Supplemental Digital Appendix 1

Search Strategy

We conducted the search in two stages. For the first stage, we’ve listed below the Ovid MEDLINE and EMBASE search process. The searches for Cochrane Library, and ERIC are not shown and used terms similar to the two below (last update: December 13, 2013). The second stage of our search of MEDLINE and EMBASE is also reported below (last update: April 13, 2015).

Search 1: Ovid MEDLINE
1. Anesthesiology/
2. Clinical Clerkship/
3. Emergency Medicine/
4. General Practitioners/
5. General Surgery/
6. Gastroenterology/
7. Hospitalists/
8. Internal Medicine/
9. Neurology/
10. Occupational Health Physicians/
11. Orthopedics/
12. Physicians, Family/
13. Physicians, Primary Care/
14. Pulmonary Medicine/
15. Radiology, Interventional/
16. Rheumatology/
17. Students, Medical/
18. Schools, Medical/
21. specialist?.tw.
22. sub-specialist?.tw.
23. subspecialist?.tw.
24. an?esthesiolog$.tw.
25. clerkship?.tw.
27. (family adj physician?).tw.
28. (general adj practitioner?).tw.
29. gastroenterolog$.tw.
30. hospitalist?.tw.
32. internship?.tw.
33. intern.tw.
34. interns.tw.
35. internist$.tw.
36. (internal adj medicine).tw.
37. (medical adj student?).tw.
Supplemental digital content for Brydges R, Stroud L, Wong BM, Holmboe ES, Imrie K, Hatala R.
Core competencies or a competent core? A scoping review and realist synthesis of
invasive bedside procedures training in internal medicine. Acad Med.

38. (medical adj practitioner?).tw.
39. (medical adj trainee?).tw.
40. neurology.tw.
41. neurologist.tw.
42. neurologists.tw.
43. "primary care physician?".tw.
44. pulmonolog$.tw.
45. respirolog$.tw.
46. rheumatolog$.tw.
47. resident.tw.
48. residents.tw.
49. residency.tw.
50. residencies.tw.
51. fellow*.tw.
52. (clinic* adj1 fellow*).tw.
53. or/1-52
54. exp Education, Medical/
55. exp Curriculum/
56. Computer Simulation/
57. Computer-Assisted Instruction/
58. Credentialing/
59. exp Certification/
60. Games, Experimental/
61. Educational Measurement/
62. Learning/
63. Licensure, Medical/
64. Models, Anatomic/
65. Patient Simulation/
66. Programmed Instruction as Topic/
67. Role Playing/
68. Self-Evaluation Programs/
69. Self-Assessment/
70. Teaching/
71. (augmented adj reality).tw.
72. (anatomic adj model?).tw.
73. (bench$ adj train$).tw.
74. (box adj trainer?).tw.
75. curriculum.tw.
76. "computer assist$ instruct$".tw.
77. curricula.tw.
78. credential?ing.tw.
79. certification.tw.
80. ed.fs.
81. educat$.tw.
82. e-learning.tw.
83. elearning.tw.
84. (enhanced adj reality).tw.

