

**Additional file 1: PICO-scheme of our applied search-term**

PICO-scheme	Search term	MeshTerm(s)
P (Patient; Population)	Medical Students, Physicians; Medical education	Students Medical; Education, medical; Medicine
I (Intervention)	Factors during the course of study; Influencing factors; Determinants and variables for specialty choice; Curriculum	Curriculum
C (Comparison; Control)		
O (Outcome)	Specialty preferences; Medical specialization/specialties; Career choice	Career choice

**Additional file 2:** List of all included studies in the systematic review

1. Abendroth J, Schnell U, Lichte T, Oemler M, Klement A. Motives of former interns in general practice for speciality-choice - results of a cross-sectional study among graduates 2007 to 2012. *GMS Z Med Ausbild.* 2014;31(1):Doc11. doi:[10.3205/zma000903](https://doi.org/10.3205/zma000903)
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12. Alkatout I, Günther V, Brügge S, et al. Involvement of medical students in a surgery congress: impact on learning motivation, decision-making for a career in surgery, and educational curriculum. *Wien Med Wochenschr.* 2021;171(7-8):182-193. doi:[10.1007/s10354-020-00802-w](https://doi.org/10.1007/s10354-020-00802-w)
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**Additional file 3: Characteristics of the included studies**

Author(s)	Year	Location	Study-design	Sample size (response rate)	Length of data collection	Study population	Intracurricular factor(s) studied/mentioned
Abendroth et al. <sup>1*</sup>	2014	Europe	Cross-sectional (quantitative)	45 of 97 (46%)	5 years	Graduates; Residents	4, 8, 11
Admani et al. <sup>2</sup>	2014	America	Cross-sectional (quantitative)	115 of 162 (71%)	/	Pediatrics Dermatologists	1, 4
Ahsin and Saeed <sup>3</sup>	2016	Asia	Cross-sectional (quantitative)	/	/	Medical students (2 <sup>nd</sup> to final year of study)	1
Al Salehi et al. <sup>4</sup>	2019	Asia	Cross-sectional (quantitative)	145 of 150 (97%)	/	Medical students	1, 7, 8, 11
Al-Asnag and Jan <sup>5</sup>	2002	Asia	Longitudinal (quantitative)	195 of 195 (100%)	3 years	Medical students	1
Al-Jaeed et al. <sup>6</sup>	2021	Asia	Cross-sectional (quantitative)	566 of 601 (94%)	/	Medical students (2 <sup>nd</sup> to 6 <sup>th</sup> year of study)	4
Al-Mendalawi <sup>7</sup>	2010	Asia	Cross-sectional (quantitative)	108 of 118 (92%)	/	Medical students (last year of study)	7
Al-Nuaimi et al. <sup>8</sup>	2010	Europe	Cross-sectional (quantitative)	395 of 1 988 (20%)	/	Medical students	1, 3, 7, 12
Alavi et al. <sup>9</sup>	2019	America	Cross-sectional (qualitative)	/	2 years	Medical students (4 <sup>th</sup> year of study)	1, 2, 4, 8
Albert et al. <sup>10</sup>	2016	America	Cross-sectional (qualitative)	/	/	Medical students; Graduates, Residents, Specialists	1, 4, 11
Alberti et al. <sup>11</sup>	2017	Europe	Cross-sectional (quantitative)	31 of 31 (100%)	/	Directors of teaching	1, 2, 6, 8, 11
Alkatout et al. <sup>12</sup>	2020	Europe	Application observation cross-sectional - workshop/congress (quantitative)	143 of 176 (81%)	/	Medical students (2 <sup>nd</sup> year of study)	6
Amalba et al. <sup>13</sup>	2016	Africa	Cross-sectional (quantitative + qualitative)	134 of 139 (96%)	/	Medical students (3 <sup>rd</sup> 4 <sup>th</sup> year of study)	2, 7, 11
Ambrozy et al. <sup>14</sup>	1997	America	Cross-sectional (quantitative)	177 of 210 (84%)	/	Selected role models	7
Andlauer et al. <sup>15</sup>	2012	Europe	Cross-sectional (quantitative)	145 of 430 (34%)	/	Medical students (last year of study)	1, 3, 8
Appleton et al. <sup>16</sup>	2017	Europe	Cross-sectional (qualitative)	/	/	Residents (psychiatry)	1, 4, 5, 8, 11, 13
Are et al. <sup>17</sup>	2018	America	Longitudinal (quantitative)	165 of 249 (66%)	4 years	Medical students	1, 8
Arleo et al. <sup>18</sup>	2016	America	Cross-sectional (quantitative)	1 219 of 18 078 (7%)	/	Medical students (4 <sup>th</sup> year of study)	1, 7, 8
Asaad et al. <sup>19</sup>	2020	Asia	Cross-sectional (quantitative)	561 of 644 (87%)	/	Medical students (2 <sup>nd</sup> , 4 <sup>th</sup> , 6 <sup>th</sup> year of study)	4, 11
Atalabi et al. <sup>20</sup>	2013	Africa	Cross-sectional (quantitative)	249 of 249 (100%)	/	Medical students (last 2 years of study)	1, 4, 8
Azizzadeh et al. <sup>21</sup>	2003	America	Cross-sectional (quantitative)	111 of 160 (69%)	/	Medical students (4 <sup>th</sup> year of study)	1, 4, 7
Balogun and Adebayo <sup>22</sup>	2019	Africa	Cross-sectional (quantitative + qualitative)	256 of 264 (97%)	2 years	Medical students (last year of study)	1, 8, 9
Barat et al. <sup>23</sup>	2019	Europe	Longitudinal (quantitative)	Year 1: 40 412 of 71 026 (57%); Year 3: 31 466 of 50 477 (63%); Year 5: 24 970 of 45 071 (55%)	41 years	Graduates	1, 8
Barber et al. <sup>24</sup>	2018	Europe	Cross-sectional (quantitative + qualitative)	280 of 315 (89%)	/	Medical students (5 <sup>th</sup> + 6 <sup>th</sup> year of study)	1, 3, 4, 7, 10, 12, 13

