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Global Emergency Medicine Journal Club: A Social Media Discussion About the Age-Adjusted D-Dimer Cutoff Levels to Rule Out Pulmonary Embolism Trial

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Study objective: *Annals of Emergency Medicine* collaborated with an educational Web site, Academic Life in Emergency Medicine (ALiEM), to host an online discussion session featuring the 2014 *Journal of the American Medical Association* publication on the Age-Adjusted D-Dimer Cutoff Levels to Rule Out Pulmonary Embolism (ADJUST-PE) trial by Righini et al. The objective is to describe a 14-day (August 25 to September 7, 2014) worldwide academic dialogue among clinicians in regard to 4 preselected questions about the age-adjusted D-dimer cutoff to detect pulmonary embolism.

Methods: Five online facilitators hosted the multimodal discussion on the ALiEM Web site, Twitter, and Google Hangout. Comments across the social media platforms were curated for this report, as framed by the 4 preselected questions, and engagement was tracked through various Web analytic tools.

Results: Blog and Twitter comments, as well as video expert commentary involving the ADJUST-PE trial, are summarized. The dialogue resulted in 1,169 page views from 391 cities in 52 countries on the ALiEM Web site, 502,485 Twitter impressions, and 159 views of the video interview with experts. A postdiscussion summary on the Journal Jam podcast resulted in 3,962 downloads in its first week of publication during September 16 to 23, 2014.

Conclusion: Common themes that arose in the multimodal discussions included the heterogeneity of practices, D-dimer assays, provider knowledge about these assays, and prevalence rates in different areas of the world. This educational approach using social media technologies demonstrates a free, asynchronous means to engage a worldwide audience in scholarly discourse. [Ann Emerg Med. 2015;65:604-613.]

INTRODUCTION

In 2013, *Annals of Emergency Medicine* and Academic Life in Emergency Medicine (ALiEM) launched the Global Emergency Medicine Journal Club to increase awareness of key emergency medicine literature, highlight critical appraisal skills, and increase the speed of knowledge translation into clinical practices.[1-3] In this fourth installment, we discussed the merits and applicability of age-adjusted D-dimer thresholds as described in the ADJUST-PE study by Righini et al.[4]

In this multicenter, prospective validation study in Belgium, France, and Switzerland, the authors aimed to determine whether an age-adjusted D-dimer cutoff would improve the diagnostic yield in excluding pulmonary embolism in older patients. This cutoff value (in micrograms per liter) was defined as age in years times 10 in patients aged at least 50 years. The authors concluded that this age-adjusted cutoff, in combination with a "nonhigh or an unlikely" clinical pretest probability, could safely exclude pulmonary embolism compared with the standard cutoff of 500 µg/L.

ALiEM facilitated a multiplatform discussion using social media technologies. These digital conversations occurred on the blog, Twitter, a Google Hangout video interview with clinical experts, and a Journal Jam podcast review. The main Global Emergency Medicine Journal Club proceedings were hosted on ALiEM as a blog post published on August 25, 2014, which also provided hyperlinks to all the other digital platforms. The objective of this article was to curate (ie, collect, organize, and summarize) the global online discussions and proceedings, as well as to report objective Web analytics for the various online modalities used.

MATERIALS AND METHODS

The *Annals* editors selected the article for the fourth edition of the Global Emergency Medicine Journal Club collaboration with ALiEM.[5] All 5 facilitators were chosen for their expertise in critical appraisal and medical education. Four were experienced bloggers (SRR, AS, TC, ML) and all have active Twitter accounts with

follower numbers greater than 190 (SS, @SynthShaikh), 1,800 (TC, @TChanMD), 3,000 (SRR, @Srrezaie), 3,000 (AS, @EMSwami), and 7,700 (ML, @M_Lin) at the discussion.

Before selection of the Global Emergency Medicine Journal Club questions, an inventory of the previous emergency medicine social media discussions on age-adjusted D-dimer testing was taken. A Boolean search on "D-dimer ADJUST-PE" was entered into the Free Open Access Medical Education Really Simple Syndication (FOAM RSS) Web site (http://www.foamem.com/). This Web site curates from more than 100 known open-access blogs, podcasts, and Web sites in emergency medicine. The first 100 results were reviewed, and all blog posts and podcasts discussing the trial were compiled (Table 1). Based on this review and the questions posed in the July 2014 edition of the Annals journal club, 4 featured Global Emergency Medicine Journal Clubs were developed by the ALiEM team.[5] Questions were selected to encourage discussion and reflection about the study and its clinical implications.