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85. (experiment$ adj game$).tw.
86. learn$.tw.
87. licensure.tw.
88. manikin?.tw.
89. mannequin?.tw.
90. moulage?.tw.
91. OSCE?.tw.
92. "objective structured clinical exam"$.tw.
93. (professional adj development).tw.
94. (practice adj scenario?).tw.
95. (predicted adj performance).tw.
96. (program$ adj instruct$).tw.
97. (role adj play$).tw.
98. recertification.tw.
99. re-certification.tw.
100. (reflective and practice).tw.
102. (self adj (direct$ or regulat$)).tw.
103. (self adj assess$).tw.
104. (self adj evaluat$).tw.
105. simulat$.tw.
107. teach$.tw.
108. train$.tw.
110. session*.tw.
111. workshop*.tw.
112. seminar?.tw.
113. forum?.tw.
114. symposi????.tw.
115. roundtable*.tw.
116. round-table*.tw.
117. convention?.tw.
118. meeting?.tw.
119. assessment?.tw.
120. (checklist? or check-list?).tw.
121. (criteria or criterion).tw.
122. Patient Safety/
123. Quality Improvement/
124. (refresh* adj1 course?).tw.
125. (retention adj2 skill?).tw.
126. (retain* adj2 skill?).tw.
127. testing?.tw.
128. or/54-127
129. Catheterization, Central Venous/
130. CVC.tw.
131. (central adj2 catheter$).tw.
132. (central adj line?).tw.
133. PICC.tw.
134. (venous adj access).tw.
135. (venous adj cannul$).tw.
136. (venous adj line?).tw.
137. arthrocent$.tw.
139. (joint adj effusion).tw.
140. (joint adj sepsis).tw.
141. "synovial fluid aspiration".tw.
142. thoracentes$.tw.
143. thoracocentes$.tw.
144. (pleural adj tap$).tw.
145. "pleural fluid aspiration?".tw.
146. Paracentesis/
147. paracentes$.tw.
149. Spinal Puncture/
150. (lumbar adj puncture?).tw.
151. (lumbar adj tap$).tw.
152. (spinal adj punct$).tw.
153. (spine adj punctur$).tw.
154. (spinal adj tap$).tw.
155. or/129-154
156. 53 and 128 and 155
157. ((procedur* or clinical or technical) adj2 (skill? or abilit$ or competen$ or aptitude or proficien$)).tw.
158. 53 and 128 and procedur*2.tw. and (157 or clinical competence/ or st.fs.)
159. anesthesiology/ed or clinical clerkship/ed or emergency medicine/ed or general practitioners/ed or general surgery/ed or gastroenterology/ed or hospitalists/ed or internal medicine/ed or neurology/ed or occupational health physicians/ed or orthopedics/ed or physicians, family/ed or physicians, primary care/ed or pulmonary medicine/ed or radiology, interventional/ed or rheumatology/ed
160. or/17-50
161. (156 or 158) and (159 or 160)
162. remove duplicates from 161
163. exp Animals/ not (exp Animals/ and Humans/)
164. 162 not 163
165. limit 162 to humans
166. 164 or 165
167. Surgical Procedures, Operative/
168. Endovascular Procedures/
169. Endoscopy, Digestive System/
170. Gastroenterostomy/
171. Surgical Procedures, Minimally Invasive/
172. Surgical Procedures, Elective/
173. Laparoscopy/
174. (laparoscop* or "minimally invasive" or endoscop* or cholecystect*).tw.
175. or/167-174
176. 166 not 175
Search 1: Ovid EMBASE
1. Anesthesiology/
2. anesthesiologist/
3. an?esthetist?.tw.
4. (clinical adj1 clerk*).tw.
5. emergency physician/
6. general practitioner/
7. general surgery/
8. surgeon/
9. Gastroenterology/
10. Internal Medicine/
11. internist/
12. medical specialist/
13. Neurology/
14. neurologist/
15. occupational physician/
16. Orthopedics/
17. orthopedic surgeon/
18. family doctor?.tw.
19. primary care doctor?.tw.
20. pulmonology/
21. interventional radiology/
22. radiologist/
23. Rheumatology/
24. medical student/
25. medical school/
26. resident/
27. (general adj surg$).tw.
30. orthopaedist?.tw.
31. specialist?.tw.
32. sub-specialist?.tw.
33. subspecialist?.tw.
34. an?esthesiolog$.tw.
35. clerkship?.tw.
36. (emergency adj medicine).tw.
37. (family adj physician?).tw.
38. (general adj practitioner?).tw.
39. gastroenterolog$.tw.
40. hospitalist?.tw.
41. (interventional adj radiolog$).tw.
42. internship?.tw.
43. intern.tw.
44. interns.tw.
45. internist$.tw.
46. (internal adj medicine).tw.
47. (medical adj student?).tw.
48. (medical adj practitioner?).tw.
49. (medical adj trainee?).tw.
50. neurology.tw.
51. neurologist.tw.
52. neurologists.tw.
53. "primary care physician?".tw.
54. pulmonolog$.tw.
55. respirolog$.tw.
56. rheuma$.tw.
57. resident.tw.
58. residents.tw.
59. residency.tw.
60. residencies.tw.
61. fellow?.tw.
62. (clinic* adj1 fellow*).tw.
63. or/1-62
64. exp medical education/
65. curriculum/