Barron et al. <sup>25</sup>	2012	America	Interventional (workshop) (quantitative + qualitative)	IG: 246 of 914 (27%); KCG: 109 of 1098 (10%)	/	Medical students; Specialists (psychiatry)	6
Bauer et al. <sup>26</sup>	2015	Europe	Application observation longitudinal - workshop (quantitative)	54 of 54 (100%)	/	Medical students (3 <sup>rd</sup> – 5 <sup>th</sup> year of study)	6
Bédard et al. <sup>27</sup>	2006	Europe	Longitudinal (quantitative)	1 <sup>st</sup> Survey: 485 of 500 (97%); 2 <sup>nd</sup> Survey: 353 of 500 (71%)	2 years	Medical students	1, 7, 9
Beier et al. <sup>28</sup>	2015	Europe	Application observation cross-sectional – microsurgical beginner-course for medical students (quantitative)	39 of 44 (89%)	/	Medical students	6
Berger et al. <sup>29</sup>	2017	America	Longitudinal (quantitative)	M1: 245 (78%); M2: 270 (86%); M3: 295 (94%) of 314	3 years	Medical students	4
Bhat et al. <sup>30</sup>	2012	Asia	Cross-sectional (quantitative)	250 of 250 (100%)	/	Residents (1 <sup>st</sup> + 2 <sup>nd</sup> year); /Students practical year	8
Bhutta et al. <sup>31</sup>	2016	Europe	Cross-sectional (quantitative + qualitative)	81 of 93 (87%)	/	Medical students; Residents	1, 7
Bien et al. <sup>32</sup>	2019	Europe	Cross-sectional (quantitative)	361 of 509 (71%)	/	Medical students (4 <sup>th</sup> + 5 <sup>th</sup> year of study)	1, 7, 11, 13
Blatt et al. <sup>33</sup>	2022	America	Application observation cross-sectional - Summer Genetics Scholar Program (quantitative)	55 of 125 (44%)	/	Medical students	6
Blue et al. <sup>34</sup>	1996	America	Cross-sectional (quantitative)	187 of 516 (36%)	/	General practitioners; Internists; Pediatricians	1, 4, 6, 7, 11
Bobo et al. <sup>35</sup>	2009	America	Cross-sectional + longitudinal (quantitative)	647 of 674 (96%)	5 years	Medical students (3 <sup>rd</sup> year of study)	1
Bolger et al. <sup>36</sup>	2015	Europe	Cross-sectional (quantitative)	595 of 615 (97%)	/	Medical students (3 <sup>rd</sup> - 5 <sup>th</sup> year of study); Graduates	4
Bonura et al. <sup>37</sup>	2016	America	Cross-sectional (quantitative)	590 of / (/)	/	Residents (internal medicine)	1, 4, 6, 8, 12
Borges et al. <sup>38</sup>	2009	America	Cross-sectional (quantitative)	356 of 494 (72%)	5 years	Medical students (4 <sup>th</sup> year of study)	1, 4, 8, 12
Boyd et al. <sup>39</sup>	2009	America	Cross-sectional (quantitative)	13 440 of 31 686 (42%)	/	Graduates	4
Boyle et al. <sup>40</sup>	2014	Australia	Cross-sectional (quantitative)	711 of / (79%)	5 years	Medical students (last year of study)	1, 7, 8
Briggs et al. <sup>41</sup>	2006	Europe	Cross-sectional (quantitative)	1 036 of 1 902 (54%)	/	Physicians	1, 2, 8
Brooks et al. <sup>42</sup>	2016	America	Application observation cross-sectional - Summer Angevine Pathology Course (quantitative + qualitative)	20 of 31 65%)	/	Specialists	6
Brown et al. <sup>43</sup>	2015	Europe	Application observation cross-sectional -	145 of 214 (68%) + 13 Focus-groups	/	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	1, 8