On August 25, 2014, the blog post was published and launched the 14-day discussion period (http://aliem.link/1J2XuQ8). On August 28, 2014, a live Google Hangout On Air video recording was conducted of a panel discussion featuring Jeff Kline, MD, (Indiana University) and Jonathan Kirschner, MD (Indiana University), who were the authors on the Annals Journal Club series article,[5] and representatives from ALiEM. The video interview was automatically recorded and archived into ALiEM's YouTube account (ALiEM Interactive Videos). The discussion was hosted on the ALiEM Web site, with comments moderated both on the blog Web site and Twitter. After this 14-day discussion period, on September 16, 2014, a summary Journal Jam podcast was published by the Emergency Medicine Cases podcast organization (http://emergencymedicinecases.com/journal-jam-podcast/), which is hosted by Anton Helman, MD (University of Toronto). On release, this podcast was promoted through the podcast organization's social media channels, which included Twitter and Google+, as well as the ALiEM Twitter account. Throughout the discussion period, any participant could primarily share their perspectives by one of 2 methods: writing a comment on the blog Web site or tweeting a response using the #ALiEMJC hashtag.

A full transcript of the blog Web site discussion is archived at http://aliem.link/1J2XuQ8, all tweets with the #ALiEMJC are archived on Symplur.com at http://aliem.link/1wkxtGx, the Google Hangout video can be accessed on YouTube at https://www.youtube.com/watch?v=UlmihmT1Xj4, and the Journal Jam podcast can be accessed at http://aliem.link/journaljam1.

Promotion for the Global Emergency Medicine Journal Club included notices on the ALiEM and Annals Web sites, as well as the ALiEM Facebook and Google+ pages and individual Twitter accounts. The majority of the promotion began on Twitter in the days leading up to the dialogue and then several times daily during the first 5 days of the discussion period, using the #ALiEMJC hashtag.

Written transcripts from Twitter, the blog Web site, and the video interview discussions during the 14-day discussion period (August 25 to September 7, 2014) were curated to summarize the discussion on each of the 4 featured questions. This content curation and individual comment selection were conducted by 1 author (SRR) and independently member checked by 2 others (TC, ML).

Web analytics were recorded for this 14-day discussion period. Viewership and engagement were measured with such tools as Google Analytics, the ALiEM social media post widget, YouTube Analytics, and Symplur. Table 2 provides descriptions for each of these tools. Furthermore, 7-day Journal Jam podcast download statistics (September 16 to 23, 2014) were collected. The number of comments and words per comment in the Web site discussion were also calculated, excluding the initial comments by the facilitators and references.

Table 1. Identified online emergency medicine blog posts and podcasts discussing the ADJUST-PE trial before the Global Emergency Medicine Journal Club discussion.

Web Site	Author(s)	Title	Type	Country	Date
Boring EM	Brent Thoma	ADJUST-PE: Should We Adjust the D-Dimer Cut-Off for Age?	Blog	Canada	July 18, 2014
Boring EM	Brent Thoma	ADJUST-PE	Blog	Canada	July 20, 2014
EM Literature of Note	Ryan Radecki	Go Ahead, Age-Adjust the D-Dimer	Blog	United States	April 16, 2014
EM Nerd	Rory Spiegel	The Adventure of the Golden Standard	Blog	United States	July 1, 2014
Emergency Medicine Ireland	Andy Neill	Age Adjusted D-dimer Cut Offs	Blog	Ireland	April 7, 2014
REBEL EM	Salim Rezaie	Update on Age-Adjusted D-Dimer	Blog	United States	April 28, 2014
REBEL EM	Salim Rezaie	Age-Adjusted D-Dimer Testing	Blog	United States	July 11, 2014

ADJUST-PE, Age-Adjusted D-Dimer Cutoff Levels to Rule Out Pulmonary Embolism.

Table 2. Aggregate analytic data from various social media–based discussions for the first 14 days of the event.

Social Media Analytic Aggregator	Metric	Metric Definition	Count
Google Analytics: a free online service to track page views and other blog metrics	Page views	Number of times the Web page containing the post was viewed	1,169
	Users	Number of times individuals from different IP addresses viewed the site (previously termed "unique visitors" by Google)	986
	Number of cities	Number of unique jurisdictions by city as registered by Google Analytics	391
	Number of countries	Number of unique jurisdictions by country as registered by Google Analytics	52
	Average time on page	Average amount of time spent by a viewer on the page	4 min 24 s
ALiEM social media post widget: a Web-based tool embedded into each blog post that tracks engagement metrics for multiple social media platforms	Number of tweets from page	Number of unique 140-character notifications sent directly from the blog post by Twitter to raise awareness of the post	104
	Number of Facebook likes	Number of times viewers "liked" the post through Facebook	11
	Number of Google+ shares	Number of times viewers shared the post through Google+	17
ALiEM comments section	Number of site comments	Comments made directly on the Web site in the blog comments section	26
	Average word count per blog comment (excluding citations)		119
Symplur Analytics: a free online service to track metrics for Twitter engagement of health-related hashtags; used to track Twitter hashtag #ALiEMJC	Number of tweets	Number of tweets containing the hashtag #ALiEMJC	206
	Number of Twitter participants	Number of unique Twitter participants using the hashtag #ALiEMJC	66
	Twitter impressions	How many impressions or potential views of #ALiEMJC tweets appear in users' Twitter streams, as calculated by number of tweets per participant and multiplying it by the number of followers that participant has	502,485
YouTube Analytics: a free online service to track YouTube video viewing statistics	Length of video interview	Total duration of recorded Google Hangout videoconference session	33 min 11 s
	Number of views	Number of times the YouTube video was viewed	159
	Average duration of viewing	Average length of time the YouTube video was played in a single viewing	8 min 31 s

IP, Internet protocol.