66. curriculum development/
67. Computer Simulation/
69. exp accreditation/
70. exp competence/ [includes 'clinical competence' or 'professional competence' which started usage in 2006]
71. Credential*.tw.
72. professional standard/
73. game/
74. education program/
75. educational model/
76. educational technology/
77. in service training/
78. interdisciplinary education/
79. Learning/
80. learning environment/
81. lifelong learning/
82. outcome of education/
83. postgraduate education/
84. refresher course/
85. licensing/
86. anatomic model/
87. exp simulation/
88. simulator/
89. Program* Instruction?.tw.
90. residency education/
91. Role Playing/
92. self-evaluation/
93. "evaluation and follow up"/
94. Self-Assess*.tw.
95. exp teaching/
96. (augmented adj reality).tw.
97. (anatomic adj model?).tw.
98. (bench$ adj train$).tw.
99. (box adj trainer?).tw.
100. curriculum.tw.
101. "computer assist$ instruct$".tw.
102. curricula.tw.
103. credential?ing.tw.
104. certification.tw.
105. [ed.fs. ==> "education" as a floating subheading does not exist in Embase]
106. educat$.tw.
107. e-learning.tw.
108. elearning.tw.
110. (experiment$ adj game$).tw.
111. learn$.tw.
112. licensure.tw.
113. manikin?.tw.
114. mannequin?.tw.
115. moulage?.tw.
116. OSCE?.tw.
117. "objective structured clinical exam$".tw.
118. (professional adj development).tw.
119. (practice adj scenario?).tw.
120. (predicted adj performance).tw.
121. (program$ adj instruct$).tw.
122. (role adj play$).tw.
123. recertification.tw.
124. re-certification.tw.
125. (reflective and practice).tw.
126. (reflection and practice).tw.
127. (self adj (direct$ or regulat$)).tw.
129. (self adj evaluat$).tw.
130. simulat$.tw.
132. teach$.tw.
133. train$.tw.
134. (virtual adj reality).tw.
135. session*.tw.
136. workshop*.tw.
137. seminar?.tw.
138. forum?.tw.
139. symposi???.tw.
Supplemental digital content for Brydges R, Stroud L, Wong BM, Holmboe ES, Imrie K, Hatala R.
Core competencies or a competent core? A scoping review and realist synthesis of
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140. roundtable*.tw.
141. (round adj table*).tw.
142. convention?.tw.
143. meeting?.tw.
144. assessment?.tw.
145. (checklist? or check-list?).tw.
146. (criteria or criterion).tw.
147. Patient Safety/
148. Quality Improvement/
149. (refresh* adj1 course?).tw.
150. (retention adj2 skill?).tw.
151. (retain* adj2 skill?).tw.
152. testing?.tw.
153. or/64-152
154. central venous catheterization/
155. CVC.tw.
156. (central adj2 catheter$).tw.
157. (central adj line?).tw.
158. peripherally inserted central venous catheter/
159. PICC.tw.
160. (venous adj access).tw.
161. (venous adj cannul$).tw.
162. (venous adj line?).tw.
163. arthrocentesis/
164. arthrocent$.tw.
165. joint aspiration/
166. (joint adj aspiration).tw.
167. (joint adj effusion).tw.
168. (joint adj sepsis).tw.
169. "synovial fluid aspiration".tw.
170. thoracocentesis/
171. thoracentes$.tw.
172. thoracentes$.tw.
173. (pleural adj tap$).tw.
174. "pleural fluid aspiration?".tw.
175. Paracentesis/
176. paracentes$.tw.
177. (peritoneal adj tap$).tw.
178. lumbar puncture/
179. (lumbar adj puncture?).tw.
180. (lumbar adj tap$).tw.
181. (spinal adj punctu$).tw.
182. (spine adj punctur$).tw.
183. (spinal adj tap$).tw.
184. or/154-183
185. 63 and 153 and 184
186. ((procedur* or clinical* or technical*) adj2 (skill? or abilit$ or competen$ or aptitude or proficien$)).tw. [truncation added to 'clinical' and 'technical']
187. 63 and 153 and procedur*2.tw. and (186 or exp competence/) [NB: .st.fs does not exist in Embase; clinical competence is from 2006 - ]
188. (exp animals/ or exp animal experimentation/ or nonhuman/) not ((exp animals/ or exp animal experimentation/ or nonhuman/) and exp human/)
189. 63 or 153
190. (185 or 187) and 189
191. 190 not 188
192. remove duplicates from 191
193. limit 192 to embase
194. limit 193 to (book or book series or conference proceeding or "conference review")
195. 193 not 194
196. surgical procedures, operative/
197. Endovascular Procedures/
198. endoscopy, digestive system/
199. Gastroenterostomy/
200. Surgical Procedures, Minimally Invasive/
201. Surgical Procedures, Elective/
202. Laparoscopy/
203. (laparoscop* or "minimally invasive" or endoscop* or cholecystect*).tw.
204. or/196-203
205. 195 not 204
### Search 2: Ovid MEDLINE