			Learning Opportunities in the Clinical Setting (LOCS) (quantitative + qualitative)				
Buddeberg-Fischer et al. <sup>44</sup>	2002	Europe	Cross-sectional (qualitative)	/	/	State Exam Candidates	1, 2, 3, 4, 9, 11
Burack et al. <sup>45</sup>	1997	America	Cross-sectional (quantitative + qualitative)	133 of 157 (95%) + 47 interviews	/	Medical students (last year of study)	4, 7
Calligaro and Dougherty <sup>46</sup>	2006	America	Cross-sectional (quantitative)	Group 1: 80 of 174 (46%); Group 2: 135 of 174 (78%); Group 3: 78 of / (/)	/	Physicians; Specialists/ Residents; Medical students (4 <sup>th</sup> year of study)	1, 4
Campos-Outcalt et al. <sup>47</sup>	2004	America	Cross-sectional (quantitative)	1 457 of 2 985 (52%)	/	Graduates (with application of general medicine)	1, 7, 8, 13
Carmichael et al. <sup>48</sup>	2020	America	Application observation cross-sectional - Bedside Anatomy (quantitative + qualitative)	83 of 185 (45%)	/	Medical students (preclinical years)	6, 11
Celenza et al. <sup>49</sup>	2012	Australia	Cross-sectional (quantitative)	216 of 280 (77%)	/	Specialists; Residents; Medical students	1, 4
Chan et al. <sup>50</sup>	2016	Africa	Cross-sectional (quantitative + qualitative)	75 von 75 (100%)	/	Medical students (last year of study)	1, 4, 7
Chan et al. <sup>51</sup>	2020	Asia	Cross-sectional (qualitative)	/	/	Medical students (2 <sup>nd</sup> – 5 <sup>th</sup> year of study)	1, 6, 8, 13
Chang et al. <sup>52</sup>	2006	Asia	Cross-sectional (quantitative)	283 of 500 (57%)	/	Medical students (5 <sup>th</sup> , 6 <sup>th</sup> , 7 <sup>th</sup> year of study)	7
Chang et al. <sup>53</sup>	2019	America	Application observation cross-sectional - Domestic One-Week Service Learning Program (quantitative + qualitative)	48 of 84 (57%) + 7 diary entries	/	Medical students	6
Chapman et al. <sup>54</sup>	1999	Europe	Application observation longitudinal - Course in Emergency Medical Services (EMS) (quantitative)	pre: 190 of 210 (91%); post: 194 of 210 (92%)	3,5 years	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	6
Chaudhuri et al. <sup>55</sup>	2013	Europe	Cross-sectional (quantitative + qualitative)	Group 1: 2 315 of 6 223 (37%); Group 2: 728 of 3 165 (23%); Group 3: 212 of 1 178 (18%)	/	Specialists; Residents; students in practical year	7
Cheng et al. <sup>56</sup>	2017	America	Application observation cross-sectional - Cambridge Integrated Clerkship (quantitative + qualitative)	30 of 100 (30%)	/	Medical students	1
Cherry-Bukowiec et al. <sup>57</sup>	2015	America	Application observation longitudinal - Trauma-Burn	/	2 years	Medical students (3 <sup>rd</sup> year of study)	1

			Acute Care Surgery Rotation (qualitative)				
Chew et al. <sup>58</sup>	2018	Asia	Cross-sectional (quantitative)	800 of 1 300 (62%)	/	Medical students (1 <sup>st</sup> – 5 <sup>th</sup> year of study)	1
Chew et al. <sup>59</sup>	2011	Asia	Cross-sectional (quantitative)	402 of 524 (77%)	/	Medical students (4 <sup>th</sup> + 5 <sup>th</sup> year of study)	1, 3, 8, 11
Chung et al. <sup>60</sup>	2016	Europe	Cross-sectional (quantitative + qualitative)	121 of 285 (42%)	/	Medical students (5 <sup>th</sup> year of study)	6, 8
Cichon and Feldman <sup>61</sup>	2013	America	Cross-sectional (quantitative)	Residents: 72 v of 127 (57%); Directors: 35 of 50 (70%)	/	Residents; Directors	1, 4, 6
Clayton et al. <sup>62</sup>	2009	Europe	Cross-sectional (quantitative)	311 of 709 (44%)	/	Dermatologists	1, 5, 11
Clayton and Trotter <sup>63</sup>	2013	America	Cross-sectional (quantitative)	155 of 897 (17%)	/	Medical students (last year of study)	1, 4, 8, 11
Cochran et al. <sup>64</sup>	2005	America	Cross-sectional (quantitative)	408 of / (/)	/	Medical students (4 <sup>th</sup> year of study)	1, 4
Codsi et al. <sup>65</sup>	2019	America	Cross-sectional (quantitative)	121 of 183 (66%)	/	Medical students (3 <sup>rd</sup> + 4 <sup>th</sup> year of study)	1, 2, 8, 11
Corbett et al. <sup>66</sup>	2002	America	Longitudinal (quantitative)	350 of 406 (86%)	7 years	Medical students (2 <sup>nd</sup> year of study)	1
Correia Lima de Souza et al. <sup>67</sup>	2015	Europe	Cross-sectional (quantitative)	1 223 of 1 547 (79%)	/	Medical students (last year of study)	1, 6, 7
Coyan et al. <sup>68</sup>	2019	America	Cross-sectional (quantitative)	126 of 579 (22%)	/	Medical students	1, 4, 6, 11
Croghan and Baker <sup>69</sup>	2020	Europe	Cross-sectional (quantitative + qualitative)	117 of 580 (20%)	/	Students in practical year	1, 2, 7, 8, 9, 11, 13
Cronin et al. <sup>70</sup>	2019	Europe + Asia	Cross-sectional (quantitative + qualitative)	464 of 1 376 (34%)	/	Medical students (3 <sup>rd</sup> – 5 <sup>th</sup> year of study)	7, 9, 14
Dallas et al. <sup>71</sup>	2019	America	Application observation longitudinal - Neurosurgery Elective for Preclinical Medical Students (quantitative + qualitative)	32 of 32 (100%)	/	Medical students (1 <sup>st</sup> – 3 <sup>rd</sup> year of study)	6
Daniels and Kassam <sup>72</sup>	2011	America	Cross-sectional (qualitative)	/	/	Residents (internal medicine)	1, 7
Davis et al. <sup>73</sup>	2010	Europe	Interventional - (British Association of Plastic, Reconstructive and Aesthetic Surgeons (BAPRAS) one-day course) (quantitative)	IG: 93 of 121 (77%); CG: 93 of / (/)	/	Medical students	6
Day et al. <sup>74</sup>	2016	America	Interventional (Preclinical Elective in Surgery) (quantitative)	IG (EP): 18 of 18 (100%); KG (EA): 8 of / (/)	/	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	4, 6, 11
de Cates et al. <sup>75</sup>	2019	Europe	Cross-sectional (quantitative + qualitative)	105 of 321 (33%)	2 years	Medical students	1, 2, 6, 7
DeBolle et al. <sup>76</sup>	2018	America	Application observation cross-sectional - Surgery Interest Group	/ of 106 (/)	/	Medical students (1 <sup>st</sup> – 4 <sup>th</sup> year of study)	4, 6

