

- Studies have found that ECG interpretation skills among internal medicine, family practice, and emergency medicine residents are suboptimal;
- Berger, et al., found that among 87 IM residents and 33 EM residents that nearly 60% of residents incorrectly diagnosed complete heart blocks, and where 42% of the residents felt their training in ECG's was insufficient. The authors concluded that there was a need "to find optimal methods to improve electrocardiogram competency."

The objective of this study was to determine the efficacy of an immediate feedback loop program in ECG readings among residents and attendings while working in a busy academic, urban ED.

Methods

This IRB approved prospective observational study consisted of a convenience sample of residents, attendings, and patients. Data was collected in the ED ICU area on Tuesdays, Wednesdays, and Fridays during all 3 shifts (7a-3p, 3p-11p, and 11p-7a).

Once patients were admitted to the Adult ED ICU area, and required an ECG per physician or nurse order as part of standard of care, on data collection days:

1. ECG technicians printed 2 copies of the patients' ECG.
2. One ECG was stamped as "research copy" the other was placed in the patient's chart per standard protocol. The ECG technician then stapled the data collection sheet to the research copy of the ECG and it was given to the resident.
3. The resident then read the ECG as per standard of care and marked on the sheet his/her reading. The resident then took the ECG to the attending for him/her to read and mark the ECG. The attending was to take time to discuss with the resident his/her agreement or disagreement with the read and provide constructive feedback to the resident.
4. Completed ECG's were placed in data collection boxes for research assistants (RAs) to collect and enter data into Excel. All patient identifiers were blacked out to blind physicians.
5. A set of ED physicians then served as the QA ECG readers and marked their reading of the ECG, and finally, the RAs recorded the Cardiologists read.
6. Data collected included: DOB, age, gender, date and time of visit, chief complaint, differential dx, and performance of the ECG with results. Data collected on the resident included: doctor number, and training year. Data collected on the attending included, physician number

Inclusion criteria:

- Patients who present to UF&Shands ED, 18 years and older
- ED ICU patients triaged as level 1 or 2, patients presenting Tuesday, Wednesday, or Friday between the hours of 7am – 7pm.

Exclusion criteria:

- Paced ECG rhythm - Transmitted ECGs by EMS
- Under 18 years of age - Fast tract and intermediate care ECGs

Study Aims

This study's aims were to determine:

- the percentage of misread ECGs among EM residents;
- if bedside teaching through immediate feedback increases EM residents' accuracy in interpreting ECG's; and
- the efficacy of a quality improvement program in regards to ECG readings in the ED.

Results

Demographic Data of Patients:

Age (n=298):

- 17.4% of patients were between the age of 20 and 40 years
- *76.2% were between 41 and 70 years *majority of patients in this age group
- 6.4% were 71 years and older

Gender (n=300):

- Almost evenly split between males (46.7%) and females (53.3%)

Race (n=300):

- Most were African American (59%), with 38% White, and 3% reporting as other

EM Physician Participants

- EM PGY1s read 31% of the cases, EM PGY2s read 24%, and PGY3s read 45%
- EM Attendings agreed with residents' EKG readings 86% of the time (n=287)
- Cardiologist agreed with EM residents' EKG readings 71% of the time; leaving 29% disagreement between Cardiologist readings and EM resident interpretations (n=278)

Resident Survey in Regard to the Feedback Loop and QA System (n=16)

On an agreement Likert Scale of SA=Strongly Agree, A=Agree, N=Neutral, D=Disagree, and SD=Strongly Disagree

- 50% Agreed that their interpretation skills improved with the QA system, however, 31% were Neutral and 13% Disagreed
- 44% Agreed that the QA system increased their confidence in reading ECGs, however, 38% were Neutral, and 13% Disagreed
- 57% Strongly Agreed or Agreed that the QA system would assist in providing better patient outcomes, with 38% Neutral
- In regard to barriers to implementing the system, 14 residents completed this section with the majority expressing that time and the fact that the ED was busy interfered with immediate feedback, but most did not offer suggestions for improvement