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<td>2. Clinical Clerkship/</td>
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<td>3. Emergency Medicine/</td>
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<tr>
<td>4. General Practitioners/</td>
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<tr>
<td>5. General Surgery/</td>
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<td>9. Neurology/</td>
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<td>10. Occupational Health Physicians/</td>
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<td>12. Physicians, Family/</td>
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<td>13. Physicians, Primary Care/</td>
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<td>14. Pulmonary Medicine/</td>
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<td>16. Rheumatology/</td>
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<td>21. specialist?.tw.</td>
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<td>22. sub-specialist?.tw.</td>
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<td>23. subspecialist?.tw.</td>
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<tr>
<td>25. clerkship?.tw.</td>
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<tr>
<td>27. (family adj physician?).tw.</td>
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<tr>
<td>28. (general adj practitioner?).tw.</td>
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<td>29. gastroenterolog$.tw.</td>
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<td>30. hospitalist?.tw.</td>
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<td>32. internship?.tw.</td>
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<td>33. intern.tw.</td>
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<td>34. interns.tw.</td>
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<td>35. internist$.tw.</td>
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<td>37. (medical adj student?).tw.</td>
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<td>38. (medical adj practitioner?).tw.</td>
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<tr>
<td>39. (medical adj trainee?).tw.</td>
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<td>40. neurology.tw.</td>
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<td>41. neurologist.tw.</td>
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<td>42. neurologists.tw.</td>
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<tr>
<td>43. &quot;primary care physician?&quot;.tw.</td>
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<td>44. pulmonolog$.tw.</td>
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<tr>
<td>45. respirolog$.tw.</td>
</tr>
<tr>
<td>46. rheumatolog$.tw.</td>
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</tbody>
</table>
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94. (practice adj scenario?).tw.
95. (predicted adj performance).tw.
96. (program$ adj instruct$).tw.
97. (role adj play$).tw.
98. recertification.tw.
99. re-certification.tw.
100. (reflective and practice).tw.
102. (self adj (direct$ or regulat$)).tw.
103. (self adj assess$).tw.
104. (self adj evaluat$).tw.
105. simulat$.tw.
107. teach$.tw.
108. train$.tw.
110. session*.tw.
111. workshop*.tw.
112. seminar?.tw.
113. forum?.tw.
114. symposi????.tw.
115. roundtable*.tw.
116. round-table*.tw.
117. convention?.tw.
118. meeting?.tw.
119. assessment?.tw.
120. (checklist? or check-list?).tw.
121. (criteria or criterion).tw.
122. Patient Safety/
123. Quality Improvement/
124. (refresh* adj1 course?).tw.
125. (retention adj2 skill?).tw.
126. (retain* adj2 skill?).tw.
127. testing?.tw.
128. or/54-127
129. Catheterization, Central Venous/
130. CVC.tw.
131. (central adj2 catheter$).tw.
132. (central adj line?).tw.
133. PICC.tw.
134. (venous adj access).tw.
135. (venous adj cannul$).tw.
136. (venous adj line?).tw.
137. arthrocent$.tw.
139. (joint adj effusion).tw.
140. (joint adj sepsis).tw.
141. "synovial fluid aspiration".tw.
142. thoracentes$.tw.
143. thoracocentes$.tw.
144. (pleural adj tap$).tw.
145. "pleural fluid aspiration?".tw.
146. Paracentesis/
147. paracentes$.tw.
149. Spinal Puncture/
150. (lumbar adj puncture?).tw.
151. (lumbar adj tap$).tw.
152. (spinal adj punctu$).tw.
153. (spine adj punctur$).tw.
154. (spinal adj tap$).tw.
155. or/129-154
156. 53 and 128 and 155
157. ((procedur* or clinical or technical) adj2 (skill? or abilit$ or competen$ or aptitude or proficien$)).tw.
158. 53 and 128 and procedur*2.tw. and (157 or clinical competence/ or st.fs.)
159. anesthesiology/ed or clinical clerkship/ed or emergency medicine/ed or general practitioners/ed or general surgery/ed or gastroenterology/ed or hospitalists/ed or internal medicine/ed or neurology/ed or occupational health physicians/ed or orthopedics/ed or physicians, family/ed or physicians, primary care/ed or pulmonary medicine/ed or radiology, interventional/ed or rheumatology/ed
160. or/17-50
161. (156 or 158) and (159 or 160)
162. remove duplicates from 161
163. exp Animals/ not (exp Animals/ and Humans/)
164. 162 not 163
165. limit 162 to humans
166. 164 or 165
167. Surgical Procedures, Operative/
168. Endovascular Procedures/
169. Endoscopy, Digestive System/
170. Gastroenterostomy/
171. Surgical Procedures, Minimally Invasive/
172. Surgical Procedures, Elective/
173. Laparoscopy/
174. (laparoscop* or "minimally invasive" or endoscop* or cholecystect*).tw.
175. or/167-174
176. 166 not 175
177. limit 176 to yr="2014 -Current"
178. 177 not 5
179. 178 not 11
180. 179 not 19-20.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier]
182. 181 not 20
183. (embol* or biopsy or intraoss* or dentis* or dental* or resuscit* or hysteroscop* or peripheral* or PICC or surg* or anastomosis).tw.
184. 182 not 183
Search 2: Ovid EMBASE