			(SCRUBS) (quantitative)				
Deutsch et al. <sup>77</sup>	2014	Europe	Cross-sectional (quantitative + qualitative)	659 v of 1 027 (64%)	/	Medical students	1, 6, 7
Deutsch et al. <sup>78</sup>	2013	Europe	Application observation longitudinal - Short Community-based Family Practice Elective (quantitative)	133 of 140 (95%)	2 years	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	6, 7
Deutsch et al. <sup>79</sup>	2015	Europe	Cross-sectional (quantitative)	659 of 1 027 (64%)	/	Medical students	1, 6
Dever et al. <sup>80</sup>	2001	Europe	Longitudinal (quantitative)	340 of 397 (86%)	11 years	Medical students	12
Dewey and Agostini <sup>81</sup>	2010	America	Cross-sectional (quantitative)	306 of 306 (100%)	/	Medical students (3 <sup>rd</sup> + 4 <sup>th</sup> year of study)	1
Dogbey et al. <sup>82</sup>	2018	America	Cross-sectional (quantitative)	282 of 433 (74%)	/	Medical students ; Residents; Specialists	1, 4
Doucet et al. <sup>83</sup>	1999	America	Cross-sectional (quantitative)	155 of 229 (68%)	/	Applicants internal medicine, pediatrics + internal medicine/	7
Drolet et al. <sup>84</sup>	2014	America	Interventional- (Preclinical Elective in Surgery) (quantitative)	IG: 24 von 24 (100%); KG: 147 von / (/)	1,5 years	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	6
Dunkley et al. <sup>85</sup>	2008	Europe	Cross-sectional (quantitative+ qualitative)	165 of 227 (73%)	/	Residents; Specialists (rheumatology)	1, 6, 7, 8, 11
Ek et al. <sup>86</sup>	2005	Australia	Cross-sectional (quantitative)	251 of 410 (61%)	/	Medical students (last year of study)	1, 7, 11
Ekenze et al. <sup>87</sup>	2013	Africa	Cross-sectional (quantitative)	275 of 391 (70%)	/	Medical students (last year of study)	1, 11
Ellsbury et al. <sup>88</sup>	1996	America	Cross-sectional (quantitative + qualitative)	291 of 320 (91%)	/	Medical students (4 <sup>th</sup> year of study)	1, 7
Ellsbury et al. <sup>89</sup>	1998	America	Cross-sectional (quantitative)	214 of 305 (70%)	/	Medical students (3 <sup>rd</sup> year of study)	1, 8, 11
Erraji et al. <sup>90</sup>	2015	Africa	Cross-sectional (quantitative)	45 of / (/)	/	Residents (traumatology and orthopedics)	1, 2, 11
Erzurum et al. <sup>91</sup>	2000	America	Cross-sectional (quantitative)	76 of 205 (37%)	/	Medical students (3 <sup>rd</sup> + 4 <sup>th</sup> year of study)	7
Farooq et al. <sup>92</sup>	2014	Inter- national	Cross-sectional (quantitative)	2 195 of 9 135 (24%)	/	Medical students (last year of study)	1, 6, 8
Fehlmann et al. <sup>93</sup>	2019	Europe	Cross-sectional (quantitative)	1 749 of 3 123 (56%)	6 years	Medical students (last year of study)	1, 4
Feit <sup>94</sup>	1994	America	Cross-sectional (quantitative)	351 of / (/)	/	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	7
Fereydooni et al. <sup>95</sup>	2021	America	Cross-sectional (quantitative)	70 of 73 (96%)	/	Applicants vascular surgery	1, 4
Firth and Wass <sup>96</sup>	2011	Europe	Cross-sectional (qualitative)	/	/	Graduates in foundation year	1, 9, 11, 13
Fitzgerald et al. <sup>97</sup>	2013	Europe	Cross-sectional (quantitative + qualitative)	208 of 320 (66%)	/	Graduates	7, 11, 14
Fogarty et al. <sup>98</sup>	2003	America	Cross-sectional (quantitative)	562 of 1 128 (50%)	/	Graduates	1, 11
Ford <sup>100</sup>	2005	America	Cross-sectional (quantitative)	1 4370 (PBL: 6 391; Non-PBL: 7 979)	/	Graduates; University- Curriculum	12

