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Authors

Hsiao, Jonie J
Pedigo, Ryan
Bae, Shirley W
[et al.](#)

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Systematic online academic resource (SOAR) review: Endocrine, metabolic, and nutritional disorders

Jonie J. Hsiao MD^{1,2}  | Ryan Pedigo MD, MHPE^{2,3} | Shirley W. Bae MD⁴ | JooYeon Jung MD⁵ | Lisa Zhao MD^{1,2} | Nathan S. Trueger MD, MPH⁶ | Teresa M. Chan MD, MHPE⁷  | Andrew Grock MD^{1,2} 

¹Division of Emergency Medicine, Greater Los Angeles VA Healthcare System, Los Angeles, California, USA

²Department of Emergency Medicine, David Geffen School of Medicine, UCLA, Los Angeles, California, USA

³Harbor-UCLA Medical Center, Torrance, California, USA

⁴Loma Linda University Health Emergency Medicine, Loma Linda, California, USA

⁵UC Davis Ophthalmology, Davis, California, USA

⁶Department of Emergency Medicine, Northwestern University, Chicago, Illinois, USA

⁷Division of Emergency Medicine, Department of Medicine, McMaster University, and the McMaster Education Research, Innovation, and Theory Program, Hamilton, Ontario, Canada

Correspondence

Jonie J. Hsiao, MD, Faculty Physician, Division of Emergency Medicine, Greater Los Angeles VA Healthcare System, David Geffen School of Medicine at UCLA, Los Angeles, CA 90095, USA.
Email: Jonie.Hsiao@va.gov

Abstract

Background: Free open-access medical education (FOAM) has become an integral resource for medical school and residency education. However, questions of quality and inconsistent coverage of core topics remain. In this second entry of the SAEM Systematic Online Academic Resource (SOAR) series, we describe the application of a systematic methodology to identify, curate, and describe FOAM topics specific to endocrine, metabolic, and nutritional disorders as defined by the 2016 Model of the Clinical Practice of Emergency Medicine (MCPEM).

Methods: We developed an automated algorithm to search 264 keywords derived from nine subtopics within the MCPEM category in the FOAM Search (a customized FOAM search tool) and the Social Media index. The top 100 results were extracted for each keyword. Resources underwent a manual iterative screening process, and those relevant to endocrine, metabolic, or nutritional disorders and EM were evaluated with the revised Medical Education Translational Resources: Impact and Quality (rMETRIQ) tool.

Results: The search yielded 36,346 resources, of which 756 met the criteria for quality assessment. After rMETRIQ tool training, four raters demonstrated an average measured intraclass correlation coefficient of 0.94 (95% confidence interval = 0.88 to 0.97, $p < 0.001$). A total of 121 posts (16% of posts) covering 25 subtopics were identified as high quality (rMETRIQ ≥ 16). The most covered subtopic was potassium disorders, representing 15% of all posts. Subtopics that did not have a high-quality resource identified include metabolic alkalosis, respiratory alkalosis, fluid overload, phosphorus metabolism, hyperglycemia, malabsorption, malnutrition, and thyroiditis. From most to least common, the overall target audience was junior resident (91%), PGY-1 resident (88%), senior resident (81%), clerk (64%), attending (50%), and pre-clerkship (9%).

Conclusions: We systematically identified, described, and curated FOAM resources for EM learners on the topic of endocrine, metabolic, and nutritional disorders. A

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final list of high-quality resources can guide trainees, educator recommendations, and FOAM authors.

KEYWORDS

asynchronous education, emergency medicine, endocrine, FOAM, free online open access medical education, metabolic disorders, nutritional disorders, revised Medical Education Translational Resources: Impact and Quality, rMETRIQ, SOAR, systematic online academic resource review

INTRODUCTION

Free open-access medical education (FOAM) resources in emergency medicine (EM) are routinely used informally via independent resident curation and formally as part of local and national residency curricula.¹⁻⁷ The abundance of these online resources and the diversity in platforms and formats make it difficult to compare and assess the quality of the information presented.⁸⁻¹¹ Furthermore, FOAM has limited comprehensiveness in addition to being entirely decentralized, which can make navigation complicated.^{12,13} These factors plus the enormous volume of FOAM produced makes curation extraordinarily difficult on the local level. Thus, the need exists for a systematic search of FOAM content to produce a curated list of resources organized by subtopic and learner level.

Here, we present the second in a series that aims to create a new type of synthesis scholarship that borrows from the systematic review format to aggregate and filter high-quality, online academic resources for the purposes of creating a centralized resource¹⁴ (please see Box 1 for details of this initiative).

METHODS

Study design

As in the first SOAR publication, the design of this review was conducted similar to that of a traditional systematic literature review. We again attempted to adhere to the PRISMA guidelines as closely as possible.¹⁵

Topic identification

Appropriate subtopic searches were based on the 2016 American Board of Emergency Medicine's Model of the Clinical Practice of Emergency Medicine (MCPPEM) document because it "represents essential information and skills necessary for the clinical practice of EM by board-certified emergency physicians."^{16,17} For the "endocrine, metabolic, and nutritional" disorders search, we used the MCPPEM topic's nine headings and over 30 subheadings to create a list of keywords, including synonyms, for the search. In addition, the authors also reviewed signs, symptoms, and presentations of

BOX 1 The Objective of the SAEM Systematic Online Academic Resource (SOAR) Topic Review Series

This is the second entry in the SAEM Systematic Online Academic Resource (SOAR) Topic Review series. We aim to systematically identify online resources by topic to determine FOAM's current coverage of EM topics and subtopics, assess the quality of these resources with a validated tool, and collate links to identified high-quality online resources in a user-friendly framework. Thus, the SAEM SOAR Topic Reviews will enable all users (individual learners, educators, and program leaders) to easily find relevant, high-quality online resources. Additionally, this ongoing series will help create a durable scientific evaluation of FOAM in EM.

This second entry in the SAEM Systematic Online Academic Resource (SOAR) Topic Review series identifies and evaluates online education resources related to endocrine, metabolic, and nutritional disorders. Future editions will continue to review other topics. This article and its methodology can serve as a guide to future authors for future topics (and, eventually, updated reviews of prior topics) to provide a comprehensive description of the FOAM landscape.

the MCPPEM topic and subtopics. The final search included 264 keywords (see Table S1).

Database search

We selected FOAM Search (a customized FOAM search tool; GoogleFoam.com) and the top 50 FOAM websites per the Social Media index (SMI) as our two search repositories to identify online educational resources targeted to health professionals.¹⁸⁻²⁰ This strategy was chosen to avoid capturing irrelevant content intended for lay public consumption that would have resulted from a generic engine (e.g., Google). We restricted our search to the top 50 sites on the SMI (SMI-50) based on input from the prior SOAR review authors, who observed that sites ranked lower than

50 were generally of less high quality in addition to resource limitations.

With the use of a novel software program, each term was entered into FOAM Search and the search engines of each site from the SMI-50 list, and the program automatically extracted and collated the top 100 results for every keyword searched. The results of the initial search were extracted with their page title, keyword, source type (journal, blog, podcast, archive), and URL. Of note, one author (JH) performed a manual review of sites listed and discovered a flaw in the automated search of one site and found 22 posts initially missed.

Inclusion criteria

All open-access educational resources listed on FOAM Search and found on the SMI-50 list related to endocrine, metabolic, and nutritional disorders and EM were included, as determined by matching with a heading or subheading listed on the MCPPEM. Of note, written show notes from podcasts were included in this review.

Exclusion criteria

Each item was screened by a single author (AG, JH, RP, NST) and was excluded if they were deemed irrelevant to endocrine, metabolic, or nutritional disorders or EM. Of note, resources that was better categorized under a different MCPPEM category were generally not included. For example, hypovolemia content that primarily focused on ultrasound or septic shock was generally not included because those are classified by MCPPEM in their own respective categories. In addition, if a topic was only mentioned in brief, e.g., in a list of the differential diagnosis, it was also generally not included. The authors met multiple times to establish consensus for determining topic relevance. Finally, the following resource types were excluded: posts without text to review, such as pure audio or video links without associated written notes or “show notes”; articles in peer-reviewed journals; reposts or tagged repositories of posts published initially elsewhere; and non-English and paid content. Resources were then screened a second time by one author (JH) to ensure the final list of resources met all criteria.

Data extraction and quality and usage assessment

Google Forms (Mountain View, CA) was used as an abstraction and organization tool for the final list of resources and included publication date, described and inferred audience level, subtopic reviewed, author information, and quality assessment via the revised METRIQ (rMETRIQ) score. The rMETRIQ score contains seven categories with scores of 0 to 3 for a maximal score of 21 (Table S2).