1. Anesthesiology/
2. anesthesiologist/
3. an?esthetist?.tw.
4. (clinical adj1 clerk*).tw.
5. emergency physician/
6. general practitioner/
7. general surgery/
8. surgeon/
9. Gastroenterology/
10. Internal Medicine/
11. internist/
12. medical specialist/
13. Neurology/
14. neurologist/
15. occupational physician/
16. Orthopedics/
17. orthopedic surgeon/
18. family doctor?.tw.
19. primary care doctor?.tw.
20. pulmonology/
21. interventional radiology/
22. radiologist/
23. Rheumatology/
24. medical student/
25. medical school/
26. resident/
27. (general adj surg$).tw.
30. orthopaedist?.tw.
31. specialist?.tw.
32. sub-specialist?.tw.
33. subspecialist?.tw.
34. an?esthesiolog$.tw.
35. clerkship?.tw.
36. (emergency adj medicine).tw.
37. (family adj physician?).tw.
38. (general adj practitioner?).tw.
39. gastroenterolog$.tw.
40. hospitalist?.tw.
41. (interventional adj radiolog$).tw.
42. internship?.tw.
43. intern.tw.
44. interns.tw.
45. internist$.tw.
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46. (internal adj medicine).tw.
47. (medical adj student?).tw.
48. (medical adj practitioner?).tw.
49. (medical adj trainee?).tw.
50. neurology.tw.
51. neurologist.tw.
52. neurologists.tw.
53. "primary care physician?".tw.
54. pulmonolog$.tw.
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57. resident.tw.
58. residents.tw.
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63. or/1-62
64. exp medical education/
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66. curriculum development/
67. Computer Simulation/
69. exp accreditation/
70. exp competence/ [includes 'clinical competence' or 'professional competence' which started usage in 2006]
71. Credential*.tw.
72. professional standard/
73. game/
74. education program/
75. educational model/
76. educational technology/
77. in service training/
78. interdisciplinary education/
79. Learning/
80. learning environment/
81. lifelong learning/
82. outcome of education/
83. postgraduate education/
84. refresher course/
85. licensing/
86. anatomic model/
87. exp simulation/
88. simulator/
89. Program* Instruction?.tw.
90. residency education/
91. Role Playing/
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92. self-evaluation/
93. "evaluation and follow up"/
94. Self-Assess*.tw.
95. exp teaching/
96. (augmented adj reality).tw.
97. (anatomic adj model?).tw.
98. (bench$ adj train$).tw.
99. (box adj trainer?).tw.
100. curriculum.tw.
101. "computer assist$ instruct$".tw.
102. curricula.tw.
103. credential?ing.tw.
104. certification.tw.
105. [ed.fs. ==> "education" as a floating subheading does not exist in Embase]
106. educat$.tw.
107. e-learning.tw.
108. elearning.tw.
110. (experiment$ adj game$).tw.
111. learn$.tw.
112. licensure.tw.
113. manikin?.tw.
114. mannequin?.tw.
115. moulage?.tw.
116. OSCE?.tw.
117. "objective structured clinical exam$".tw.
118. (professional adj development).tw.
119. (practice adj scenario?).tw.
120. (predicted adj performance).tw.
121. (program$ adj instruct$).tw.
122. (role adj play$).tw.
123. recertification.tw.
124. re-certification.tw.
125. (reflective and practice).tw.
126. (reflection and practice).tw.
127. (self adj (direct$ or regulat$)).tw.
129. (self adj evaluat$).tw.
130. simulat$.tw.
132. teach$.tw.
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135. session*.tw.
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137. seminar?.tw.
138. forum?.tw.
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139. symposi????.tw.
140. roundtable*.tw.
141. (round adj table*).tw.
142. convention?.tw.
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156. (central adj2 catheter$).tw.
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158. peripherally inserted central venous catheter/
159. PICC.tw.
160. (venous adj access).tw.
161. (venous adj cannul$).tw.
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163. arthrocentesis/
164. arthrocent$.tw.
165. joint aspiration/
166. (joint adj aspiration).tw.
167. (joint adj effusion).tw.
168. (joint adj sepsis).tw.
169. "synovial fluid aspiration".tw.
170. thoracocentesis/
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172. thoracocentes$.tw.
173. (pleural adj tap$).tw.
174. "pleural fluid aspiration?".tw.
175. Paracentesis/
176. paracentes$.tw.
177. (peritoneal adj tap$).tw.
178. lumbar puncture/
179. (lumbar adj puncture?).tw.
180. (lumbar adj tap$).tw.
181. (spinal adj punctu$).tw.
182. (spine adj punctur$).tw.
183. (spinal adj tap$).tw.
184. or/154-183
185. 63 and 153 and 184
Supplemental digital content for Brydges R, Stroud L, Wong BM, Holmboe ES, Imrie K, Hatala R. Core competencies or a competent core? A scoping review and realist synthesis of invasive bedside procedures training in internal medicine. Acad Med.