RESULTS

Social Media Analytics

The 14-day analytic data for the multiplatform discussion about the ADJUST-PE trial during August 25 to September 7, 2014, are summarized in Table 2. Figure 1 displays the global geographic distribution of participants who read the blog post. There were 12 unique users who posted comments on the ALiEM page. After this discussion period, a 34-minute 28-second summary Journal Jam podcast was recorded. This podcast incorporated elements from the blog, Twitter, and Google Hangout video and was published on September 16, 2014. In its first week of release, there were 3,962 podcast downloads.

Summary of the Online Discussion

Participants from around the globe asynchronously contributed to the dialogue on the ALiEM Web site, Twitter, and Google Hangout on Air. The dialogue was summarized for each of the 4 preselected journal club questions.

Q1: The median age of this European study population was 63 years, which is older than most American populations tested for pulmonary embolism. What effect might the older population studied have on the diagnostic accuracy of the D-dimer assay? What effect might older age have on the overall findings of this study?

Although there was no discussion of this question by any participants on Twitter and the blog, these issues were addressed by the Google Hangout video discussants. Kirschner responded first by noting that the mean age of US patients with a pulmonary embolism is in the 40- to 50-year range, whereas this study reported a mean age 20 years older. Furthermore, the risk of pulmonary embolisms increases with age,[6] and older patients often present with more severe clinical features.[7] Kirschner concluded the following:

"[The differences in mean age are] probably going to affect the calculated sensitivities from the study. The reasoning lies really in what we call spectrum effect—often called spectrum bias. Essentially when the severity of a disease lies across a continuum or a spectrum, as is true in pulmonary embolism, more severe presentations will be a little bit easier to identify for a diagnostic test…. So if you have a patient spectrum that is sicker in general, you're probably going to have a higher sensitivity in the exact same test in a population where the spectrum of disease is less severe."
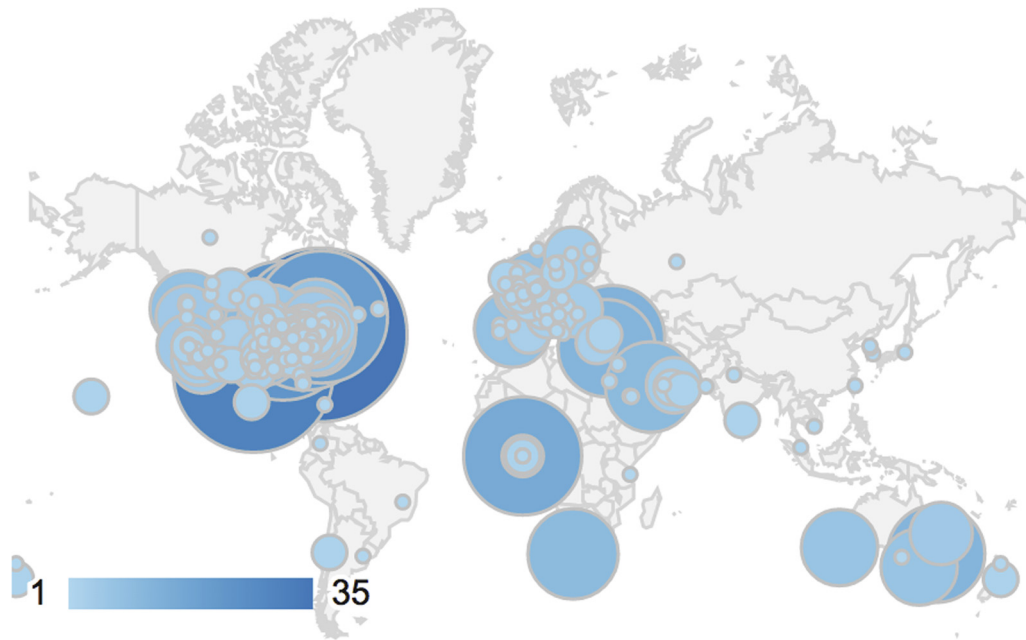
Figure 1. Geographic distribution of readers who viewed the Global Emergency Medicine Journal Club during the first 14 days of discussion.

Kline further reflected that there are fewer older patients in the United States than in Europe, so "the incremental advantage [of the age-adjusted D-dimer threshold] that they saw in Europe might be a little less—meaning that there is less rule-out power of [the adjusted D-dimer cutoff]."

Q2: Although all of the D-dimer assays used in this study had the same 500 µg/L cutoff for an abnormal value, many other quantitative D-dimer assays have different cutoffs for abnormal. What is the basis of the differences in cutoffs? Can the results of this study be translated to D-dimers with different cutoffs?