To ensure reliable and consistent scoring with the tool, four reviewers (AG, JH, RP, LZ) underwent two rounds of tool rater training. Prior to any training, the average-measures intraclass correlation coefficient (ICC) was 0.72 (95% confidence interval [CI] = 0.72 to 0.92). After the first round of training, the ICC improved to 0.86 (95% CI = 0.75 to 0.92), and after the second round of training, the final ICC was 0.91 (95% CI = 0.82 to 0.96), indicating a very strong inter-rater reliability.

A quality cutoff of ≥ 16 was determined to be high quality based on the modified Angoff method as in the prior SOAR review study.¹⁴ Like in the previous SOAR edition, each reviewer also determined the appropriate audience level (as indicated by the post or as determined by the rater if not indicated) and appropriate usage (e.g., journal club, postshift reading, or appropriate for on-shift “just-in-time” reference). More than one appropriate usage could be chosen for each article. Finally, prior to evaluations, the authors together reviewed the definitions of each appropriate usage category through discussion and negotiated consensus.¹⁴

One author (JH) reviewed all posts deemed high quality for duplicate entries and final scores for accuracy. Four of the 124 remaining posts were removed: four duplicates and one toxicologic post. One post met high-quality criteria after additional points were added due to a missed conflicts-of-interest disclosure. Of note, authors did not review any posts for which they authored, edited, or had any other specific conflict of interest.

RESULTS

The search yielded a total of 36,346 resources. Figure 1 displays the search and review results. After removing duplicates (19,413) and journal articles (7,108), we were left with 9,825 unique resources. Next, four

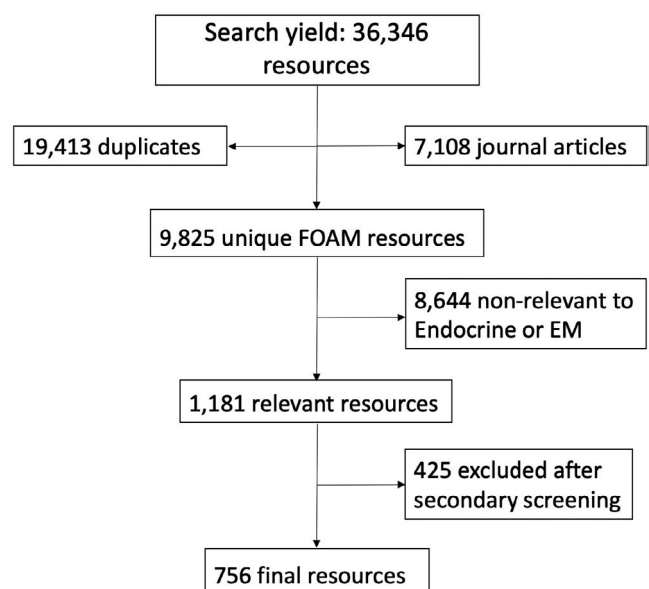


FIGURE 1 Search and review results. FOAM, free open-access medical education resources

TABLE 1 List of all high-quality posts (rMETRIQ ≥ 16)

| Topic | Subtopic | Name of First Author | Name of Blog Post | URL | Level of trainee recommendation | rMETRIQ score |
|------------------------|------------------------------|-------------------------------|---|---|--|---------------|
| Acid-base disturbances | Metabolic acidosis | Farkas, Josh | PulmCrit: pH-guided fluid resuscitation & BICAR-ICU | https://emcrit.org/pulmcrit/bicar-icu/ | PGY-1 resident, junior, senior, attending | 18 |
| Acid-base disturbances | Metabolic acidosis | Farkas, Josh | Is correcting hyperchloremic acidosis beneficial? | https://emcrit.org/pulmcrit/is-correcting-hyperchloremic-acidosis-beneficial/ | PGY-1 resident, junior, senior, attending | 16 |
| Acid-base disturbances | Metabolic acidosis | Rusyniak, Dan | Tox & Hound - aka AKA | https://emcrit.org/toxhound/aka-aka/ | PGY-1 resident, junior, senior, attending | 16 |
| Acid-base disturbances | Metabolic acidosis | Multiple | Alcoholic ketoacidosis - WikEM | https://wikem.org/wiki/Alcoholic_Ketoacidosis | Clerk, PGY-1 resident, junior, senior | 16 |
| Acid-base disturbances | Metabolic acidosis | Spiegel, Rory | CC Nerd-The Case of the Neutral Documents | https://emcrit.org/emmerd/cc-nerd-the-case-of-the-neutral-documents/ | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Acid-base disturbances | Respiratory acidosis | Chan, Wendy | VBG vs ABG in Hypercarbia | http://blog.clinicalmonster.com/2016/09/06/vbg-reliability-hypercarbia/ | Clerk, PGY-1 resident, junior, senior | 18 |
| Acid-base disturbances | Acid-base (mixed) | Farkas, Josh | Fluid selection using pH-guided resuscitation | https://emcrit.org/pulmcrit/fluid-selection-using-ph-guided-resuscitation/ | PGY-1 resident, junior, senior, attending | 17 |
| Acid-base disturbances | Acid-base (mixed) | Weingart, Scott | Acid Base in the Critically Ill - Part V - Enough with the Bicarb Already | https://emcrit.org/emcrit/enough-with-the-bicarb-already/ | PGY-1 resident, junior, senior, attending | 17 |
| Adrenal disease | Corticoadrenal insufficiency | Long, Brit | Mimics of Sepsis: What do ED Physicians Need to Know? | http://www.emdocs.net/mimics-of-sepsis/ | PGY-1 resident, junior, senior | 18 |
| Adrenal disease | Corticoadrenal insufficiency | Farkas, Josh | Adrenal crisis - EMCrit Project | https://emcrit.org/ibcc/adrenal-crisis/ | PGY-1 resident, junior, senior, attending | 17 |
| Adrenal disease | Corticoadrenal insufficiency | Gaillard, Frank | Adrenal hemorrhage Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/adrenal-haemorrhage?lang=en | PGY-1 resident, junior, senior, attending | 17 |
| Adrenal disease | Cushing's syndrome | Jin, Tee Yu & Gaillard, Frank | Cushing syndrome Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/cushing-syndrome | Clerk, PGY-1 resident, junior, senior, attending | 17 |
| Fluid and electrolytes | Calcium | Long, Brit | Oncologic Emergencies Part I: Pearls and Pitfalls | http://www.emdocs.net/oncologic-emergencies-part-i-pearls-and-pitfalls/ | PGY-1 resident, junior, senior, attending | 17 |
| Fluid and electrolytes | Calcium | Swaminathan, Anand | Hypercalcemia | http://www.emdocs.net/core-em-hypercalcemia/ | PGY-1 resident, junior, senior, attending | 16 |
| Fluid and electrolytes | Calcium | Multiple | Hypocalcemia - WikEM | https://wikem.org/wiki/Hypocalcemia | PGY-1 resident, junior, senior, attending | 16 |
| Fluid and electrolytes | Calcium | Taliaferro, Dustin | EM@3AM: Hyper- and HypoCa | http://www.emdocs.net/em3am-hyper-and-hypoca/ | PGY-1 resident, junior, senior, attending | 16 |

TABLE 1 (Continued)

