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Title

A 3D Printed Model for Simulated Arthrocentesis Training

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Table 1. Observed themes among tweets of influential emergency physicians.

Code	Definition	Exemplary Tweet
Resource summary	A mostly-sterile accounting of the main points of something - including the title of a linked to resource or the summary of a case.	The problem with calf clots? Everyone handles them differently...and @emergencypdx explains why http://blog.ercast.org/the-problem-with-calf-clots/ ... #FOAMed
Rapport Building	Explicitly pursuing relational connection, especially harmonious or sympathetic relation.	@JohnPurakal @mksheehy @UICBrownCoat Really great idea and stellar start. Can't wait for the next video! Keep up the good work
Illumination	A statement that adds substantially to, clarifies, explains, reveals, or enlightens - including their interpretation of data, conclusions, and results. Often in the middle of a conversation.	@FireEMSChief There was probably a little leeway between 30 and 60. Also the breathalysers were reasonably inaccurate for this sort of thing
Opinion	The substantive idea that a person has about something or someone, which is based mainly on their feelings, beliefs, or personal views.	agree w @ketaminh bad hypotension with verapamil I have good results with dilt @MDaware @RAGEpodcast @stemlyns
Humor	Attempting to offer a funny or comical slant to a topic in discussion	As everyone leaves for #smaccus, ketamine use plummets in EDs around the world...
Reflection	Meditation or serious thought about one's character, actions, professional practice, and motives with purpose of understanding self or situation.	Sitting amongst the debris of Monday, picking up pieces of rubble & turning them over. My hands are grubby with start of week dust & decay.
Networking	Interacting to meet professionally, exchange information, or develop contacts - especially to further one's career.	.@PEMEMS @artangelo I'd be happy to look at what you sent, but I meant he should DM me too. I'd be happy to send him resources.

49 You've Got Mail: Efficacy of an Electronic Mail System as an Educational Strategy in Residency Training

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Background: Computer-assisted instruction (CAI) has been used in many areas of medical education to improve teaching and compares favorably with lectures or reading. Our emergency medicine (EM) residency program has been sending a daily emergency medicine-based question electronically to all learners since July 2010.

Objectives: To assess a computer-based teaching program utilizing multiple-choice questions sent daily to EM learners. Our study hypothesis was that daily CAI throughout residency training would lead to higher scores on qualifying examinations.

Methods: A prospective, self-administered online survey sent to residents, graduates and mid-level providers affiliated with one EM residency program. The survey instrument had 13 open-ended and closed questions to assess the level of training, clinical experience, recommendations, satisfaction with electronic mail system and quality (content) of the CAI. A secondary outcome measure was the annual composite scores on resident inservice exams and written board exams for the past 7 years. To assess the statistical significance of trends in exam scores, we used weighted χ^2 test for trend.

Results: Sixty-six respondents completed the survey (50% response rate), and included board-certified physicians (59%), residents (26%), mid-level providers (9%), and board-eligible physicians (6%). Respondents have been receiving daily CAI for approximately 4 years, and that they read the CAI daily (54%) or weekly (43%). The majority (97%) felt the content of the CAI was "of high quality and relevant to my practice" and 98% believed the content would "help in preparation for the national written exams." Overall, 98% replied that the content was balanced across all of the core topics in Emergency Medicine. The main reason for reading the CAI was to keep current with the medical literature (60%), followed by preparing for written tests (29%), and "just for fun" (11%). Despite the overwhelming acceptance of CAI by respondents, the secondary outcome measures (annual composite scores on resident inservice exams and written board exams) showed no significant long-term impact over the last seven years.

Conclusions: CAI using a daily question format was well received by clinicians in our residency program. Surprisingly, the majority of respondents used the questions to keep current with medical literature rather than to prepare for written qualifying examinations.

Innovations Abstracts

1 A 3D Printed Model for Simulated Arthrocentesis Training

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Background: Arthrocentesis is a commonly performed emergency department procedure. Improper performance

can lead to complications including patient discomfort and damage to surrounding tissues. Current low cost models lack the anatomical fidelity required to replicate the procedure. Cadavers are costly and the number of procedures that can be performed on each is limited. High fidelity simulation models are expensive, making them less suitable for repeated training by inexperienced learners. A low cost, reusable, high fidelity model is conducive to repeated simulation of this important procedure, allowing the learner to become familiar with proper technique prior to performing arthrocentesis on a patient.