Study sites in the ADJUST-PE study used one of 6 D-dimer tests (VIDAS D-Dimer Exclusion test [bioMérieux], second-generation Tina-quant and Cobas h 232 [Roche], STA-Liatest D-Dimer [Stago], D-Dimer HS 500 [IL Diagnostics], and Innovance D-Dimer [Siemens]). A D-dimer 500 µg/L cutoff was used to detect venous thromboembolism disease for these assays. Several participants cited D-dimer assays and the study's methodological limitations involving these assays as potential areas of confusion for bedside clinicians.

Brent Thoma, MD, MA, (University of Saskatchewan) highlighted the disproportionate use of the D-dimer assays, which may have skewed the results. "While it [the ADJUST-PE trial] used 6 different D-dimer assays, only 3 of them were used on >50% [of] patients in the population of interest (those with D-Dimers >500 and

< the age-adjusted cut-off). That makes it difficult to know whether some of the assays performed well at a 500 cutoff or just 'got lucky.' Notably, when it was registered on clinicaltrials.gov this study was planned to use only the VIDAS D-Dimer. Had it only used a single one we could just learn how our institutions' assays compare with it. By using 6 (and some of them for a very small number of patients) the waters are muddied."

Anand Swaminathan, MD, MPH, (New York University) led a discussion in the Google Hangout about the different D-dimer assays and the different cutoff values that local clinical laboratories use. Kline said that almost all Food and Drug Administration–approved D-dimer assays use a 500 µg/L threshold for venous thromboembolism, except HemosIL, which uses 230 ng/mL, which was not used in the ADJUST-PE trial. It thus remains unclear how to extrapolate and use the HemosIL assay in an age-adjusted D-dimer formulaic approach. Thus, the ADJUST-PE trial should be applied only if the clinician has one of the 6 studied assays. Unfortunately, in an as-yet-unpublished survey of approximately 950 emergency physicians, Kirschner said that about 80% of clinicians do not know which D-dimer assay their clinical laboratory uses. He continued by challenging clinicians on the video to inquire about what assay their institution uses.

David Todd Schwartz, MD, (New York University) provided clarification in a blog comment about the HemosIL assay and the fact that there are 2 different assays,

HemosIL D-Dimer HS and HemosIL D-Dimer HS 500, which have different units of measure:

"Regarding the different cut-off values for D-dimer assays among various manufacturers, the units are actually different. For the assays that have a cut-off of 500, the units are ng/mL in Fibrinogen Equivalent Units (FEU). For the Instrumentation Laboratories (IL) HemosIL D-Dimer HS, the cut off of 230 is in ng/mL in D-dimer Units (DDU). IL has a newer assay called HemosIL D-Dimer HS 500 with a cut-off value of 500 that uses ng/mL FEU and therefore corresponds with other manufacturers. Therefore, the affinity of the monoclonal antibody used in these assays may be equivalent, only the units used to quantify the D-dimer levels are different. The HS in the assay name refers to "High Specificity" meaning that there is less confounding with other molecules and substances that affect turbidity assessment in the assay."

Swaminathan, who works at multiple clinical sites, noted that each uses a different cutoff value for a normal reference D-dimer level despite having the same assay. His hematologists explained that each laboratory locally sets its own reference ranges, as required by the Clinical Laboratory Improvement Amendments, which are standards established by the Centers for Medicare & Medicaid Services. D-dimer cutoff values are often different when disseminated intravascular coagulation versus venous thromboembolism diseases are diagnosed.

Kline also discussed other areas of potential confusion. For instance, occasionally different units may be used, causing a 10-fold difference in values, which may increase the risk of clinician error. Also, some companies, such as Tina-quant, may develop different assays with different antibodies, resulting in different cutoff thresholds, but which have a similar name. These "layers of complexity" all can lead to potentially "significant patient safety issues," as Kline summarized.

Both Kirschner and Kline thus advocated that the Food and Drug Administration (FDA) work toward developing a single normalized D-dimer cutoff value for all the different D-dimer assays, similar to the international normalized ratio value in coagulation studies. This would help reduce areas of potential confusion and patient management errors. Kline suggested that "the only way they [FDA] are going to change is by pressure from consumers."

In response to a follow-up question by Teresa Chan, MD (McMaster University), about whether creating a normalized D-dimer value would be currently feasible or whether it would require much more bench research before it could be implemented, Kline responded that it was indeed possible, explaining that "these antibodies are all capturing the same protein. The protein doesn't differ. It is just that they are using epitopes that have different affinities and bind to different parts of the protein, and so they all have standard curves." He concluded that standard curves can then undergo computer software correction to normalize to a set value.

During the live video interview, Swaminathan interrupted the conversation to share a real-time tweet comment by Richard Body, MB ChB, MRCS (A&E), FCEM, PhD (Manchester Academic Health Science Centre, UK), who echoed the need to address the heterogeneity of D-dimer assays. He supported an internationally normalized D-dimer reference, similar to how the International Federation of Clinical Chemistry and Laboratory Medicine tables list each manufacturer's reported performance characteristics of troponin assays.