| Topic | Subtopic | Name of First Author | Name of Blog Post | URL | Level of trainee recommendation | rMETRIQ score |
|------------------------|-------------|---------------------------------|---|---|--|---------------|
| Fluid and electrolytes | Hypovolemia | Astin, Matt | The SPLIT Trial: Saline vs Plasma-Lyte Fluid Therapy | https://rebelem.com/the-split-trial-saline-vs-plasma-lyte-fluid-therapy/ | PGY-1 resident, junior, senior, attending | 18 |
| Fluid and electrolytes | Hypovolemia | Rezaie, Salim | SMART Trial Part 2: Secondary Analysis of Balanced Crystalloids vs Saline in Sepsis | https://rebelem.com/smart-trial-part-2-secondary-analysis-of-balanced-crystalloids-vs-saline-in-sepsis/ | Clerk, PGY-1 resident, junior, senior | 18 |
| Fluid and electrolytes | Hypovolemia | Rezaie, Salim | Is the Great Debate Between Balanced vs Unbalanced Crystalloids Finally Over? | https://rebelem.com/great-debate-balanced-vs-unbalanced-crystalloids-finally/ | Clerk, PGY-1 resident, junior, senior | 18 |
| Fluid and electrolytes | Hypovolemia | Rezaie, Salim | Does Lactated Ringers (LR) Raise Serum Lactate? | https://rebelem.com/does-lactated-ringers-lr-raise-serum-lactate/ | Clerk, PGY-1 resident, junior, senior | 18 |
| Fluid and electrolytes | Hypovolemia | Farkas, Josh | PulmCrit- Get SMART: Nine reasons to quit using normal saline for... | https://emcrit.org/pulmcrit/smart/ | PGY-1 resident, junior, senior, attending | 17 |
| Fluid and electrolytes | Hypovolemia | Farkas, Josh | IBCC chapter & cast - Fluid selection & pH-guided fluid resuscitation | https://emcrit.org/pulmcrit/fluid/ | PGY-1 resident, junior, senior, attending | 17 |
| Fluid and electrolytes | Hypovolemia | Farkas, Josh | The SPLIT trial: Internal vs. external validity | https://emcrit.org/pulmcrit/the-split-trial-internal-vs-external-validity/ | PGY-1 resident, junior, senior, attending | 17 |
| Fluid and electrolytes | Hypovolemia | Rezaie, Salim | Balanced vs Unbalanced Fluids in Pediatric Severe Sepsis | https://rebelem.com/balanced-vs-unbalanced-fluids-in-pediatric-severe-sepsis/ | Clerk, PGY-1 resident, junior, senior | 17 |
| Fluid and electrolytes | Hypovolemia | Levesque, Adrianna & Long, Brit | Fluid Choice in Sepsis: Does it matter? | http://www.emdocs.net/fluid-choice-does-it-matter/ | Clerk, PGY-1 resident, junior, senior, attending | 17 |
| Fluid and electrolytes | Hypovolemia | Kenny, Jon-Emile | Are balanced crystalloids better than saline? SMART Talk with Dr ... | https://pulmccm.org/randomized-controlled-trials/smart-talk-dr-michael-pinksey/ | PGY-1 resident, junior, senior, attending | 16 |
| Fluid and electrolytes | Hypovolemia | Farkas, Josh | PulmCrit- Overcoming occult diuretic resistance: Achieving diuresis ... | https://emcrit.org/pulmcrit/occult-diuretic-resistance/ | Attending | 16 |
| Fluid and electrolytes | Hypovolemia | Multiple | CT hypoperfusion complex Radiology Reference Article ... | https://radiopaedia.org/articles/ct-hypoperfusion-complex?lang=en | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Fluid and electrolytes | Hypovolemia | Multiple | Dehydration (peds) - WIKEM | https://wikem.org/wiki/Dehydration_(peds) | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Fluid and electrolytes | Hypovolemia | Rezaie, Salim | The Great Debate Between Balanced and Unbalanced Crystalloids Continues | https://rebelem.com/the-great-debate-between-balanced-and-unbalanced-crystalloids-continues/ | Junior, senior, attending | 16 |
| Fluid and electrolytes | Hypovolemia | Morgenstern, Justin | IV fluid choice part 1: The SPLIT trial | https://first10em.com/split/ | Clerk, PGY-1 resident, junior, senior, attending | 16 |

TABLE 1 (Continued)

| Topic | Subtopic | Name of First Author | Name of Blog Post | URL | Level of trainee recommendation | rMETRIQ score |
|------------------------|-------------|---------------------------------|--|---|---|---------------|
| Fluid and electrolytes | Hypovolemia | Drenzla, Adam | SALT OF THE EARTH (PART 1) | https://intensiveblog.com/salt-earth-part-1/ | Clerk, PGY-1 resident, junior, senior | 16 |
| Fluid and electrolytes | Potassium | Meyers, Pendell | Critical Hyperkalemia by H. Pendell Meyers, EMCrit Intern - EMCrit | https://emcrit.org/emcrit/critical-hyperkalemia/ | Junior, senior, attending | 17 |
| Fluid and electrolytes | Potassium | Farkas, Josh | Hyperkalemia - EMCrit Project | https://emcrit.org/ibcc/hyperkalemia/ | Clerk, PGY-1 resident, junior, senior | 17 |
| Fluid and electrolytes | Potassium | Farkas, Josh | Management of severe hyperkalemia in the post-Kayexalate era | https://emcrit.org/pulmcrit/management-of-severe-hyperkalemia-in-the-post-kayexalate-era/ | PGY-1 resident, junior, senior, attending | 17 |
| Fluid and electrolytes | Potassium | Swaminathan, Anand | Is Kayexalate Useful in the Treatment of Hyperkalemia in the ... | https://rebelem.com/kayexalate-useful-treatment-hyperkalemia-emergency-department/ | Clerk, PGY-1 resident, junior, senior | 17 |
| Fluid and electrolytes | Potassium | Singh, Manpreet | Hyperkalemia - The Great Imitator | http://www.emdocs.net/ecg-pointers-hyperkalemia-great-imitator/ | Clerk, PGY-1 resident, junior, senior | 17 |
| Fluid and electrolytes | Potassium | Belcher, Chris & Rogers, Rob | Tumor Lysis Syndrome - Diagnosis and Treatment | http://www.emdocs.net/9077-2/ | Clerk, PGY-1 resident, junior | 17 |
| Fluid and electrolytes | Potassium | Paik, John & Kulstad, Christine | Management of the Sick Dialysis/ESRD Patient | http://www.emdocs.net/management-of-the-sick-dialysesrd-patient/ | Clerk, PGY-1 resident, junior, senior | 17 |
| Fluid and electrolytes | Potassium | Meyers, Pendell | A young man with back spasms | http://hqmed-ecg.blogspot.com/2018/11/a-young-man-with-back-spasms.html | PGY-1 resident, junior, senior | 17 |
| Fluid and electrolytes | Potassium | Helman, Anton | Emergency Management of Hyperkalemia EM Cases Podcast | https://emergencymediccases.com/emergency-management-hyperkalemia/ | Junior, senior, attending | 16 |
| Fluid and electrolytes | Potassium | Long, Brit | Updates in Management of Hyperkalemia | http://www.emdocs.net/emdocs-cases-updates-management-hyperkalemia/ | Clerk, PGY-1 resident, junior, senior | 16 |
| Fluid and electrolytes | Potassium | Weingart, Scott | Treatment of hyperkalemia in the ED | https://emcrit.org/emcrit/hyperkalemia/ | Clerk, PGY-1 resident, junior, senior | 16 |
| Fluid and electrolytes | Potassium | Farkas, Josh | PulmCrit- BRASH syndrome: Bradycardia, Renal failure, AV blocker ... | https://emcrit.org/pulmcrit/brash-syndrome-bradycardia-renal-failure-av-blocker-shock-hyperkalemia/ | PGY-1 resident, junior, senior, attending | 16 |
| Fluid and electrolytes | Potassium | Farkas, Josh | Myth-busting: Lactated Ringers is safe in hyperkalemia, and is ... | https://emcrit.org/pulmcrit/myth-busting-lactated-ingers-is-safe-in-hyperkalemia-and-is-superior-to-ns/ | Junior, senior, attending | 16 |

TABLE 1 (Continued)