Ford et al. <sup>99</sup>	2018	America	Application observation cross-sectional - Student Continuity of Practice Experience (SCOPE) program (quantitative)	/	/	Graduates	12
Foster <sup>101</sup>	1994	America	Application observation cross-sectional - Alternative Curriculum (quantitative)	37 of 44 (85%)	/	Medical students	12
Frey et al. <sup>102</sup>	2021	America	Application observation longitudinal - Neuro Day (quantitative)	pre: 50 of 103 (49%); post: 103 of 103 (100%)	/	Medical students (1 <sup>st</sup> year of study)	6
Gami and Howe <sup>103</sup>	2020	Europe	Cross-sectional (quantitative + qualitative)	131 of 490 (27%)	/	Medical students	1, 4, 5, 7, 11
Gawad et al. <sup>104</sup>	2013	America	Application observation longitudinal - Surgical Exploration and Discovery (SEAD) Program (quantitative)	19 of 19 (100%)	/	Medical students (1 <sup>st</sup> year of study)	6
Gebhard and Müller-Hilke <sup>105</sup>	2019	Europe	Cross-sectional (quantitative)	421 of 1 143 (31%)	/	Medical students	1, 8, 11
Glasbey et al. <sup>106</sup>	2017	Europe	Application observation longitudinal - Foundation Skills in Surgery (FSS) (quantitative)	529 of 570 (93%)	/	Medical students; Residents; Specialists	6
Goldacre et al. <sup>107</sup>	2013	Europe	Longitudinal (quantitative + qualitative)	Year 1: 33 974 of 51 538 (66%); Year 3: 26 174 of 38 131 (69%); Year 5: 20 239 of 19 111 (70%)	35 years	Residents	1, 8
Goldacre et al. <sup>108</sup>	2010	Europe	Longitudinal (quantitative)	Year 1: 27 749 of 38 280 (73%), Year 3: 23 468 of 33 151 (71%), Year 5: 17 689 of 24 870 (71%)	31 years	Residents	1, 8
Golden et al. <sup>109</sup>	2010	America	Application observation cross-sectional - Required Fourth-Year Geriatric Clerkship (quantitative + qualitative)	150 of 150 (100%)	/	Medical students (4 <sup>th</sup> year of study)	12
Golden et al. <sup>110</sup>	2014	America	Application observation longitudinal - Radiation Oncology Clerkships (quantitative + qualitative)	18 of 18 (100%)	/	Medical students (4 <sup>th</sup> year of study)	12
Goldenberg et al. <sup>111</sup>	2017	America	Longitudinal (quantitative)	Start: 17 995 of 29 713 (61%); End: 23 712 of 29 713 (78%)	/	Medical students	1, 11
Goldman et al. <sup>112</sup>	2018	America	Cross-sectional (quantitative)	Residents: 114 of 295 (39%); Applicants Interventional Radiology: 70 of	/	Applicants + Residents (interventional radiology)	4