Resident reading	No. of Attending Disagreements (N = Total no. of resident reads with the variable)		
	1 st yr resident	2 nd yr resident	3 rd yr resident
NSR	16 (N=58)	9 (N=48)	4 (N=93)
ST Elevation	2 (N=3)	0 (N=3)	0 (N=4)
ST Depression	1 (N=1)	1 (N=2)	0 (N=2)
LBBB	0 (N=1)	N=0	0 (N=1)
Arrhythmia	1(N=2)	0 (N=5)	0 (N=6)
2 nd degree block	N=0	N=0	N=0
3 rd degree block	N=0	N=0	N=0
Brugada Syndrome	N=0	N=0	N=0
Wellens Syndrome	N=0	N=0	N=0
Interval abnormalities	N=0	0 (N=2)	0 (N=3)
T wave abnormalities	4 (N=20)	0 (N=16)	3 (N=47)
Q wave abnormalities	0 (N=3)	1 (N=7)	0 (N=7)
Total	24 (88)	11 (83)	7 (163)

Resident reading	No. of Cardiologist Disagreements (N = Total no. of resident reads with the variable)		
	1 st yr resident	2 nd yr resident	3 rd yr resident
NSR	20 (N=57)	10 (N=45)	21 (N=92)
ST Elevation	1 (N=3)	0 (N=3)	3 (N=4)
ST Depression	1 (N=1)	2 (N=2)	0 (N=2)
LBBB	0 (N=1)	N=0	0 (N=1)
Arrhythmia	1(N=2)	3 (N=5)	2 (N=6)
2 nd degree block	N=0	N=0	N=0
3 rd degree block	N=0	N=0	N=0
Brugada Syndrome	N=0	N=0	N=0
Wellens Syndrome	N=0	N=0	N=0
Interval abnormalities	N=0	1 (N=2)	1 (N=3)
T wave abnormalities	7 (N=19)	5 (N=16)	16 (N=46)
Q wave abnormalities	0 (N=3)	2 (N=7)	1 (N=7)
Total	30 (86)	23 (80)	44 (161)

Attending did not agree with

- 1st yr resident on 27% of the ECGs
- 2nd yr resident on 13% of the ECGs
- 3rd yr resident on 0.04% of the ECGs.

- 1st yr residents, 69.9% were a NSR. Of these, 27.6% interpretations were disagreed by the attendings as being a NSR. Of the remaining 30.1%, attending did not agree with the resident's interpretation on 24% EKGs.
- 2nd yr residents: 72.7% EKGs as having a NSR. Attendings did not agree on 18.8% of these interpretations.
- 3rd yr residents: 75% had a NSR and of these 4.3% of the interpretations were not agreed upon by the attendings.

Cardiologist did not agree with

- 1st yr resident on 35% of the ECGs
- 2nd yr resident on 29% ECGs
- 3rd yr residents on 27% ECGs

- Cardiologist not agreeing with the 1st yr residents: 53% disagreement between the attending and the cardiologist where the attending agreed with the resident interpretations.
 - For 2nd yr resident interpretations, disagreement between attending and cardiologist was on 78% of the ECGs
 - For the 3rd yrs this number was as high as a 93%.
- Overall, the cardiologist vs. attending disagreement accounted for 77% of the ECG interpretations by the residents.

Conclusion

The agreements vs. disagreements between the residents, attendings, and cardiologist show a positive trend towards the level of accuracy of ECG interpretations with increasing level of training which signifies the appropriateness of the medical education received by the residents. However, there is a clear discrepancy between the cardiologist and the attending agreements on resident interpretations of the ECGs interpreted as NSR. This may not be of consequential importance.

In reviewing the Feedback loop and the QA system, nearly half of the residents agreed that the QA system increased their level of confidence while interpreting ECGs, however, almost a similar percentage had no opinion about the system or disagreed to its usefulness. Further evaluation is needed to determine the barriers in providing consistent feedback while in the ED in regard to ECGs..