Until such a normalized D-dimer value is implemented, Patrick Bafuma, PA, (Columbia Memorial Hospital) warned in a blog comment about the application of the age-adjusted D-dimer cutoff if one's department does not use one of the 6 D-dimer assays. If so, "adjust that dimer at your own peril. Or until Kline convinces the [Food and Drug Administration] to standardize the dimer assay" (Figure 2).

Q3: In diagnostic test accuracy studies, the prevalence of disease in the study population will directly affect the derived positive and negative predictive values, so-called posttest probabilities. The prevalence of pulmonary embolism in this study was 19%. How does that number compare with the prevalence of pulmonary embolism in studies performed in other countries? How does prevalence of disease in the study population affect the sensitivity and specificity of the diagnostic strategy?

Multiple participants commented that the sensitivity, specificity, and likelihood ratios for any given test should not be directly affected by disease prevalence. In contrast, predictive values will be affected. For example, a given test would result in a higher negative predictive value and lower positive predictive value, with a lower disease prevalence.

On the Google Hangout video, Kirschner expanded on these statistical concepts about prevalence and its effect on predictive values, sensitivities, specificities, and likelihood ratios. He added that he was "uncomfortable with using predictive values derived from this study, because we know

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Guess what? The FDA got back to me about my request to require commercial D dimer assays to normalize their threshold to 500. A first step!

Figure 2. Tweet by Jeff Kline, MD, about D-dimer assay normalization.

that they vary with test prevalence…. As the true positives increase, you are just going to get artificially inflated positive and negative predictive values." He instead advocated applying likelihood ratios to help clinicians determine their posttest probabilities. "Unfortunately we don't have the information in this study to calculate… likelihood ratios because we don't really know how accurate the positive D-dimers were—those D-dimers that were above the age-adjusted thresholds." For a more detailed statistical analysis on this topic and a range of possible likelihood ratio calculations, read the *Annals* Journal Club Answers article by Kirschner and Kline.[8]

Several participants on the video and blog attempted to theorize why there was a difference in pulmonary embolism prevalence rates in different parts of the world. The 19% pulmonary embolism prevalence in this study population was found to be lower than or near those reported for the European population but was substantially higher than the prevalence rates in the United States and Canada. Salim Rezaie, MD (University of Texas Health Science Center, San Antonio), noted that this 19% prevalence rate was lower than in older European studies, which showed prevalence rates as high as 30%. Kline theorized that this downtrend might be a result of a change in European health systems. With weaker primary care networks, which previously had evaluated patients at low risk for pulmonary embolisms and spared them from an emergency department (ED) visit, now a more full-spectrum range of patient acuities is presenting to the ED in a "much more Americanized" way. Consequently, a greater proportion of diagnostic evaluations are negative for pulmonary embolism and thus potentially decreasing the apparent prevalence rate.

Another subject discussed was the fact that the United States and Canada shared similar pulmonary embolism prevalence rates, in the 5% to 10% range. Several were expecting Canadian rates to be similar to those of Europe, given the more similar medicolegal structure. Helman proposed that "[w]hile Canadians generally seem to practice less defensively from a legal perspective than Americans, I think we share a culture of a desire for diagnostic certainty, which may account for the similar prevalence rates for [pulmonary embolism]." Additionally, Chan shared her local experiences that Canadians seemingly prefer ED evaluations over those of family physicians or walk-in clinics, mirroring Kline's observations about the shifting European health system networks. Helman concluded that because of the lower prevalence, application of the proposed age-adjusted D-dimer cutoff would likely lead only small reductions in computed tomography (CT) imaging use.

Q4: Based on this study, would you change your practice, assuming that you have one of the 6 studied D-dimer assays? For instance, you see a 60-year-old woman with a nonhigh pretest probability for a pulmonary embolism. Your D-dimer result is 590 µg/L. Would you perform a CT pulmonary angiogram (CTPA)?

This discussion generated the most controversy among the participants. Thoma highlighted that "this study was not nearly as big as it claimed." Several noted that the total number of patients that were actually ruled out with the age-adjusted cutoff was only 331 and not 2,898. The latter was the starting number of patients with a nonhigh pretest probability for pulmonary embolism, which made them eligible for study inclusion. "This is a big change of practice to consider based on such a relatively small validation cohort," stated Thoma. Both Thoma and Cenker Eken, MD, (Akdeniz University Hospital, Turkey) noted that the cause of death for the 7 deaths was determined by 3-person adjudication rather than a more objective postmortem autopsy. Ultimately, only 1 was attributed to venous thromboembolism disease by adjudication. Three of the remaining 6 deaths were attributed to chronic obstructive pulmonary disease. If these patients in reality were misclassified and indeed had venous thromboembolism instead of or in addition to chronic obstructive pulmonary disease, Thoma noted it would result in a much higher miss rate. "This would wreck their conclusions and brings confidence intervals above a 2% miss rate for a very bad outcome."