| Topic | Subtopic | Name of First Author | Name of Blog Post | URL | Level of trainee recommendation | rMETRIQ score |
|------------------------|-----------|----------------------------------|---|---|--|---------------|
| Fluid and electrolytes | Potassium | Moussavi, Kayvan & Fitter, Scott | Insulin Dosing in Hyperkalemia | http://www.emdoccs.net/insulin-dosing-in-hyperkalemia-is-it-a-one-size-fits-all/ | PGY-1 resident, junior, senior, attending | 16 |
| Fluid and electrolytes | Potassium | Rezaie, Salim | ECG Changes of Hyperkalemia | https://rebelem.com/ecg-changes-hyperkalemia/ | Clerk, PGY-1 resident, junior, senior | 16 |
| Fluid and electrolytes | Potassium | Santistevan, Jamie | emDOCs.net – Emergency Medicine Education/Subtle ECG findings... | http://www.emdoccs.net/hyperacute-t-waves/ | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Fluid and electrolytes | Potassium | Morton, A. Ross | Management of Hyperkalemia with ECG Changes | https://canadiem.org/management-hyperkalemia-ecg-changes/ | Clerk, PGY-1 resident, junior, senior | 16 |
| Fluid and electrolytes | Potassium | Awad, Nadia | Thyroid Storm: Treatment Strategies | https://www.aliem.com/thyroid-storm-treatment-strategies/ | PGY-1 resident, junior, senior, attending | 16 |
| Fluid and electrolytes | Potassium | Grock, Andrew | Bicarbonate: Completely Useless? | https://www.aliem.com/bicarbonate-completely-useless/ | Junior, senior, attending | 16 |
| Fluid and electrolytes | Potassium | Hayes, Bryan D | Hyperkalemia Management: Preventing Hypoglycemia From Insulin | https://www.aliem.com/hyperkalemia-management-preventing-hypoglycemia-from-insulin/ | Senior, attending | 17 |
| Fluid and electrolytes | Sodium | Smarandache, Andrei | When and how to treat hyponatremia in the ED | https://canadiem.org/hyponatremia-in-the-ed/ | PGY-1 resident, junior, senior | 19 |
| Fluid and electrolytes | Sodium | Farkas, Josh | Hyponatremia & dehydration in the ICU - EMCrit Project | https://emcrit.org/ibcc/hyponatremia/ | Senior, attending | 18 |
| Fluid and electrolytes | Sodium | Farkas, Josh | Emergent treatment of hyponatremia or elevated ICP with bicarb ... | https://emcrit.org/pulmcrit/emergent-treatment-of-hyponatremia-or-elevated-icp-with-bicarb-ampules/ | PGY-1 resident, junior, senior, attending | 17 |
| Fluid and electrolytes | Sodium | Farkas, Josh | Taking control of severe hyponatremia with DDAVP | https://emcrit.org/pulmcrit/takin-g-control-of-severe-hyponatremia-with-ddavp/ | Attending | 16 |
| Fluid and electrolytes | Sodium | Helman, Anton | Emergency Management of Hyponatremia EM Cases | https://emergencymedicinecases.com/episode-60-emergency-management-hyponatremia/ | PGY-1 resident, junior, senior, attending | 16 |
| Fluid and electrolytes | Sodium | Farkas, Josh | Unconventional therapies for hyponatremia: Thinking outside the ... | https://emcrit.org/pulmcrit/unconventional-therapies-for-hyponatremia-thinking-outside-the-collecting-duct/ | PGY-1 resident, junior, senior, attending | 16 |
| Fluid and electrolytes | Sodium | Farkas, Josh | PulmCrit- Controlled aquaresis: Management of hypervolemic or euvolemic hyponatremia with oral urea | https://emcrit.org/pulmcrit/aquaresis/ | Junior, senior, attending | 16 |

(Continues)

TABLE 1 (Continued)

| Topic | Subtopic | Name of First Author | Name of Blog Post | URL | Level of trainee recommendation | rMETRIQ score |
|------------------------|-----------------------|--|---|---|--|---------------|
| Fluid and electrolytes | Magnesium | Morgenstern, Justin | Torsades de Pointes: Approach to resuscitation | https://first10em.com/torsades-de-pointes/ | PGY-1 resident, junior, senior | 17 |
| Fluid and electrolytes | Magnesium | Multiple | Hypermagnesemia - WikEM | https://wikem.org/wiki/Hypermagnesemia | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Glucose metabolism | Diabetic ketoacidosis | Lodeserto, Frank | Pediatric DKA: Do Fluids Really Matter? - REBEL EM - Emergency ... | https://rebelem.com/pediatric-dka-do-fluids-really-matter/ | Clerk, PGY-1 resident, junior, senior | 19 |
| Glucose metabolism | Diabetic ketoacidosis | Morgenstern, Justin | IV fluids do not cause cerebral edema in pediatric DKA - First10EM | https://first10em.com/kuppermann-2018/ | Clerk, PGY-1 resident, junior, senior, attending | 19 |
| Glucose metabolism | Diabetic ketoacidosis | Farkas, Josh | Blood gas measurements in DKA: Are we searching for a unicorn? | https://emcrit.org/pulmcrit/blood-gas-measurements-dka-searching-unicorn/ | PGY-1 resident, junior, senior, attending | 18 |
| Glucose metabolism | Diabetic ketoacidosis | Farkas, Josh | Anatomy of a DKA resuscitation - EMCrit Project | https://emcrit.org/ibcc/dka/ | Clerk, PGY-1 resident, junior, senior | 18 |
| Glucose metabolism | Diabetic ketoacidosis | Hughes, Darrel | Is There Any Benefit to an Initial Insulin Bolus in Diabetic... | https://rebelem.com/benefit-initial-insulin-bolus-diabetic-ketoacidosis/ | Clerk, PGY-1 resident, junior, senior, attending | 18 |
| Glucose metabolism | Diabetic ketoacidosis | Abela, Nikki | Fluid Type and Infusion Rate in Paediatric DKA | https://thesgem.com/2019/05/sgem255-it-dont-matter-now-fluid-type-and-infusion-rate-in-paediatric-dka/ | Clerk, PGY-1 resident, junior, senior, attending | 17 |
| Glucose metabolism | Diabetic ketoacidosis | Multiple | Cerebral edema in DKA - WikEM | https://wikem.org/wiki/Cerebral_edema_in_DKA | Clerk, PGY-1 resident, junior, senior, attending | 17 |
| Glucose metabolism | Diabetic ketoacidosis | Lubberdink, Ashley | TREKK Series Diabetic Ketoacidosis | https://canadiem.org/diabetic-ketoacidosis/ | Clerk, PGY-1 resident, junior | 17 |
| Glucose metabolism | Diabetic ketoacidosis | Farkas, Josh | PulmCrit- Dominating the acidosis in DKA | https://emcrit.org/pulmcrit/bicarbonat-e-dka/ | PGY-1 resident, junior, senior, attending | 16 |
| Glucose metabolism | Diabetic ketoacidosis | Farkas, Josh | PulmCrit - Four DKA Pearls | https://emcrit.org/pulmcrit/four-dka-pearls/ | PGY-1 resident, junior, senior, attending | 16 |
| Glucose metabolism | Diabetic ketoacidosis | Reynolds, Catherine, Fisher, Kathryn & Fairbrother, Hilary | emDOCs.net – Emergency Medicine Education/Diabetic... | http://www.emdocs.net/diabetic-ketoacidosis-sneaky-triggers-clinical-pearls/ | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Glucose metabolism | Diabetic ketoacidosis | Multiple | Diabetic ketoacidosis Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/diabetic-ketoacidosis?lang=gb | Clerk, PGY-1 resident, junior, senior, attending | 16 |

TABLE 1 (Continued)

| Topic | Subtopic | Name of First Author | Name of Blog Post | URL | Level of trainee recommendation | rMETRIQ score |
|-----------------------|----------------------------------|----------------------------------|--|---|--|---------------|
| Glucose metabolism | Diabetic ketoacidosis | Woods, Jason & Bukowski, Josh | PEM Pearls: Treatment of Pediatric Diabetic Ketoacidosis and the Two-Bag Method | https://www.aliem.com/pediatric-diabetic-ketoacidosis-two-bag-method/ | Junior, senior, attending | 16 |
| Glucose metabolism | Diabetic ketoacidosis | Monette, Derek | PEM Practice Changing Paper: Clinical Trial of Fluid Infusion Rates for Pediatric DKA | https://www.aliem.com/pem-practice-changing-paper-clinical-trial-fluid-infusion-rates-pediatric-dka/ | Junior, senior, attending | 16 |
| Glucose metabolism | Hyperosmolar hyperglycemic state | Multiple | Hyperosmolar hyperglycemic state - WIKEM | https://wikem.org/wiki/Hyperosmolar_hyperglycemic_state | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Glucose metabolism | Hyperosmolar hyperglycemic state | Multiple | Hyperosmolar hyperglycemic state Radiology Reference Article... | https://radiopaedia.org/articles/hyperosmolar-hyperglycaemic-state | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Glucose metabolism | Hyperosmolar hyperglycemic state | Multiple | Non-ketotic hyperglycaemic seizure Radiology Reference Article... | https://radiopaedia.org/articles/non-ketotic-hyperglycaemic-seizure?lang=gb | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Glucose metabolism | Hyoglycemia | Multiple | Hyoglycemic encephalopathy Radiology Reference Article... | https://radiopaedia.org/articles/hyoglycaemic-encephalopathy?lang=us | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Glucose metabolism | Insulin pump | Hamm, Joel & Aioub, Anasemon | Insulin Pumps: Complications and Emergency Department Presentations | http://www.emdocs.net/insulin-pumps-complications-and-emergency-department-presentations/ | PGY-1 resident, junior, senior, attending | 17 |
| Glucose metabolism | Insulin pump | Weingart, Scott | Podcast 198 - Insulin Pumps and Such with Josh Miller, MD | https://emcrit.org/emcrit/insulin-pumps/ | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Glucose metabolism | Insulin pump | Rezaie, Salim | Diabetic Gastroparesis Needs HUGS | https://rebelem.com/diabetic-gastroparesis-needs-hugs/ | PGY-1 resident, junior, senior, attending | 16 |
| Nutritional disorders | Nutritional disorders | Multiple | Osteoporosis Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/osteoporosis-3?lang=us | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Nutritional disorders | Nutritional disorders | Long, Brit | Protein Shakes and Dietary Supplements: What are their ingredients and how much is too much? | http://www.emdocs.net/protein-shakes-and-dietary-supplements-what-are-their-ingredients-and-how-much-is-too-much/ | Senior, attending | 16 |
| Nutritional disorders | Vitamin deficiencies | Multiple | Rickets Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/rickets?lang=us | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Nutritional disorders | Vitamin deficiencies | Groth, Meghan | Mythbusting the Banana Bag | https://www.aliem.com/mythbusting-banana-bag/ | PGY-1 resident, junior, senior, attending | 16 |
| Nutritional disorders | Wernicke-Korsakoff | Reyes, Jennifer & Baker, Annalee | Thiamine Deficiency | http://www.emdocs.net/thiamine-deficiency-pearls-pitfalls/ | PGY-1 resident, junior, senior, attending | 18 |