186. ((procedur* or clinical* or technical*) adj2 (skill? or abilit$ or competen$ or aptitude or proficien$)).tw. [truncation added to 'clinical' and 'technical']
187. 63 and 153 and procedur*2.tw. and (186 or exp competence/) [NB: .st.fs does not exist in Embase; clinical competence is from 2006 - ]
188. (exp animals/ or exp animal experimentation/ or nonhuman/) not ((exp animals/ or exp animal experimentation/ or nonhuman/) and exp human/)
189. 63 or 153
190. (185 or 187) and 189
191. 190 not 188
192. limit 192 to embase
193. limit 193 to (book or book series or conference proceeding or "conference review")
194. 193 not "194".mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]
195. surgical procedures, operative/
196. Endovascular Procedures/
197. endoscopy, digestive system/
198. Gastroenterostomy/
199. Surgical Procedures, Minimally Invasive/
200. Surgical Procedures, Elective/
201. Laparoscopy/
202. (laparoscop* or "minimally invasive" or endoscop* or cholecystect*).tw.
203. or/196-203
204. 195 not "204".mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword]
205. limit 191 to embase
206. remove duplicates from 205
207. limit 206 to (book or book series or conference proceeding or "conference review")
208. 206 not 207
209. or/195-202
210. 208 not 209
211. limit 210 to yr="2014 -Current"
212. 211 not 7
213. 212 not 8
214. 213 not (or/16-17)
215. 214 not (or/27-30)
216. 215 not 195
217. (hysterscop* or peripheral*).tw.
218. 216 not 217
219. (PICC or surg* or anastomosis).tw.
220. 218 not 219
221. (embol* or biopsy or intraoss* or dentis* or dental* or resuscit*).tw.
222. 220 not 221
Supplemental Digital Appendix 2
Data Extraction Form for Realist Synthesis