Helman broached a potentially unexpected consequence from the ADJUST-PE trial findings. He asked, "Would this study increase our imaging utilization with [D-dimer] false positives the way the Well's score inadvertently did?" In the video discussion, Kline anticipated that CT use to detect pulmonary embolisms in older patients would likely continue to be unchanged. "These old people will be getting CT's anyway" because the provider is often assessing for several potential causes for undifferentiated symptoms in these higher-risk patients, as tweeted by Benjamin Zabar, MD (Long Island Jewish Medical Center) (Figure 3).
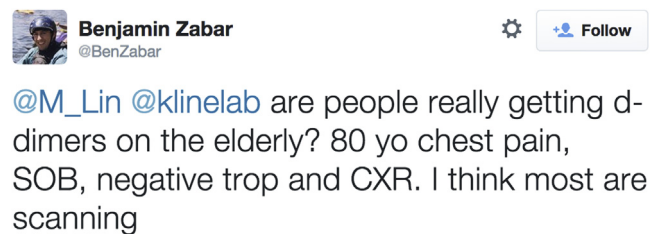

Benjamin Zabar @BenZabar ✪ Follow

@M_Lin @klinelab are people really getting d-dimers on the elderly? 80 yo chest pain, SOB, negative trop and CXR. I think most are scanning

Figure 3. Tweet by Benjamin Zabar, MD, on D-dimer tests in the elderly.

As an aside, Kline proposed that future research focus on raising the D-dimer cutoff for younger patients with a low pretest probability for pulmonary embolism. He observed that these patients are undergoing excessive CT imaging for pulmonary embolisms with current standard D-dimer cutoffs.

Other participants highlighted the positive aspects of the ADJUST-PE trial. Anand Senthi, MD, (Kinross Medical Centre, Australia) advocated that these results can serve as a foundation for discussion, specifically toward a more shared decisionmaking approach with patients about whether to undergo CT imaging. He prefaced his comments by saying he thought that "there is no good evidence that the investigation of patients who are at low risk for pulmonary embolism provides them with a net benefit and there is some evidence they are probably exposed to net harm instead." Observing that current low-risk pulmonary embolism patients often undergo excessive diagnostic testing because of the nonadjusted D-dimer cutoff, Senthi hopes that higher D-dimer cutoffs with increasing age will swing the pendulum "back towards the patient favour."

Minh Le Cong, MBBS(Adelaide), FRACGP, FACRRM, FARGP, GDRGP, GCMA, Dip AeroMedical, (James Cook University, Australia) was hopeful that this study might encourage a change to address the heterogeneity of D-dimers and to standardize "a cut-off that's sensible and individualized to a degree." Additionally, he believed that this study provided sufficient evidence to start implementing into practice.

Even among the skeptics, there was a consensus that this study advanced the field of diagnostic screening for pulmonary embolism and that with further research, they may change their practice. Several even would start changing their practice in accordance with this and previous age-adjusted studies. During the Google Hangout, both Kline and Kirschner were comfortable recommending this age-adjusted cutoff value in clinical practice for patients with a nonhigh pretest probability for pulmonary embolism in conjunction with patients in a shared decision model approach. Kline stated that this was "ready for prime time," especially because he thought that a larger-scale prospective study would likely be too costly and resource intensive to perform. "We're going to have to make a decision with some degree of ambiguity." Kline tweeted his suggested diagnostic algorithm incorporating the age-adjusted D-dimer cutoff (Figures 4 and 5).

Additional Reading Recommendations

During the discussion of the effect of prevalence on predictive values, 2 resources were recommended by the participants for further reading: Lin recommended the University of Ottawa's Faculty of Medicine Web site reviewing the basics on sensitivity, prevalence, and predictive values.[9] Helman recommended *Evidence-Based Emergency Care: Diagnostic Testing and Clinical Decision Rules* by Pines et al.[10]

LIMITATIONS

The primary limitations have been addressed in previous publications in this series and the ALiEM-*Annals* Residents' Perspective articles.[1-3] A common cited limitation involves sampling bias because participants were more likely to be technologically inclined, interested in the selected topic, and comfortable with sharing their opinions in an open forum. Furthermore, the tracking of Twitter comments was possible only if the #ALiEMJC hashtag was used, which may have resulted in underreporting of Twitter reach, as measured by impressions. Moreover, actual engagement with the Journal Jam podcast is unknown. Because push technology allows many podcast series to automatically deliver content to subscribers' mobile devices, the download metrics likely overestimate the actual listener population. To our knowledge, there are no data to date that correlate download numbers to the proportion of actual listeners.