(Continues)

TABLE 1 (Continued)

| Topic | Subtopic | Name of First Author | Name of Blog Post | URL | Level of trainee recommendation | rMETRIQ score |
|-----------------------|---------------------|-------------------------|--|---|--|---------------|
| Nutritional disorders | Wernicke-Korsakoff | Pescatore, Rick | Should You Prescribe Oral Thiamine for Chronic Alcoholics... | https://rebelem.com/should-you-prescribe-oral-thiamine-for-chronic-alcoholics/ | Senior, attending | 17 |
| Nutritional disorders | Wernicke-Korsakoff | Multiple | Wernicke-Korsakoff syndrome - WikEM | https://wikem.org/wiki/Wernicke-Korsakoff_syndrome | Clerk, PGY-1 resident, junior, senior, attending | 17 |
| Nutritional disorders | Wernicke-Korsakoff | Multiple | Wernicke encephalopathy Radiology Reference Article... | https://radiopaedia.org/articles/wernicke-encephalopathy | Clerk, PGY-1 resident, junior, senior, attending | 17 |
| Nutritional disorders | Wernicke-Korsakoff | Swaminathan, Anand | Wernicke's Encephalopathy Archives - REBEL EM - Emergency... | https://rebelem.com/tag/wernicke-encephalopathy/ | Junior, senior, attending | 16 |
| Parathyroid disease | Parathyroid disease | Multiple | Parathyroid hormone Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/parathyroid-hormone | Clerk, PGY-1 resident, junior, senior, attending | 17 |
| Parathyroid disease | Parathyroid disease | Multiple | Parathyroid glands Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/parathyroid-glands?lang=us | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Parathyroid disease | Parathyroid disease | Newman, Samantha | PTH versus PTHrP – Small Differences, Big Implications - Clinical... | https://www.clinicalcorrelations.org/2016/03/03/pth-versus-pthrp-small-differences-big-implications/ | PGY-1 resident, junior, senior | 16 |
| Pituitary disorders | Pituitary disorders | Multiple | Sheehan syndrome Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/sheehan-an-syndrome | Clerk, PGY-1 resident, junior, senior, attending | 17 |
| Pituitary disorders | Pituitary disorders | Long, Drew & Long, Brit | emDOCs.net – Emergency Medicine EducationThunderclap... | http://www.emdocs.net/thunderclap-headache-pearls-pitfalls/ | PGY-1 resident, junior, senior | 17 |
| Pituitary disorders | Pituitary disorders | Multiple | Pituitary gland Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/pituitary-gland?lang=us | Clerk, PGY-1 resident, junior, senior, attending | 17 |
| Pituitary disorders | Pituitary disorders | Multiple | Optic pathway glioma Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/optic-pathway-glioma | Clerk, PGY-1 resident, junior, senior, attending | 17 |
| Pituitary disorders | Pituitary disorders | Multiple | Pituitary apoplexy Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/pituitary-apoplexy?lang=us | PGY-1 resident, junior, senior, attending | 17 |
| Pituitary disorders | Pituitary disorders | Multiple | Empty sella Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/empty-sella | PGY-1 resident, junior, senior, attending | 16 |
| Pituitary disorders | Pituitary disorders | Multiple | Elevated prolactin (differential) Radiology Reference Article... | https://radiopaedia.org/articles/elevated-prolactin-differential?lang=us | Clerk, PGY-1 resident, junior, senior, attending | 16 |
| Thyroid disorders | Hyperthyroid | Multiple | Thyroid storm - WikEM | https://wikem.org/wiki/Thyroid_storm | PGY-1 resident, junior, senior, attending | 18 |

TABLE 1 (Continued)

| Topic | Subtopic | Name of First Author | Name of Blog Post | URL | Level of trainee recommendation | rMETRIQ score |
|----------------------------|----------------------------|--|---|---|--|---------------|
| Thyroid disorders | Hyperthyroid | Lipp, Chris | CRACKCast E128 – Thyroid and Adrenal Disorders | https://canadiem.org/crackcast-e128-thyroid-adrenal-disorders/ | PGY-1 resident, junior, senior, attending | 18 |
| Thyroid disorders | Hyperthyroid | Multiple | Hyperthyroidism - WikEM | https://wikem.org/wiki/Hyperthyroidism | Clerk, PGY-1 resident, junior, senior | 17 |
| Thyroid disorders | Hyperthyroid | Mackey, Cassandra & Kulstad, Christine | Thyroid Storm and Aortoiliac Occlusive Disease | http://www.emdocs.net/quality-corne-r-thyroid-storm-and-aortoiliac-occlusive-disease/ | PGY-1 resident, junior, senior, attending | 17 |
| Thyroid disorders | Hyperthyroid | Remus, Kristin & Brenner, Judith | Bedside Rounds Series: Goiter – Clinical Correlations | https://www.clinicalcorrelations.org/2008/02/21/bedside-rounds-series-goiter/ | Clerk, PGY-1 resident, junior, senior | 16 |
| Thyroid disorders | Hyperthyroid | Lee, Terrance | Diagnosing hyperthyroidism: Answers to 7 common questions | https://www.aliem.com/2013/10/diagnosing-hyperthyroidism/ | Clerk, PGY-1 resident, junior, senior | 16 |
| Thyroid disorders | Hypothyroid | Fox, Sean | Hypothyroidism and Myxedema Coma – Pediatric EM Morsels | https://pedemorsels.com/hypothyroidism-and-myxedema-coma/ | PGY-1 resident, junior, senior, attending | 17 |
| Thyroid disorders | Hypothyroid | Multiple | Myxedema coma - WikEM | https://wikem.org/wiki/Myxedema_coma | PGY-1 resident, junior, senior, attending | 17 |
| Thyroid disorders | Hypothyroid | Zhao, Leah | Spot the Diagnosis! The case of the Pale Woman | https://canadiem.org/spot-the-diagnosis-the-case-of-the-pale-woman/ | PGY-1 resident, junior, senior | 17 |
| Tumors of endocrine glands | Tumors of endocrine glands | Multiple | Parathyroid adenoma Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/parathyroid-adenoma?lang=us | Clerk, PGY-1 resident, junior, senior, attending | 17 |
| Tumors of endocrine glands | Tumors of endocrine glands | Multiple | Central nervous system germinoma Radiology Reference Article... | https://radiopaedia.org/articles/central-nervous-system-germinoma | PGY-1 resident, junior, senior, attending | 16 |
| Tumors of endocrine glands | Tumors of endocrine glands | Multiple | Craniopharyngioma Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/craniopharyngioma | Junior, senior, attending | 16 |
| Tumors of endocrine glands | Tumors of endocrine glands | Multiple | Carcinoid tumor Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/carcinoid-tumour-2?lang=us | PGY-1 resident, junior, senior, attending | 16 |
| Tumors of endocrine glands | Adrenal tumor | Multiple | Pheochromocytoma Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/pheochromocytoma-1?lang=us | PGY-1 resident, junior, senior, attending | 17 |
| Tumors of endocrine glands | Adrenal tumor | Multiple | Adrenal adenoma Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/adrenal-adenoma?lang=us | PGY-1 resident, junior, senior, attending | 16 |

(Continues)

