INNOVATIONS

ECG Stampede

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ABSTRACT:

Audience: ECG Stampede is designed to instruct junior-level residents; however, some of the content is quite advanced and has been successfully used for senior-level residents.

Introduction: ECG Stampede is a novel educational program designed to standardize emergency medicine (EM) resident training in electrocardiogram (ECG) interpretation and triage. Practicing emergency physicians are tasked with rapidly and accurately determining the acuity of ECGs obtained on arriving patients - generally with little more information than the patient's age, (potentially) their chief complaint, and a historical ECG for comparison.[1] With this data, they must determine whether the patient can safely wait for evaluation, if they require a bed for immediate evaluation, or if a ST-elevation myocardial infarction (STEMI) is identified and requires appropriate resource activation. Unfortunately, many EM residents do not receive specific training in this task which requires both a strong foundation and unique application of ECG knowledge.[2–4] ECG Stampede combines a novel video-based curriculum and engaging game aimed at preparing EM trainees for this core competency. The game and curriculum can be accessed, free of charge, at ecgstampede.com.

Educational Objectives: Upon completion of the ECG Stampede curriculum, learners will be able to rapidly interpret and identify potentially life-threatening conditions that are identifiable on ECG, and triage appropriately. This goal will be realized by achieving the following objectives: (1) Identify a standard approach to ECG interpretation, (2) distinguish the anatomic location of STEMIs, (3) explain conduction disturbances and their electrocardiographic findings, (4) identify ischemia mimics including (but not limited to) pericarditis, early repolarization, left ventricular aneurysm, and Brugada syndrome, (5) diagnose subtle findings of ischemia and non-traditional indications for emergent and/or urgent reperfusion, (6) generate an approach to ECG interpretation of a patient presenting with syncope, (7) describe the variable electrocardiographic findings of pulmonary embolism, (8) compare alternative explanations for T wave inversions including (but not limited to) Wellens' syndrome, cerebral T waves, and left ventricular hypertrophy, (9) diagnose and manage bradydysrhythmias, (10) evaluate ECGs for electrolyte disturbances

including (but not limited to) hypokalemia, hyperkalemia, and hypocalcemia, (11) diagnose and manage narrow and wide-complex tachydysrhythmias, and (12) analyze paced rhythms, and identify and manage pacemaker failures.

Educational Methods: ECG Stampede is a unique educational program comprised of a comprehensive, video-based curriculum with accompanying student and instructor guides. ECG Stampede also features an engaging game accessible via modern browsers and dedicated mobile applications for iOS and Android devices. The gamified model presents learners with a batch of ECGs for which they must assign one of four triage acuities.

Research Methods: The entire curriculum was delivered longitudinally during the 2018-19 emergency medicine didactic conferences at the McGovern Medical School at the University of Texas Health Science Center at Houston (UTHealth) and survey data was collected. The gamified model has been available online and through a mobile application since January 2018.

Results: The curriculum was well-received. To date, over 30 residency programs have signed up to use the curriculum, and the gamified model has been played over 40,000 times on the mobile application alone. The ECG stampede curriculum was delivered in its entirety to the McGovern Medical School at UTHealth emergency medicine interns during the 2019-2020 academic year orientation month, and more detailed data are being collected on its efficacy.

Discussion: Learner feedback prompted the creation of videos to be viewed asynchronously and the recommendation for small-group (rather than large-group) discussion.

Topics: ECG, cardiology, STEMI, bundle branch block, fascicular block, bifascicular block, trifascicular block, syncope, Brugada syndrome, long QT, Wolf-Parkinson-White syndrome, early repolarization, pericarditis, deWinter T waves, Wellen's syndrome, cerebral T waves, hypokalemia, hyperkalemia, hypocalcemia, atrioventricular heart block, supraventricular tachycardia, atrial fibrillation with rapid ventricular response, sodium channel blocker, paced rhythm, failure to capture, failure to sense, failure to pace.

USER GUIDE

List of Resources:

Learner Audience:
Interns, Junior Residents, Senior Residents

Time Required for Implementation:
The innovation is complete and can be found online at ecgstampede.com. There is no additional time required of the instructor to create the innovation.