<table>
<thead>
<tr>
<th>Context</th>
<th>Mechanism</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reasons for the training intervention? (e.g., complication rates too high, local trainee need assessment, external drivers like ABIM or RCSPC).</td>
<td>• What are the underlying assumptions about how this intervention is supposed to improve competence?</td>
<td>• To what degree do you believe the mechanism(s) was well implemented and tested by the outcome measures/design of this study?</td>
</tr>
<tr>
<td>• Who was there? learner(s) / instructor(s) / patient(s)</td>
<td>• Hypothesized educational mechanisms of intervention?</td>
<td>• Do the measured outcomes “fit with” the proposed mechanism (e.g., intervention aimed at changing behaviour but measures knowledge outcomes)?</td>
</tr>
<tr>
<td>• What were trainees taught about the procedure (e.g., technical skills, indications, resource utilization, communication skills)?</td>
<td>• What are the hunches/expectations/ rationales and rationalizations for why this was supposed to work?</td>
<td>• Did the outcomes follow the hypothesized effect? Why or why not?</td>
</tr>
<tr>
<td>• Where did training take place? (i.e., setting)</td>
<td>• Was any theory mentioned as inspiring the intervention?</td>
<td>• Did the intervention ‘misfire’ or work differently than expected (e.g., participant follow up was problematic, lots of drop outs, etc.)? How so?</td>
</tr>
<tr>
<td>• When did training occur? (e.g., at what stage of training?)</td>
<td>• If so, only note if they actually used the theory to design the intervention (i.e., didn’t just name a theory)</td>
<td>• Do the authors provide a list of barriers and/or facilitators? What are they?</td>
</tr>
<tr>
<td>• How were resources acquired? How was faculty/educator buy-in generated?</td>
<td></td>
<td>• Can you suggest anything else that may be driving the outcomes other than those stated by the authors?</td>
</tr>
<tr>
<td>• Was the training stand-alone or part of a larger system-level change (e.g., CLABSI bundles etc.)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Was the training stand-alone or integrated with other parts of the curriculum (e.g., academic half-day vs. ongoing course vs. just-in time training)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• What role is the trainee expected to play in the procedure after training (e.g., primary operator vs. referral to other services)?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Supplemental Digital Appendix 3
Study Characteristics of 91 Full-Text Articles Included Prior to Realist Synthesis