TABLE 1 (Continued)

| Topic | Subtopic | Name of First Author | Name of Blog Post | URL | Level of trainee recommendation | rMETRIQ score |
|----------------------------|-----------------|----------------------|---|---|--|---------------|
| Tumors of endocrine glands | Adrenal tumor | Multiple | Adrenal cortical carcinoma Radiology Reference Article... | https://radiopaedia.org/articles/adrenal-cortical-carcinoma-1?lang=us | PGY-1 resident, junior, senior, attending | 16 |
| Tumors of endocrine glands | Pituitary tumor | Multiple | Acromegaly Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/acromegaly?lang=us | Clerk, PGY-1 resident, junior, senior, attending | 17 |
| Tumors of endocrine glands | Pituitary tumor | Multiple | Pituitary adenoma Radiology Reference Article Radiopaedia.org | https://radiopaedia.org/articles/pituitary-adenoma | Clerk, PGY-1 resident, junior, senior, attending | 17 |
| Tumors of endocrine glands | Thyroid tumor | Multiple | Medullary thyroid carcinoma Radiology Reference Article... | https://radiopaedia.org/articles/medullary-thyroid-carcinoma-1?lang=us | Clerk, PGY-1 resident, junior, senior | 17 |
| Tumors of endocrine glands | Thyroid tumor | Multiple | Anaplastic thyroid carcinoma Radiology Reference Article... | https://radiopaedia.org/articles/anaplastic-thyroid-carcinoma?lang=us | PGY-1 resident, junior, senior, attending | 16 |

Abbreviation: rMETRIQ, revised Medical Education Translational Resources: Impact and Quality.

reviewers screened the entries for relevance to the topics as well as to EM. We excluded any remaining journal articles, audio-only podcasts, image only, non-English, paid content, nonfunctioning resources, or re-tagged posts. A remaining count totaled 1181 resources. A secondary screen and full-text review of these resources yielded 756 final resources that were assessed for quality with the rMETRIQ tool. A total of 121 resources were deemed high quality with an rMETRIQ score ≥ 16 (see Table 1 for a list of all high-quality posts).

Topic coverage

All topics and subtopics listed in MCPem were covered at least once. There was an uneven distribution of FOAM posts for endocrine, metabolic, and nutritional disorders. Nearly half of all resources were categorized under fluid and electrolyte disturbances. The four most represented topics were fluid and electrolytes (42%), followed by glucose metabolism at (16%), then acid-base disturbances (11%), and nutritional disorders (11%). The three most underrepresented topics were parathyroid disease (2%), followed by pituitary disorders (3%) and endocrine tumors (3%). Among subtopics, potassium disorders was the most highly represented, constituting 37% within its own topic category and 15% of all posts (see Figure S1). Table 2 displays the distribution of all topics and subtopics.

Types of posts

For each of the 756 resources reviewed, each reviewer determined appropriate uses yielding a total of 1964 assigned uses, with an average of 2.6 assigned uses per resource. In descending order of frequency, resources were determined to be appropriate for personalized reading (98%), postshift reading assignment (79%), on-shift review of best evidence on a topic or just-in-time resources (52%), flipped classroom (17%), adjunct to journal club (9%), and individualized interactive instruction credit (7%).

Target audience

Of the 756 posts reviewed, each was reported to be appropriate for at least one type of learner: preclerkship (i.e., first- or second-year medical student), clerkship (i.e., third- or fourth-year medical student), PGY-1 resident, junior resident, senior resident, and/or attending physician. Authors of the posts specified target audience levels in 167 posts (22% of all posts). Reviewers assigned an appropriate target audience level for the remaining posts. A total of eight posts had only one designated target audience level: seven for attending physicians only and one for preclerkship. All other resources were deemed appropriate for multiple levels (mean = 3.8 levels). In order of frequency, the most common audience was junior resident (91%), PGY-1 resident (88%), senior

TABLE 2 Endocrine, metabolic, and nutritional disorders SOAR subtopic analysis

| Subtopic | Total posts | High-quality posts rMETRIQ ≥ 16 |
|--|-------------|---|
| Potassium | 117 (15%) | 20 (17%) |
| Hypovolemia | 51 (7%) | 16 (13%) |
| Diabetic ketoacidosis | 67 (9%) | 14 (12%) |
| Sodium | 71 (9%) | 7 (6%) |
| Pituitary Disorders/ panhypopituitarism | 24 (3%) | 7 (6%) |
| Hyperthyroid | 34 (4%) | 6 (5%) |
| Metabolic acidosis | 40 (5%) | 5 (4%) |
| Wernicke-Korsakoff | 18 (2%) | 5 (4%) |
| Calcium | 42 (6%) | 4 (3%) |
| Other tumors of endocrine glands | 5 (1%) | 4 (3%) |
| Corticoadrenal insufficiency | 28 (4%) | 3 (2%) |
| Parathyroid disease | 17 (2%) | 3 (2%) |
| Adrenal tumor | 12 (2%) | 3 (2%) |
| Hypothyroid | 12 (2%) | 3 (2%) |
| Hyperosmolar hyperglycemic state | 8 (1%) | 3 (2%) |
| Insulin pump | 3 (0.4%) | 3 (2%) |
| Vitamin deficiencies | 35 (5%) | 2 (2%) |
| Nutritional disorders | 24 (3%) | 2 (2%) |
| Magnesium | 17 (2%) | 2 (2%) |
| Acid-base, mixed | 30 (4%) | 2 (2%) |
| Pituitary tumor | 5 (1%) | 2 (2%) |
| Thyroid tumor | 2 (0.3%) | 2 (2%) |
| Cushing's syndrome | 3 (0.4%) | 1 (1%) |
| Respiratory acidosis | 5 (0.7%) | 1 (1%) |
| Hypoglycemia | 34 (4%) | 1 (1%) |
| Metabolic alkalosis | 6 (0.8%) | 0 (0%) |
| Respiratory alkalosis | 4 (0.5%) | 0 (0%) |
| Fluid overload | 3 (0.4%) | 0 (0%) |
| Phosphorus | 17 (2%) | 0 (0%) |
| Hyperglycemia | 12 (2%) | 0 (0%) |
| Malabsorption | 1 (0.1%) | 0 (0%) |
| Malnutrition | 5 (0.7%) | 0 (0%) |
| Thyroiditis | 4 (0.5%) | 0 (0%) |
| Total | 756 | 121 |

Abbreviations: rMETRIQ, revised Medical Education Translational Resources: Impact and Quality; SOAR, systematic online academic resource.

resident (81%), clerk (64%), attending (50%), and preclerkship (9%). The distribution among high-quality resources shifted relatively to an audience with a higher level of training: senior resident (97%), junior resident (95%), PGY-1 resident (87%), attending (75%), clerk (45%), and preclerkship (0%). Among high-quality resources, Figure 2 visually describes the distribution of covered subtopics, appropriate level, and the volume of posts.

Quality assessment

The rMETRIQ scores ranged from 1 to 19 (mean \pm SD = 11.4 \pm 3.7). Overall, 121 (16.0%) posts met our high-quality cutoff score of ≥ 16 (Figure 3). Among these high-quality posts, the subtopics with the highest numbers of posts were potassium disorders (16%), hypovolemia (13%), and diabetic ketoacidosis (12%; Table 2). Notably, although potassium had nearly twice the number of resources compared to most other topics, only 17% of its resources were deemed high quality compared to hypovolemia at 31%. Similarly, only 10% (7/71) of posts about sodium disorders were deemed high quality. Table 2 shows the distribution of the subtopics and their high-quality posts.

DISCUSSION

This study is a continuation of a series to systematically curate FOAM resources by topic and identify high-quality resources for educators, trainees, and other content creators and users. The challenges of searching and reviewing online literature are not new.²¹ Frequently, trainees report use of FOAM at the point of care, making it impractical to assess the quality of FOAM in a real-time clinical setting.⁵ Gestalt assessment is unreliable, especially in more junior trainees.^{10,19,22}

Building on other initiatives like the Academic Life in Emergency Medicine (ALIEM) Approved Instructional Resources (AIR) series, we developed a comprehensive search strategy using two well-regarded FOAM databases, the SMi and FOAM Search. In particular, websites ranked in the SMi have been shown to correlate with overall quality.^{19,22} Thereafter, all resources underwent an iterative screening process followed by a structured quality assessment with the rMETRIQ scoring tool. The rMETRIQ was a rigorously developed scoring tool that was recently refined based on user feedback.²³ In the prior SOAR entry, because of resource limitations, only a single reviewer scored resources. In an improvement, for this second entry, four reviewers scored resources and demonstrated strong inter-rater reliability, verifying that scores are likely consistent.