Learners are expected to complete the student guide for each unit prior to watching the video and discussing during (preferably) small groups. Both the student guide and corresponding video are to be completed asynchronously. Time for completion of the student guide will depend on the learner's adeptness at ECG interpretation, but we anticipate that each unit's student guide will take one hour to complete. The ten videos range from 13:41 to 36:15 in duration, with an average of 21 minutes. We recommend 30 minutes of small group discussion following completion of each unit; instructor guides are provided by registering on the website (free of charge).

The total anticipated time for the student to complete the curriculum is approximately 20 hours. We recommend that the curriculum be completed longitudinally during an orientation month or throughout the year. Students can play the game when desired as a means of monitoring their own progress.

Recommended Number of Learners per Instructor:
2-3 learners per instructor during small group discussion. Instructors can be faculty or upper level residents.

Topics:
ECG, cardiology, STEMI, bundle branch block, fascicular block, bifascicular block, trifascicular block, syncope, Brugada syndrome, long QT, Wolf-Parkinson-White syndrome, early repolarization, pericarditis, deWinter T waves, Wellen's syndrome, cerebral T waves, hypokalemia, hyperkalemia, hypocalcemia, atrioventricular heart block, supraventricular tachycardia, atrial fibrillation with rapid ventricular response, sodium channel blocker, paced rhythm, failure to capture, failure to sense, failure to pace.

Objectives:
Upon completion of the ECG Stampede curriculum, learners will be able to rapidly interpret and identify potentially life-threatening conditions that are identifiable on ECG and triage them appropriately. This goal will be realized by achieving the following objectives:

1. Identify a standard approach to ECG interpretation (unit 1).
2. Distinguish the anatomic location of STEMIs (units 1, 2, and 3).
3. Explain conduction disturbances and their electrocardiographic findings (units 1 and 2).
4. Identify ischemia mimics including (but not limited to) pericarditis, early repolarization, left ventricular aneurysm, and Brugada syndrome (units 3 and 4).
5. Diagnose subtle findings of ischemia and non-traditional indications for emergent and/or urgent reperfusion (units 3 and 4).
6. Generate an approach to ECG interpretation of a patient presenting with syncope (units 5 and 6).
7. Describe the variable electrocardiographic findings of pulmonary embolism (units 5 and 8).
8. Compare alternative explanations for T wave inversions including (but not limited to) Wellens' syndrome, cerebral T waves, and left ventricular hypertrophy (units 4, 5, 6, and 7).
9. Diagnose and manage bradydysrhythmias (units 7 and 8).
10. Evaluate ECGs for electrolyte disturbances including (but not limited to) hypokalemia, hyperkalemia, and hypocalcemia (units 4, 5, 7, and 8).
11. Diagnose and manage narrow and wide-complex tachydysrhythmias (units 9 and 10).
12. Analyze paced rhythms, identify and manage pacemaker failures (units 7 and 10).

The ECG Stampede curriculum is a systematic, integrated course intended for junior level residents; in this way, it differs from other educational content available online that is topic-selective and less comprehensive in its focus. For example, ecgweekly.com is a well-known weekly videocast in which subscribers can learn from Amal Mattu, a master ECG-educator, about a select topic – it is not, however, an educational curriculum.

Linked objectives and methods:
The ECG stampede curriculum is to be taken as a whole; ie, it is not intended to be used as a reference. While videos are tagged by topic, key concepts are interleaved, or spaced out, throughout the 10 units. These videos are most impactful when the learner attempts to interpret every ECG on his/her own and answers the corresponding questions (by accessing the student guide on the website) before viewing the videos or attending the instructor-guided small group sessions. Through active

participation, spaced retrieval, interleaved concepts, and gamification, the learner will find the curriculum engaging while satisfying the objectives. Specific topics addressed linked to their educational objectives are shown in Table 1.