Educational Objectives: The objective was to design an anatomically accurate, low cost, reusable model, providing the learner an opportunity to learn the procedure in a low-risk environment. This method can serve as an excellent tool for developing learner proficiency while also maximizing patient safety.

Curricular Design: A de-identified CT scan of a knee was converted to a printable format using specialized 3D printing software. This image was then sent to an outside facility for print into a durable plastic model of the bony structures. The plastic pieces were then attached using rubber compression bands to replicate ligaments, tendons, and a joint capsule. A small hose was placed into the joint capsule to allow for refilling of the joint space, and a watertight seal was created around the joint capsule using epoxy. This structure was then encased in ballistics gel to simulate soft tissues while allowing for palpable underlying anatomical landmarks.

Impact/Effectiveness: The 3D printed arthrocentesis simulator provides a cost effective, realistic model. Given its anatomical fidelity, this model allows for parapatellar, suprapatellar, and infrapatellar approaches. The total cost of the initial model was $215, with an estimated cost of $35 for each subsequent "rebuild". Each "build" was able to be punctured with up to 50 needle sticks by learners of multiple experience levels during our trial. This model also highlights the potential of 3D printing for use in other procedural simulations.
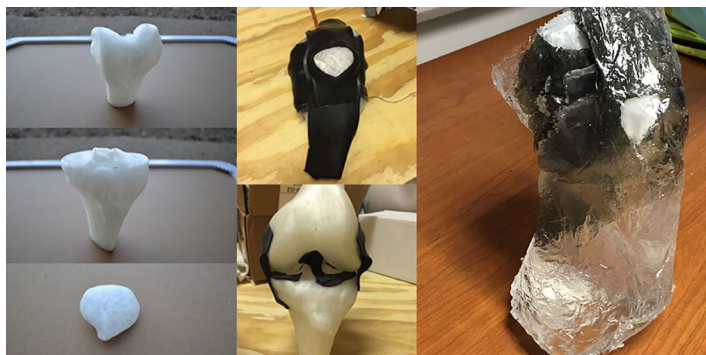
2 A Low Fidelity Model for Teaching Lateral Canthotomy Procedure

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Background: Lateral canthotomies are infrequent procedures performed on actual patients but is listed as a procedure by the EM Model of Clinical Practice that EM physicians must be able to perform. There are an edible model, a porcine model, a human cadaver model, and a ping pong ball and athletic tape model described but either they are not real-life or too expensive. To our knowledge no high-fidelity models of eyes on which lateral canthotomies can be performed.

Educational Objectives: The objective was to develop a life-like task trainer for hands on practice performing lateral canthotomies and provide an inexpensive simulator which was reusable

Curricular Design: The model was created using a ping pong ball as the eye. Eye sockets were formed by hallowing out a foam manikin head. A rubber band was placed inside the eye socket with the ping pong ball securing it into place. The rubber band was attached with straight pin laterally to the eye socket simulating the superior and inferior crura of the lateral canthal tendon. The area was covered with 2 layers of foam tape, simulating fascial layer and facial skin. The procedure was demonstrated by the faculty instructor and then each resident performed a lateral canthotomy with new rubber bands being inserted until all residents had practiced the procedure.

The materials used to create 1 training model which would allow for 4 individual cantholyses are readily available and inexpensive to purchase. Costs included 12 ping pong balls = $5, 350 dressmaker pins = $ 2-3 dollars, 6 foam mannequin heads $ 17, 200 Rubber bands = $7, foam tape roll = $9, suture kit = $8. Six trainers with 12 lateral canthal tendons = $50 dollars.

Impact/Effectiveness: Thirty-three healthcare providers, 9 PGY1 transitional (TYR) residents, 2 physician assistants, 10 PGY1 EM, 5 PGY2 EM, and 6 medical students (MS) practiced the procedure and completed an assessment of the model employed. A five-point Likert scale was used to rate knowledge and comfort with the procedure before and after practice. The mean knowledge assessment increased from 2.69 to 3.69. The mean comfort level assessment increased from 2.34 to 3.5. The rating as life-like was 3.09. The model is inexpensive, easily rebuilt and highly life-like that allows multiple learners to practice a procedure that is infrequently performed.