<table>
<thead>
<tr>
<th>Study characteristic</th>
<th>No. of studies (n = 91)*</th>
<th>No. of participants (n = 6201)</th>
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<td>Single group cross-sectional</td>
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<td>309</td>
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<tr>
<td>Single group pre-test, post-test</td>
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<td>3475</td>
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<tr>
<td>Nonrandomized, multiple groups</td>
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<td>1306</td>
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<tr>
<td>Qualitative</td>
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<td>11</td>
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<tr>
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<td>1100</td>
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<td>Oceania</td>
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<tr>
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<td>2293</td>
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<tr>
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<td>Thoracentesis</td>
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<td>483</td>
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<tr>
<td>Central line insertion</td>
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<td>4434</td>
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<td><strong>Ultra-sound guidance used in training?</strong></td>
<td></td>
<td></td>
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<tr>
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<td>42</td>
<td>1774</td>
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<tr>
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<td>4266</td>
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<td>161</td>
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<td>76</td>
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</table>
Core competencies or a competent core? A scoping review and realist synthesis of invasive bedside procedures training in internal medicine. Acad Med.

<table>
<thead>
<tr>
<th>Clinical specialty</th>
<th>Studies</th>
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<td>Lab medicine/pathology/radiology</td>
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<td>Obstetrics/gynecology</td>
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<td>Pediatrics</td>
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<table>
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<td>Reaction</td>
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<td>Knowledge</td>
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<td>1928</td>
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<td>Skill, time</td>
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<td>Skill, non-time process</td>
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<td>Behavior, non-time</td>
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<tr>
<td>Patient outcome</td>
<td>42</td>
<td>3263</td>
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</tbody>
</table>

Study quality (MERSQI score, out of 18)

| All studies, grand mean = 12.1 ± 2.6 (STDEV) | 90 | 6201 |
| MERSQI > 12.7 points                        | 42 | 3046 |

* 19 of 91 studies did not report sample size, this effects sample size estimates in all other categories.

** The number of studies and learners in some subgroups may sum to more than the number for all studies, because several studies included >1 procedure, >1 learner group, fit within >1 clinical specialty, or reported multiple outcomes.
## Supplemental Digital Appendix 4

### Study Characteristics of 58 Abstracts Included Prior to Realist Synthesis

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<tr>
<th>Study characteristic</th>
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<td>Could not tell</td>
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<td><strong>Study setting</strong></td>
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<td></td>
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<tr>
<td>Non-clinical setting (incl. simulation, computer-based, etc.)</td>
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<td>5</td>
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<tr>
<td><strong>Procedural skill studied</strong></td>
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<td></td>
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<tr>
<td>Lumbar puncture</td>
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<td>233</td>
</tr>
<tr>
<td>Arthrocentesis</td>
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<tr>
<td>Paracentesis</td>
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<td>Thoracentesis</td>
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<td>Central line insertion</td>
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<td>Nurses in practice</td>
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<td>Critical care</td>
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<td>Emergency medicine</td>
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<td>337</td>
</tr>
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<td>Lab medicine/pathology/radiology</td>
<td>1</td>
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</tbody>
</table>
Supplemental digital content for Brydges R, Stroud L, Wong BM, Holmboe ES, Imrie K, Hatala R.
Core competencies or a competent core? A scoping review and realist synthesis of invasive bedside procedures training in internal medicine. Acad Med.

<table>
<thead>
<tr>
<th>Pediatrics</th>
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**Outcomes**

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<tbody>
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<td>Behavior, non-time</td>
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<tr>
<td>Patient outcome</td>
<td>21 433</td>
</tr>
</tbody>
</table>

* 26 of 58 abstracts did not report sample size, this effects sample size estimates in all other categories.

** The number of abstracts and learners in some subgroups may sum to more than the number for all abstracts, because several studies included >1 procedure, >1 learner group, fit within >1 clinical specialty, or reported multiple outcomes.