Table 1: ECG topics linked to educational objectives

Unit	Topics	Educational Objectives
1	How to read ECGs, Anterior/Lateral STEMI, Inferior STEMI, Left Bundle Branch Block, Right Bundle Branch Block	1-3
2	Posterior STEMI, STEMI with Left Bundle Branch Block, Fascicular Blocks, Bifascicular & Trifascicular Blocks	2, 3
3	Early Repolarization, Left Ventricular Aneurysm, Global Subendocardial Ischemia, High-lateral STEMI	2, 4, 5
4	Hyperkalemia, Hypokalemia, Pericarditis, DeWinter T-waves, Right Ventricular Infarct	4, 5, 8, 10
5	Brugada Syndrome, Long QT, Pulmonary Embolism & Acute Right Heart Strain, Cerebral T waves	6-8, 10
6	Wolf-Parkinson-White Syndrome, Hypertrophic Cardiomyopathy, Wellens' Syndrome, Ischemic findings in Right Bundle Branch Block +/- Left Anterior Fascicular Block	6, 8
7	Second Degree Atrioventricular Block Types I & II, Hypokalemia, Mild-moderate Hyperkalemia	8-10, 12
8	Third Degree Atrioventricular Block, Escape Rhythms, Severe Hyperkalemia, Hyperkalemic Bradycardia	9, 10
9	Supraventricular Tachycardia, Atrial Fibrillation with Rapid Ventricular Response, Ventricular Tachycardia, Supraventricular Tachycardia with Aberrancy	11
10	Approach to Paced Rhythms, Pacemaker Malfunctions, Sodium Channel Blockade	11, 12

Recommended pre-reading for instructor:
The instructor should watch the video and read the instructor guide before facilitating small-group discussion for that unit. Additional resources are referenced within each instructor guide, but the guides are self-contained.

Learner responsible content (LRC):
It is expected that the learner has a basic understanding of electrocardiography – what electrocardiography is and how it is used clinically – but no more than a basic introductory course in medical school. To get the most out of the curriculum, learners should attempt to interpret each ECG and answer the corresponding questions (by accessing the student guide on the website) prior to watching the videos and attending the instructor-guided small-group sessions.

Associated Content:
There are no additional materials besides what can be found on the website ecgstampede.com. Instructors may choose to distribute the instructor guides to the learners after completion of each unit.

Implementation Methods:
Learners are expected to complete the student guide for each unit prior to watching the video and discussing during (preferably) small groups. Both the student guide and corresponding video are to be completed asynchronously. We recommend small group discussion following completion of each unit; instructor guides are provided by registering on the website. We recommend that the curriculum be completed longitudinally during an orientation month or throughout the year. Students can play the game when desired as a means of monitoring their own progress.

List of items required to replicate this innovation:
The only things needed to replicate this innovation are time and instructors to facilitate small group discussion. We recommend 30 minutes of small group discussion for each unit for a total of 5 hours. The rest of the curriculum is to be completed asynchronously. The game can be played asynchronously as well.

Approximate cost of items to create this innovation:
There is no cost. The game and curriculum are provided for free.

Detailed methods to construct this innovation:
The innovation is complete and can be accessed online at: www.ecgstampede.com

USER GUIDE

Results and tips for successful implementation:

The entire curriculum was delivered longitudinally during the 2018-19 emergency medicine didactic conferences at the McGovern Medical School at the University of Texas Health Science Center at Houston (UTHealth). Each month, a unit was discussed during a half-hour, interactive, flipped-classroom style presentation. Student guides were distributed to the emergency medicine residents (PGY1 to PGY3) one week in advance of the flipped-classroom lecture. Learners were expected to have completed the student guide for that unit and be prepared to give their interpretation in front of their peers. The curriculum was well-received; however, there were several comments that the large flipped-classroom style lectures provoked anxiety when called upon to interpret ECGs. Additionally, not every resident was able to attend each unit's discussion (owing to off-service rotations and disadvantageous scheduling), prompting the creation of the video-based asynchronous curriculum and the recommendation for small group discussion for reinforcement of each unit's objectives (rather than the larger flipped-classroom style lecture).

To date, over 30 residency programs have signed up to use the curriculum, and the gamified model has been played over 40,000 times on the mobile application alone. The ECG stampede curriculum was delivered in its entirety to the McGovern Medical School at UTHealth emergency medicine interns during the 2019-2020 academic year orientation month, and results will be published separately.

References/suggestions for further reading:

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