				169 (41%); Data from earlier survey: 202 of 657 (31%)			
Grayson et al. <sup>113</sup>	2001	America	Interventional (Community-Based Primary Care Course, Introduction to Primary Care (IPC)) (quantitative)	925 of 925 (100%)	6 years	Medical students	6
Greene et al. <sup>114</sup>	2015	America	Application observation longitudinal - Surgical Exploration and Discovery (SEAD) Program (quantitative + qualitative)	18 of 18 (100%)	/	Medical students (1 <sup>st</sup> year of study)	5, 6
Grimm et al. <sup>115</sup>	2017	America	Cross-sectional (quantitative)	202 of 657 (31%)	/	Applicants (diagnostic radiology)	1, 4
Guilloux et al. <sup>116</sup>	2019	Europe	Cross-sectional (quantitative)	4 601 of 16 323 (28%)	/	Graduates	1
Guraya and Almaramhy <sup>117</sup>	2018	Asia	Cross-sectional (quantitative)	220 of 300 (73%)	/	Medical students	11
Gutiérrez-Cirlos et al. <sup>118</sup>	2019	America	Cross-sectional (quantitative)	697 of 714 (81%)	/	Medical students (last year of study)	1, 8
Gutmann et al. <sup>119</sup>	2019	America	Longitudinal (quantitative)	51 816 of 74 913 (69%)	4 years	Medical students	1, 4, 8
Hagopian et al. <sup>120</sup>	2015	America	Cross-sectional (quantitative)	117 of 535 (22%)	4 years	Medical students	1
Halaas et al. <sup>121</sup>	2008	America	Application observation longitudinal - Rural Physician Associate Program (RPAP) (quantitative)	1 175 of 1 175 (100%)	36 years	Medical students (3 <sup>rd</sup> year of study)	1
Hammoud et al. <sup>122</sup>	2006	America	Longitudinal (quantitative)	268 of 483 (55%)	/	Medical students (3 <sup>rd</sup> year of study)	1
Harris et al. <sup>123</sup>	2005	Australia	Cross-sectional (quantitative)	4 259 of 7 851 (54%)	/	Graduates	1, 4
Hassoulas et al. <sup>124</sup>	2017	Europe	Application observation cross-sectional - Case-Based Learning (CBL) (quantitative)	226 of 296 (76%)	/	Medical students (2 <sup>nd</sup> year of study)	12
Hauer et al. <sup>125</sup>	2008	America	Cross-sectional (quantitative)	1 177 of 1 439 (82%)	/	Medical students (4 <sup>th</sup> year of study)	1, 2, 6, 7, 8
Hauer et al. <sup>126</sup>	2008	America	Cross-sectional (quantitative)	83 of 110 (76%)	/	Clerkship-directors	1, 6, 8, 11
Hawthorne and Dinh <sup>127</sup>	2017	America	Application observation longitudinal - Full-Day 'Intraclerkships' (quantitative)	372 of 383 (97%)	/	Medical students (3 <sup>rd</sup> year of study)	12
Head et al. <sup>128</sup>	2015	America	Interventional (Surgical Exploration and Discovery (SEAD) Program) (quantitative)	IG: 18 of 18 (100%); KG: 18 of / (/)	/	Medical students (1 <sup>st</sup> year of study)	6
Henderson et al. <sup>130</sup>	1996	America	Longitudinal (quantitative)	pre: 143 of 144 (99%); post: 181 von 194 (93%); pre+post: 138 of 144 (96%);	/	Medical students	1

				Graduation: 137 of 188 (73%)			
Henderson et al. <sup>129</sup>	2002	Europe	Cross-sectional (quantitative)	700 of 984 (72%)	/	Medical students (1 <sup>st</sup> + 5 <sup>th</sup> year of study)	1, 7, 11
Herold et al. <sup>131</sup>	1993	America	Interventional (Longitudinal Primary Care Training - Public Sector Medicine Program (PSMP)) (quantitative)	IG: 93; KG: 108; Non- Applicants: 342; total.: 543 of 543 (100%)	/	Medical students (1 <sup>st</sup> year of study)	12
Hicks et al. <sup>132</sup>	2019	America	Interventional (Surgical Exploration and Discovery (SEAD) Program) (quantitative)	IG: 30 of 30 (100%); KG: 29 of 29 (100%)	/	Medical students (1 <sup>st</sup> year of study)	6
Higgins and Thomson <sup>133</sup>	2019	Europe	Application observation longitudinal - Plastic Surgery Teaching Session (quantitative + qualitative)	160 of 279 (57%)	/	Medical students (4 <sup>th</sup> year of study)	12
Histing et al. <sup>134</sup>	2013	Europe	Application observation longitudinal – surgical course: "Playground for future bone docs"(quantitative)	119 of 119 (100%)	/	Medical students	6
Hofhansl and Körmöcz <sup>135</sup>	2014	Europe	Application observation cross-sectional - Mentoring-Program (quantitative)	Mentees: 106 of / (32%); Mentors: 37 of / (54%)	/	Medical students (2 <sup>nd</sup> – 6 <sup>th</sup> year of study)	4
Holm-Petersen et al. <sup>136</sup>	2007	Europe	Longitudinal (quantitative)	pre: 222 of 305 (73%); post: 160 of 222 (72%)	/	Medical students (4 <sup>th</sup> + 5 <sup>th</sup> year of study)	1
Holt et al. <sup>137</sup>	2019	Europe	Application observation longitudinal - Psychiatry Early Experience Program (PEEP) (quantitative + qualitative)	Baseline- Survey: 40 of 40 (100%); Year 1: 30 of 40 (75%); Year 2: 27 of 40 (68%); Year 3: 22 of 40 (55%)	3 years	Medical students (1 <sup>st</sup> year of study)	6
Hon et al. <sup>138</sup>	2020	America	Application observation cross-sectional - Hands-On Surgical Simulation in Congenital Heart Surgery (quantitative)	15 of 15 (100%)	/	Medical students	6
Hor et al. <sup>139</sup>	2019	Asia	Longitudinal (quantitative + qualitative)	1 <sup>st</sup> Survey: 106 of 111 (96%); 2 <sup>nd</sup> Survey: 103 of 111 (93%); 3 <sup>rd</sup> Survey: 100 of 111 (90%)	/	Medical students (3 <sup>rd</sup> year of study)	1, 13
Howe and Ives <sup>140</sup>	2001	Europe	Application observation longitudinal - Community- Based Teaching/Community Placement (quantitative)	504 of 692 (73%)	1 years	Medical students (3 <sup>rd</sup> + 4 <sup>th</sup> year of study)	1
Hunt et al. <sup>141</sup>	1995	America	Application observation longitudinal - Physical Diagnosis	pre: 198 of 204 (97%); post: 135 of 204 (66%)	/	Medical students (2 <sup>nd</sup> year of study)	6, 11

