

Competency Based Learning of Pediatric Musculoskeletal Radiographs Using ImageSim

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Abstract

Background: Competency in pediatric musculoskeletal (p-MSK) radiograph interpretation amongst emergency medicine residents is sub-optimal. We have developed ImageSim, a validated education system that uses an "assessment for learning" cognitive simulation platform. The p-MSK course includes seven body regions and cases are practiced using deliberate practice with feedback and continuous assessment (<https://imagesim.com/course-information/demo/>). Competency is achieved when a participant reaches a pre-set performance benchmark. However, before this can be launched as a residency learning tool standard to help bridge the existing knowledge gap, the education experience for residents should be characterized.

Research Questions: In participating residents, what was the median number of cases required to achieve competency per module and what percent of residents achieved competency in all seven modules? Further, what knowledge gains did the residents experience from baseline to competency and how long did it take them to complete the cases?

Methods: Thirty-five pediatric emergency medicine residents participated for 12 months in this cross-sectional study. Participants did cases until they reached competency, defined as at least 80% accuracy, sensitivity and specificity.

Results: Overall, the median number of cases to competency was 118 (min 56, max 756). The median number of cases to competency per specific module was as follows: skull 67 (56, 129), shoulder 60 (55, 172), elbow 70 (66, 214), forearm-hand 56 (56, 121), pelvis-femur 68 (57, 121), knee-tib/fib 93 (72, 213), and ankle-foot 410 (128, 756), $p < 0.001$. Eight-five percent of residents completed competency in all seven modules. The mean increase in accuracy from baseline to competency was 13% [95% CI 10, 15]. The mean time on case 35.8 (SD 0.45) seconds.

Conclusions: Competency was achieved on average in about 120 cases or one hour per module, except for the ankle case-set. Accuracy increased to a competency standard for most participants. Future research could explore the effectiveness of this learning intervention on patient outcomes.

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COMPETENCY BASED LEARNING OF PEDIATRIC MUSCULOSKELETAL RADIOGRAPHS

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BACKGROUND

- Pediatric emergency physicians are tasked with interpreting radiographs in real time without expert feedback
- Diagnostic errors are common – especially for pediatric musculoskeletal films where the error rate is about 15%
- In alignment with competency by design, an on-line learning system was implemented in pediatric emergency fellowships
- Studies are required to characterize the learning experience for post-graduate trainees

OBJECTIVES

- To determine the learning effectiveness and efficiency of a validated on-line pediatric musculoskeletal radiograph interpretation system using a performance-based competency endpoint
- Competency was achieved once a participant scored at least 80% in accuracy, specificity and sensitivity

METHODS

Study Design

- Prospective cohort over a 12 month study period

Study Population

- Convenience sample – 9 participating pediatric emergency fellowship programs in Canada and USA

Outcomes

- Median number of cases to competency
- Proportion of modules completed to competency
- Change in accuracy from baseline to competency
- Mean time on case
- Learning curves

Educational Intervention

- www.imagesim.com
- 7 modules, 200-400 images
- Design includes:
 - cognitive simulation
 - deliberate practice
 - performance-based competency

RESULTS

Participants

- 37 pediatric emergency medicine fellows

Table 1: Overall Participant Performance

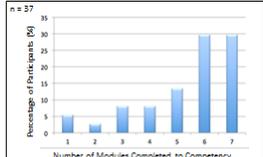
Cases to Competency Median (min, max)	Change in Accuracy Percent (95% CI)	Time on Case Median seconds (min, max)
76 (54, 756)	13.5 (12.1, 14.8)	34.1 (7.6, 89.5)

Table 2: Per Module Performance To Competency

Module	Percent Participants Competency Achieved n/N (%) *	Cases to Competency Median Number (min, max) *	Median Time On Case Seconds (min, max) **
Skull (200 cases)	25/28 (89.2)	82 (56, 429)	36.3 (15.4, 88.6)
Shoulder (300 cases)	30/31 (96.7)	75 (54, 119)	32.3 (13.4, 58.1)
Elbow (300 cases)	32/34 (94.1)	69 (55, 285)	28.9 (8.0, 63.2)
Forearm/Hand (300 cases)	33/34 (97.1)	56 (56, 132)	37.4 (10.8, 77.9)
Pelvis/Femur (300 cases)	30/33 (90.9)	72 (57, 203)	36.0 (10.4, 80.0)
Knee/ Tib/Fib (300 cases)	26/34 (76.5)	87.5 (72, 213)	26.9 (7.6, 79.5)
Ankle/Foot (400 cases)	11/34 (32.4)	366 (71, 756)	41.0 (19.8, 89.5)

* Comparison between seven modules, p<0.0001
** Comparison between seven modules, p=0.002

Figure 3: Modules Completed by Participants



RESULTS

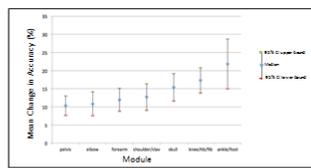


Figure 4: Mean Change in Accuracy-initial to Competency

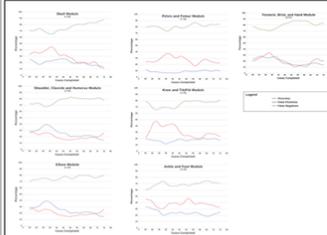


Figure 5: Participant Learning Curves for Each Module

CONCLUSIONS

- Large variation across different modules in number of cases required to achieve competency
- There was a significant change in accuracy upon completion of modules to competency

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