DISCUSSION

In this fourth edition of the ALiEM-*Annals* Global Emergency Medicine Journal Club series, we report the perspectives from a diverse audience on multiple digital platforms, as curated from the blog, Twitter, and Google Hangout video, using a 4-question framework about the ADJUST-PE trial and the age-adjusted D-dimer assay cutoff. Common themes that arose in the discussions included the heterogeneity of practices, D-dimer assays, provider knowledge about these assays, and prevalence rates in different areas of the world. This multimodal, asynchronous discussion demonstrates the creation of a virtual space to allow interested stakeholders, including clinicians, learners, experts, and policymakers, to share insights, perspectives, and concerns in an open and transparent arena to help identity knowledge gaps, generate hypotheses, and potentially achieve community consensus. Through constant innovation and feedback, this ALiEM-*Annals* Global Emergency Medicine Journal Club series of facilitated online discussions using free social media technologies has evolved with each iteration. We hope to demonstrate to others the possibilities with these technologies, especially with regard to creating

jeffrey kline
@klinelab

⚙ Following

Writing a review on PE exclusion and diagnosis in the emergency dept. This is the algorithm I'm recommending

Figure 4. Tweet by Jeff Kline, MD, about diagnosing PE using a proposed algorithm.

communities of practice and accelerating knowledge translation of published materials to bedside practice.

Reflections on the Social Media Analytics and Process

Our social media–based approach showed the power of online engagement with multiple experts and a diverse audience. The blog and Twitter metrics continued to show clinician involvement as measured by page views and Twitter impressions, respectively. The true value or influence of these numbers, however, is currently unknown, with no criterion standard available to compare with in academia. For now, we are collecting these data for more long-term trending to assess the behavior patterns of participants in these online engagement activities.

YouTube analytics continued to demonstrate that the Google Hangout video might be comparatively less successful than the other platforms, with the average viewing time being 8 minutes 31 seconds (out of 33 minutes 11 seconds), with only 159 views in the first 14 days. Potential reasons include the more passive form of learning (watching the video) and larger bandwidth needs if viewing while away from a wireless internet signal.[11]
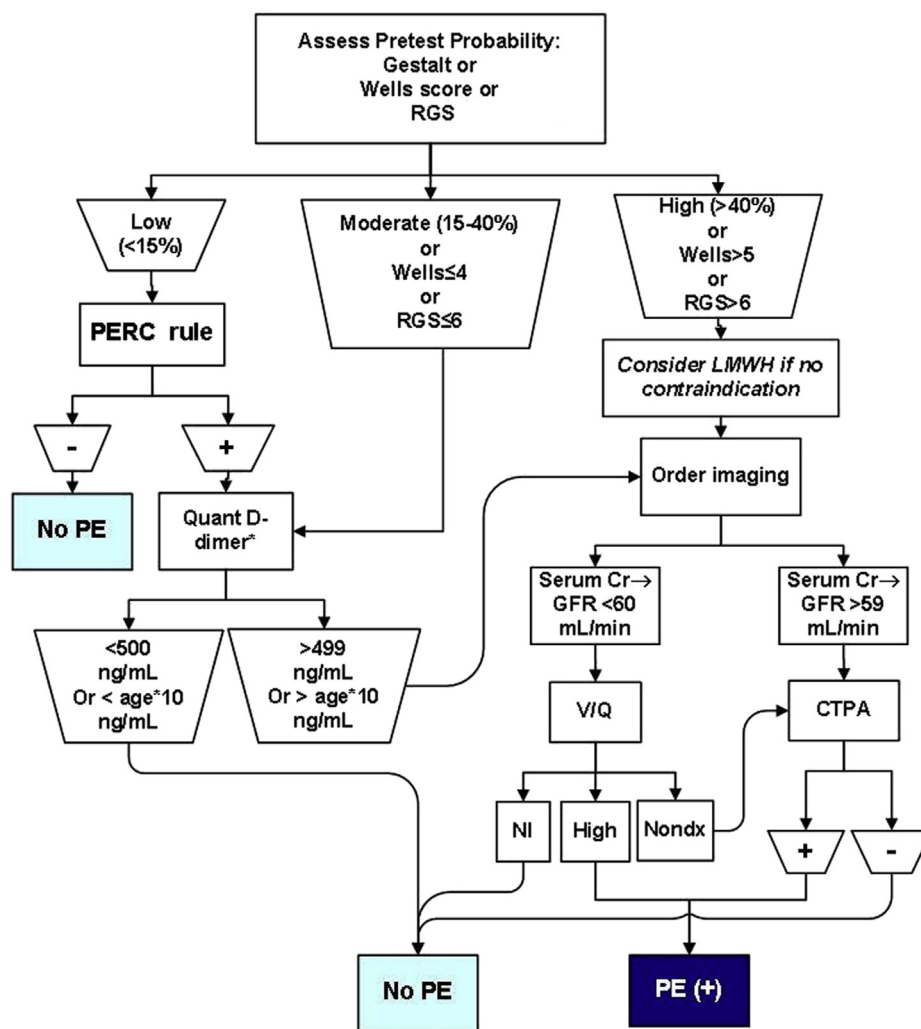
Figure 5. A proposed diagnostic algorithm for pulmonary embolism, divided into low, moderate, and high clinical pretest probabilities, suggested by Kline (@KlineLab). *RGS*, Revised Geneva score; *PERC*, pulmonary embolism rule-out criteria; *LMWH*, low molecular weight heparin; *PE*, pulmonary embolism; *GFR*, glomerular filtration rate; *V/Q*, ventilation/perfusion; *CTPA*, computed tomography pulmonary angiogram; *NI*, normal.