			Course (quantitative)				
Huntington et al. <sup>142</sup>	2014	America	Cross-sectional (quantitative)	207 of 742 (28%)	/	Applicants trauma surgery	1, 3, 4, 11, 14
Ibrahim et al. <sup>143</sup>	2016	Asia	Cross-sectional (quantitative)	378 of 512 (74%)	/	Graduates	1, 7
Ibrahim et al. <sup>144</sup>	2014	Europe	Cross-sectional (quantitative)	641 of 5 400 (12%)	/	Medical students (last year of study)	1, 7, 11,
Jagadeesan et al. <sup>145</sup>	2014	America	Cross-sectional (quantitative)	70 of 188 (37%)	/	Applicants radio-oncology	1, 8
Jayakumar et al. <sup>146</sup>	2016	Europe	Cross-sectional (quantitative)	488 of 40 625 (1,2%)	/	Medical students	6, 8, 11
Johnson et al. <sup>147</sup>	2012	America	Cross-sectional (quantitative)	618 of 1 354 (46%)	/	Medical students (4 <sup>th</sup> year of study)	1, 8, 11
Joiner et al. <sup>148</sup>	2018	Europe	Longitudinal (quantitative + qualitative)	21 of 41 (51%)	2 years	Foundation-Year-Trainees	1, 11
Kaderli et al. <sup>149</sup>	2011	Europe	Longitudinal (quantitative)	185 of 244 (53,8%)	/	Medical students (5 <sup>th</sup> – 7 <sup>th</sup> year of study)	1, 7
Kahn et al. <sup>150</sup>	2011	America	Cross-sectional (quantitative)	380 of 662 (57%)	/	Medical students (1 <sup>st</sup> – 4 <sup>th</sup> year of study)	1, 4
Kansayisa et al. <sup>151</sup>	2018	Africa	Cross-sectional (quantitative)	181 of / (49%)	/	Medical students (3 <sup>rd</sup> + 4 <sup>th</sup> year of study)	1, 11
Kapoor and Smith <sup>152</sup>	2014	America	Cross-sectional (quantitative)	55 von 122 (45%)	/	Directors of teaching (radiology)	12
Karmali et al. <sup>153</sup>	2017	America	Application observation longitudinal - Surgical Skills and Technology Elective Program (SSTEP) (quantitative)	18 of 18 (100%)	/	Medical students (2 <sup>nd</sup> year of study)	6
Kassebaum et al. <sup>154</sup>	1996	America	Longitudinal (quantitative)	11 680 of 15 888 (74%)	/	Applicants general medicine, internal medicine, pediatricians	1, 8
Keepes <sup>155</sup>	1995	America	Cross-sectional (quantitative)	136 of 259 (52%)	/	Medical students (4 <sup>th</sup> year of study)	1, 7, 8, 11
Kerfoot et al. <sup>156</sup>	2005	America	Cross-sectional (qualitative)	500 of 1 034 (48%)	/	Applicants urology, emergency medicine	1, 2, 4, 8, 11
Khader et al. <sup>157</sup>	2008	Asia	Cross-sectional (quantitative)	440 of 562 (78%)	/	Medical students (2 <sup>nd</sup> , 4 <sup>th</sup> , 6 <sup>th</sup> year of study)	11, 12
Khater-Menassa and Major <sup>158</sup>	2005	Asia	Cross-sectional (quantitative)	127 of 131 (97%)	/	Medical students (last year of study)	7, 11
Knox et al. <sup>159</sup>	2008	America	Cross-sectional (quantitative)	304 of 1 480 (21%)	/	Medical students	7, 11
Kolasinski et al. <sup>160</sup>	2007	America	Cross-sectional (quantitative)	177 of 469 (38%)	/	Residents (rheumatology)	1, 4, 7, 8
Kost et al. <sup>161</sup>	2019	America	Cross-sectional (quantitative)	1 814 of 11 998 (15%)	/	Medical students (4 <sup>th</sup> year of study) who are member of the American Academy of Family Physicians (AAFP)	4, 6
Kozar et al. <sup>162</sup>	2004	America	Cross-sectional (qualitative)	29 of 210 (14%)	/	Medical students (2 <sup>nd</sup> year of study)	6, 11, 13
Kozar et al. <sup>163</sup>	2003	America	Application observation longitudinal - Brief	pre: 121 of 210 (58%); post: 94 of 210 (45%);	/	Medical students (1 <sup>st</sup> year of study)	6