Topic coverage

As expected, given that this MCPPEM category encompasses three somewhat distinct topics—endocrine, metabolic, and nutritional disorders—the resources identified were quite heterogeneous. A total of 33 subtopics were assessed. Every subtopic was covered by at least one post. However, not all subtopics had an identified high-quality resource, e.g., metabolic alkalosis, respiratory alkalosis, thyroiditis, malnutrition, malabsorption, phosphorus, fluid overload, and hyperglycemia. Resources covering mixed acid-base disorders provide some review of both metabolic alkalosis and respiratory alkalosis. Similarly, hyperglycemia is covered in the context of the subtopics of diabetic ketoacidosis (DKA) and hyperosmolar

| Topic | Subtopic | Clerk | PGY1 resident | Junior | Senior | Attending |
|----------------------------|--|-------|---------------|--------|--------|-----------|
| Acid-base Disturbances | Metabolic Acidosis (n=5) | | | | | |
| Acid-base Disturbances | Metabolic Alkalosis | | | | | |
| Acid-base Disturbances | Respiratory Acidosis (n=1) | | | | | |
| Acid-base Disturbances | Respiratory Alkalosis | | | | | |
| Acid-base Disturbances | Acid-Base, Mixed (n=2) | | | | | |
| Adrenal Disease | Corticoadrenal Insufficiency (n=3) | | | | | |
| Adrenal Disease | Cushing's Syndrome (n=1) | | | | | |
| Fluid and Electrolytes | Calcium (n=4) | | | | | |
| Fluid and Electrolytes | Fluid Overload | | | | | |
| Fluid and Electrolytes | Hypovolemia (n=16) | | | | | |
| Fluid and Electrolytes | Potassium (n=20) | | | | | |
| Fluid and Electrolytes | Sodium (n=7) | | | | | |
| Fluid and Electrolytes | Magnesium (n=2) | | | | | |
| Fluid and Electrolytes | Phosphorus | | | | | |
| Glucose Metabolism | Hyperglycemia | | | | | |
| Glucose Metabolism | Diabetic Ketoacidosis (n=14) | | | | | |
| Glucose Metabolism | Hyperosmolar Hyperglycemic State (n=3) | | | | | |
| Glucose Metabolism | Hypoglycemia (n=1) | | | | | |
| Glucose Metabolism | Insulin Pump (n=3) | | | | | |
| Nutritional Disorders | Nutritional Disorders (n=2) | | | | | |
| Nutritional Disorders | Vitamin Deficiencies (n=2) | | | | | |
| Nutritional Disorders | Wernicke-Korsakoff (n=5) | | | | | |
| Nutritional Disorders | Malabsorption | | | | | |
| Nutritional Disorders | Malnutrition | | | | | |
| Parathyroid Disease | Parathyroid Disease (n=3) | | | | | |
| Pituitary Disorders | Pituitary Disorders / Panhypopituitarism (n=7) | | | | | |
| Thyroid Disorders | Hyperthyroidism (n=6) | | | | | |
| Thyroid Disorders | Hypothyroidism (n=3) | | | | | |
| Thyroid Disorders | Thyroiditis | | | | | |
| Tumors of Endocrine Glands | Other Tumors (n=4) | | | | | |
| Tumors of Endocrine Glands | Adrenal Tumor (n=3) | | | | | |
| Tumors of Endocrine Glands | Pituitary Tumor (n=2) | | | | | |
| Tumors of Endocrine Glands | Thyroid Tumor (n=2) | | | | | |

Legend

| |
|-----------------|
| Legend |
| Number of Posts |
| 0 |
| 1 |
| 2-3 |
| 4-5 |
| 6-7 |
| 8-9 |
| 10-11 |
| >11 |

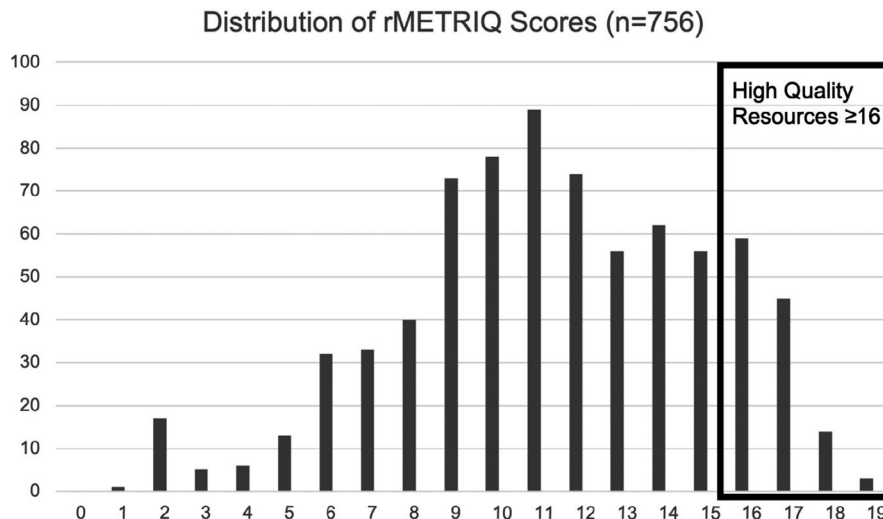
FIGURE 2 High-quality posts (rMETRIQ ≥ 16) and target audience level by subtopic. rMETRIQ, revised Medical Education Translational Resources: Impact and Quality

hyperglycemic state. Posts related to respiratory alkalosis in salicylate poisoning were not included in this review because toxicology is its own MCPDM category. Likewise, posts related to fluid overload in the context of heart failure or renal disease were also excluded.

Among 121 high-quality posts across 25 subtopics, potassium disorders were most frequently covered (20 resources), followed by hypovolemia and DKA. Most subtopics (18/33) had no more than two

high-quality posts. This is consistent with the findings of a review of all FOAM topics by Stuntz and Clontz,¹³ which found markedly uneven coverage of topics, further supported by a recent review of 2020 FOAM content by Grock et al.¹² Topic coverage seems to favor common critical and/or emergent conditions like DKA and hyperkalemia. Overall, these findings suggest a possible need for further in-depth and high-quality coverage of certain subtopics which are considered essential by ABEM standards.

FIGURE 3 Distribution of total rMETRIQ scores for all 756 resources reviewed. rMETRIQ scores ≥ 16 have been demarcated as high quality. rMETRIQ, revised Medical Education Translational Resources: Impact and Quality



Use of resources

Overall, few resources were deemed by our team suitable for individualized interactive credit (7%) or an adjunct to journal club (7%). Most often resources were recommended for personalized reading (97%), followed by postshift reading assignments (79%). Just over half of all resources were deemed appropriate for on-shift review or just-in-time resources (52%). This is consistent with literature describing trainees reporting frequent use of FOAM at the point of care (POC). Wiki-based collaborative websites like Radiopaedia and WikEM have been previously reported to be commonly used FOAM resources at the POC.²⁴⁻²⁶ Due to the time constraints of on-shift review, favored POC resources are more likely to be succinct and well structured to increase readability. Surveyed users (70.4%) often found information faster on WikEM compared to other sites.²⁴ In our review, 80% (115/145) resources from Radiopaedia and WikEM were deemed appropriate for on-shift review.

Quality of resources

While we found an abundance of resources within this selected topic, only 16% (121/756) met our high-quality standard. The reasons for heterogeneity of quality as measured by the rMETRIQ score were variable. Of note, for all resources including high-quality resources, the two rMETRIQ questions scored lowest on average were Q6 (peer review) and Q7 (postpublication commentary; see Table S3). Resources not ranked high quality were more likely to score lower for Q4 (references and citations). Author attributions were at times difficult to discern among many resources. Some sites (e.g., wikis) attributed their work to multiple authors with limited biographical and/or disclosures raising the potential for conflicts of interest and inadequate clarification of training level. For many sites, disclosure information was seldom explicitly presented in the post itself, but available only by navigating other subpages. Additionally, biographical information may be located in a separate templated section of the post or through another link without a time stamp. It was therefore unclear

whether the biographical information reflected the rank and title of the author on the date of publication or the current status of the author. No rank or academic affiliation was apparent in 30% (232/756) of all resources. When an affiliation was noted, the academic rank of the author was not apparent in 9% (49/525) of posts.

FOAM sources

Similar to the prior SOAR series topic, genitourinary disorders, we found a high level of contribution from non-EM specialties contributing to an EM-relevant FOAM space, notably Radiopaedia (Table S4). The highest number of resources was found on Life in the Fast Lane (15%) and Radiopaedia (12%). The sites with the most high-quality posts were Radiopaedia (24%), EMCrit Blog (22%), EMdocs (14%), and RebelEM (11%). Overall, this series' FOAM authors represented a broad range of specialties including but not limited to EM, toxicology, pharmacy, emergency medical services, internal medicine, pediatrics, critical care, orthopedics, nephrology, and radiology. However, within formal EM residency curricula, the frequency of and need for didactic teaching provided by non-EM specialists are not clear. Rather, ABEM's MCPPEM describes topic categories deemed core content for the practice of EM. Trainees may not receive in-depth coverage of these specialty topics in their non-EM clinical rotations. Curating FOAM from non-EM specialists and incorporating curated high-quality resources into asynchronous learning opportunities may fill in core knowledge gaps without a substantial additional resource investment from EM training programs.