Additionally, video length may have been an issue. Regular ALiEM readers may not be accustomed to spending long amounts of time reading and engaging with a single ALiEM topic. In 2014, the mean page view time for an ALiEM post was 1 minute 58 seconds. For this Global Emergency Medicine Journal Club, this doubled to 4 minutes 24 seconds, which is an encouraging sign of added engagement. The video discussion, however, which was also more than 30 minutes long, may have been too long for ALiEM viewers and busy clinicians in general, resulting in only partial viewing of the video.

To address the bandwidth, portability, and convenience issues, ALiEM partnered with an existing audio podcast organization, Emergency Medicine Cases, created by Helman, for this and ongoing Global Emergency Medicine Journal Clubs. Podcasts have been increasingly popular in emergency medicine for lifelong learning, but especially for US-trained emergency medicine residents.[12] A summary of this Global Emergency Medicine Journal Club discussion on the ADJUST-PE trial was provided after the 2-week discussion period in a new series titled Journal Jam. This podcast series ultimately may be more of an accepted modality for learning by emergency medicine clinicians compared with the videos. With more than 3,000 downloads of this inaugural ADJUST-PE trial podcast in the first week of release, it seems to suggest that an audio-only format is favored by the audience over the video format used by the current Global Emergency Medicine Journal Club audience.

CONCLUSIONS

In this fourth edition of the ALiEM-*Annals* Global Emergency Medicine Journal Club initiative, we report the curated perspectives of clinicians on the ADJUST-PE trial and the age-adjusted D-dimer cutoff value for older patients. This educational innovation to promote scholarly dialogue in the digital space was able to attract 1,169 page views from 391 cities in 52 countries to the Global Emergency Medicine Journal Club blog post during a 14-day period, using various social media platforms, including the blog, Twitter, Google Hangout live video, and a newly added Journal Jam podcast series. Although the participants represent only a small subset of the much greater emergency medicine community, most were cautiously optimistic about the incorporation of the age-adjusted D-dimer cutoff for older patients in excluding pulmonary embolism into their clinical practice, with the preface that clinical gestalt and shared decisionmaking with patients should play major roles in determining whether to obtain CT imaging. We hope that this summary report will encourage others to join and actively engage in scholarly online dialogues, whether it

be by writing a comment on the blog, tweeting a response using the #ALiEMJC hashtag, viewing the YouTube video, or listening to the Journal Jam podcast.

REFERENCES

1. Radecki RP, Rezaie SR, Lin M. *Annals of Emergency Medicine* Journal Club. Global Emergency Medicine Journal Club: social media responses to the November 2013 *Annals of Emergency Medicine* Journal Club. *Ann Emerg Med.* 2014;63:490-494.

2. Chan TM, Rosenberg H, Lin M. Global Emergency Medicine Journal Club: social media responses to the January 2014 online emergency medicine journal club on subarachnoid hemorrhage. *Ann Emerg Med*. 2014;64:88-94.

3. Thoma B, Rolston D, Lin M. Global Emergency Medicine Journal Club: social media responses to the March 2014 *Annals of Emergency Medicine* Journal Club on targeted temperature management. *Ann Emerg Med*. 2014;64:207-212.

4. Righini M, Van Es J, Den Exter PL, et al. Age-adjusted D-dimer cutoff levels to rule out pulmonary embolism: the ADJUST-PE study. *JAMA*. 2014;311:1117-1124.

5. Kirschner JM, Kline JA. Is it time to raise the bar? age-adjusted D-dimer cutoff levels to exclude pulmonary embolism. *Ann Emerg Med*. 2014;64:86-87.

6. Deitelzweig SB, Johnson BH, Lin J, et al. Prevalence of clinical venous thromboembolism in the USA: current trends and future projections. *Am J Hematol*. 2011;86:217-220.

7. Robert-Ebadi H, Righini M. Diagnosis and management of pulmonary embolism in the elderly. *Eur J Intern Med*. 2014;25:343-349.

8. Kirschner J, Kline J. Is it time to raise the bar? age-adjusted D-dimer cutoff levels for excluding pulmonary embolism: answers to the July 2014 Journal Club questions. *Ann Emerg Med*. 2014;64:678-683.

9. Sensitivity, prevalence, and predictive values. University of Ottawa's Faculty of Medicine Web site. Available at: http://www.med.uottawa.ca/sim/data/Sensitivity_and_Prevalence_e.htm. Accessed December 16, 2014.

10. Pines JM, Carpenter CR, Raja AS, et al. *Evidence-Based Emergency Care: Diagnostic Testing and Clinical Decision Rules*. West Sussex, UK: John Wiley & Sons; 2013.

11. Hayes B, Kobner S, Trueger NS, et al. Social media in the emergency medicine residency curriculum: social media responses to the residents' perspective article. *Ann Emerg Med*. 2015;65:573-583.

12. Mallin M, Schlein S, Doctor S, et al. A survey of the current utilization of asynchronous education among emergency medicine residents in the United States. *Acad Med*. 2014;89:598-601.