LIMITATIONS

There were a number of limitations to our protocol and study. First and foremost, the COVID-19 pandemic resulted in a significant delay between the initial search results and the availability of the authors to review all resources. Within that time frame, there may have been newly published resources and some sites were no longer accessible,

i.e., broken links. Second, for pragmatic reasons we excluded audio and video only entries from our review. However, podcast show notes sufficient to stand on their own were again included in our search strategy and included for review. Next, the MCPM was updated in 2019, after this project began, with the following relevant changes, deletion of “type I [diabetes],” “type II [diabetes],” and “insulin pump malfunction” as subtopics and the addition of “thyroid storm” as a separate subtopic from “hyperthyroidism.”^{16,17}

We did not directly assess the accuracy of content included in posts. Assessing accuracy of online educational resources is difficult and no criterion standard exists. The rMETRIQ score does not directly ask for a quality appraisal of the blog post, although the rMETRIQ score includes elements that are likely to correlate with accuracy (e.g., peer review processes, postpublication commentary, references, conflict of interest) and the related METRIQ-8 score is shown to correlate with expert quality assessments.^{10,27,28} Next, although we did compute inter-rater reliability for the rMETRIQ scores, we did not do so for categorization of target audience or usage suitability. Each rater made these determinations independently.

Finally, this is the second iteration of the SOAR process and validity data for this search methodology are yet to be obtained. While a broad search is ideal to prevent missing posts, increasing the search to additional resources would add significant time and resource requirements. As such, the authors concluded that the above search of SMI-50 and FOAM Search was sufficiently broad while still feasible. It is possible that additional posts were missed by our search strategy.

CONCLUSION

In this second review of the systematic online academic resource series, we present a systematic approach to reviewing online educational resources for the topic endocrine, metabolic, and nutritional disorders and discovered that less than 20% of free open-access medical education met our high-quality cutoff. Topic coverage was broad, but with variable quality and disproportionate coverage. Approximately half of subtopics had only three or fewer high-quality posts. We hope that educators and learners can use this information to find relevant educational resources and that free open-access medical education content creators can use this information to help identify topics to produce new content.

CONFLICT OF INTEREST

NST receives salary support from the AMA for his role as digital media editor at *JAMA Network Open*. The other authors have no potential conflicts to disclose.

AUTHOR CONTRIBUTIONS

Jonie J. Hsiao: drafting of the manuscript, study supervision, and analysis and interpretation of the data. Ryan Pedigo: analysis and interpretation of the data. Shirley W. Bae: acquisition of the data. JooYeon Jung: acquisition of the data. Lisa Zhao: analysis and

interpretation of the data. Nathan S. Trueger: analysis and interpretation of the data. Teresa M. Chan: statistical expertise and analysis and interpretation of the data. Andrew Grock: study concept and design, study supervision, analysis and interpretation of the data, and critical revision of the manuscript for important intellectual content.

ORCID

Jonie J. Hsiao  <https://orcid.org/0000-0003-2696-2630>

Teresa M. Chan  <https://orcid.org/0000-0001-6104-462X>

Andrew Grock  <https://orcid.org/0000-0002-3133-1529>

REFERENCES

1. Reiter DA, Lakoff DJ, Trueger NS, Shah KH. Individual interactive instruction: an innovative enhancement to resident education. *Ann Emerg Med*. 2013;61:110-113.
2. Scott KR, Hsu CH, Johnson NJ, Mamtani M, Conlon LW, DeRoos FJ. Integration of social media in emergency medicine residency curriculum. *Ann Emerg Med*. 2014;64:396-404.
3. Purdy E, Thoma B, Bednarczyk J, Migneault D, Sherbino J. The use of free online educational resources by Canadian emergency medicine residents and program directors. *CJEM*. 2015;17:101-106.
4. Mallin M, Schlein S, Doctor S, Stroud S, Dawson M, Fix M. A survey of the current utilization of asynchronous education among emergency medicine residents in the United States. *Acad Med*. 2014;89:598-601.
5. Patocka C, Lin M, Voros J, Chan T. Point-of-care resource use in the emergency department: a developmental model. *AEM Educ Train*. 2018;2:221-228.
6. Lin M, Joshi N, Grock A, et al. Approved instructional resources series: a national initiative to identify quality emergency medicine blog and podcast content for resident education. *J Grad Med Educ*. 2016;8:219-225.
7. Khadpe J, Willis J, Silverberg MA, Grock A, Smith T. Integration of a blog into an emergency medicine residency curriculum. *West J Emerg Med*. 2015;16:936-937.
8. Schriger DL. Does everything need to be “scientific”? *Ann Emerg Med*. 2016;68:738-739.
9. Krishnan K, Thoma B, Trueger NS, Lin M, Chan TM. Gestalt assessment of online educational resources may not be sufficiently reliable and consistent. *Perspect Med Educ*. 2017;6:91-98.
10. Thoma B, Sebok-Syer SS, Krishnan K, et al. Individual gestalt is unreliable for the evaluation of quality in medical education blogs: a METRIQ study. *Ann Emerg Med*. 2017;70:394-401.
11. Cadogan M, Thoma B, Chan TM, Lin M. Free Open Access Meducation (FOAM): the rise of emergency medicine and critical care blogs and podcasts (2002–2013). *Emerg Med J*. 2014;31:e76-e77.
12. Grock A, Chan W, Aluisio AR, Alsup C, Huang D, Joshi N. Holes in the FOAM: an analysis of curricular comprehensiveness in online educational resources. *AEM Educ Train*. 2021;5:1-8.
13. Stuntz R, Clontz R. An evaluation of emergency medicine core content covered by free open access medical education resources. *Ann Emerg Med*. 2016;67:649-53.e2.
14. Grock A, Bhalerao A, Thoma B, Wescott AB, Trueger NS. Systematic online academic resource (SOAR) review: renal and genitourinary. *AEM Educ Train*. 2019;3:375-386.
15. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: the PRISMA statement. *Ann Intern Med*. 2009;151:264-269.
16. Counselman FL, Babu K, Edens MA, et al. The 2016 Model of the Clinical Practice of Emergency Medicine. *J Emerg Med*. 2017;52:846-849.

17. Beeson MS, Ankel F, Bhat R, et al. The 2019 Model of the Clinical Practice of Emergency Medicine. *J Emerg Med*. 2020;59:96-120.
18. Raine T. GoogleFOAM|The FOAM Search Engine. Accessed on July 20, 2021. <http://googlefoam.com/#gsc.tab=0>
19. Thoma B, Chan TM, Kapur P, et al. The social media index as an indicator of quality for emergency medicine blogs: a METRIQ study. *Ann Emerg Med*. 2018;72:696-702.
20. Thoma B, Ma M. Social Media Index (SMi). ALiEM. Accessed July 6, 2021 <https://www.aliem.com/social-media-index/>
21. Lo A, Shappell E, Rosenberg H, et al. Four strategies to find, evaluate, and engage with online resources in emergency medicine. *CJEM*. 2018;20:293-299.
22. Thoma B, Sanders JL, Lin M, Paterson QS, Steeg J, Chan TM. The social media index: measuring the impact of emergency medicine and critical care websites. *West J Emerg Med*. 2015;16:242-249.
23. Colmers-Gray IN, Krishnan K, Chan TM, et al. The revised METRIQ score: a quality evaluation tool for online educational resources. *AEM Educ Train*. 2019;3:387-392.
24. Donaldson RI, Ostermayer DG, Banuelos R, Singh M. Development and usage of wiki-based software for point-of-care emergency medical information. *J Am Med Inform Assoc*. 2016;23:1174-1179.
25. Dixon A, Fitzgerald RT, Gaillard F. Letter by Dixon et al. regarding article, "A randomized trial of social media from *Circulation*". *Circulation*. 2015;131:e393.
26. Hoang JK, McCall J, Dixon AF, Fitzgerald RT, Gaillard F. Using social media to share your radiology research: how effective is a blog post? *J Am Coll Radiol*. 2015;12:760-765.
27. Chan T, Thoma B, Krishnan K, et al. Derivation of two critical appraisal scores for trainees to evaluate online educational resources: a METRIQ study. *West J Emerg Med*. 2016;17:574-584.
28. Thoma B, Sebok-Syer SS, Colmers-Gray I, et al. Quality evaluation scores are no more reliable than gestalt in evaluating the quality of emergency medicine blogs: a METRIQ study. *Teach Learn Med*. 2018;30:294-302.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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