			Presentation by the Department of Surgery (quantitative)	pre+post: 82 of 210 (39%)			
Kraft et al. <sup>164</sup>	2018	America	Application observation longitudinal - 2-Week Course: Foundations of Diagnostics and Therapeutics (FDT) (quantitative)	pre: 170 of 170 (100%); post: 65 of 170 (38%); pre + post: 65 of 170 (38%)	/	Medical students (1 <sup>st</sup> year of study)	12
Kreykes et al. <sup>165</sup>	2020	America	Application observation longitudinal - Six 1-h Meetings Covering Aerospace Medicine (quantitative + qualitative)	pre: 23 of 23 (100%); post 15 of 23 (65%)	/	Medical students	6
Kuhnigk et al. <sup>166</sup>	2009	Europe	Cross-sectional (quantitative)	298 of 341 (87,4%)	/	Medical students	6, 12
Kumar and Dhaliwal <sup>167</sup>	2011	Asia	Cross-sectional (quantitative)	282 of 433 (74%)	/	Medical students	1, 7, 8
Kumar et al. <sup>168</sup>	2018	America	Application observation longitudinal - Webinar-Based Course in Interventional Radiology (quantitative)	pre + post: 166 of / (74%)	/	Medical students	6
Kurlandsky et al. <sup>169</sup>	1994	America	Cross-sectional (quantitative)	463 of 499 (93%)	5 years	Medical students	12
Kurowecki et al. <sup>170</sup>	2020	America	Cross-sectional (quantitative + qualitative)	152 of 708 (22%)	/	Residents	4, 11
Kuteesa et al. <sup>171</sup>	2021	Africa	Cross-sectional (quantitative + qualitative)	135 of 145 (93%) + 31 Focus-group- interviews	/	Medical students (5 <sup>th</sup> year of study)	4, 5, 7, 8, 9, 11
Kutikov et al. <sup>172</sup>	2011	America	Cross-sectional (quantitative)	413 of 1 009 (41%)	5 years	Applicants urology	1, 6, 8, 11
Lampe et al. <sup>173</sup>	2010	Australia	Cross-sectional (quantitative + qualitative)	76 of 82 (93%)	/	Medical students (3 <sup>rd</sup> + 4 <sup>th</sup> year of study)	1, 2, 8
Lau et al. <sup>174</sup>	2015	America	Longitudinal (quantitative + qualitative)	17 von 117 (100%)	/	Directors of teaching (psychiatry)	1, 8
Lawal and Afolabi <sup>175</sup>	2013	Africa	Cross-sectional (quantitative)	271 of 310 (87%)	5 years	Internship	5, 7
Lebastchi et al. <sup>176</sup>	2017	America	Cross-sectional (quantitative)	346 of / (74%)	/	Applicants urology	1, 4
Lee et al. <sup>177</sup>	1995	America	Cross-sectional (quantitative)	57 of 113 (50%)	/	Medical students (4 <sup>th</sup> year of study)	1, 8, 11, 13
Lee et al. <sup>178</sup>	2021	Asia	Longitudinal (quantitative)	86 of 100 (86%)	3 years	Medical students	1, 8
Lee et al. <sup>179</sup>	2011	America	Application observation longitudinal - High-Fidelity Simulation-Based Preclinical Endovascular Skills Course (quantitative)	pre+post: 52 of 52 (100%); Follow-up: 46 of 52 (90%)	3 years	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	1, 4, 6, 7, 11
Lefevre et al. <sup>180</sup>	2010	Europe	Cross-sectional (quantitative)	1 780 of 2 588 (62%)	/	Medical students	1
Leong et al. <sup>181</sup>	2005	America	Application observation longitudinal - Two-Session Career-Development	pre: 161 of 161 (100%); post: 117 of 161 (73%)	/	Medical students (2 <sup>nd</sup> year of study)	6

			Workshop (quantitative)				
Lindeman et al. <sup>182</sup>	2013	America	Cross-sectional (quantitative)	275 of 700 (39%)	/	Medical students (4 <sup>th</sup> year of study)	1, 4
López-García et al. <sup>183</sup>	2019	Europe	Longitudinal (quantitative)	Albacete: pre: 74 of 88 (84%), post: 87 of 88 (99%), End of study: 73 of 88 (83%); Seville: pre: 50 of 65 (77%), End of study: 98 of /	4 years	Medical students	12
Lou et al. <sup>184</sup>	2013	America	Interventional (Supervised and Unsupervised Practice on a Coronary Anastomosis Simulator) (quantitative)	45 of 45 (100%)	/	Medical students (1 <sup>st</sup> – 4 <sup>th</sup> year of study)	6
Lukas et al. <sup>185</sup>	2017	Asia	Cross-sectional (quantitative)	103 of 200 (52%)	/	Medical students; Residents; Specialists; (senior) Physicians	1, 4, 7, 8, 11
Lyons et al. <sup>186</sup>	2015	Australia	Application observation longitudinal - The Claassen Institute of Psychiatry for Medical Students (the Institute): An Innovative Enrichment Program (quantitative)	pre+post: 117 of 117 (100%); Follow-up: 47 of 89 (53%)	7 years	Medical students	6
Lyons and Janca <sup>187</sup>	2015	Australia	Longitudinal (quantitative)	pre: 150 of 238 (63%); post: 161 of 230 (70%)	/	Medical students (4 <sup>th</sup> year of study)	1
MacDowell et al. <sup>188</sup>	2013	America	Application observation cross-sectional - Rockford Rural Medical Education (RMED) Program (quantitative)	2 823 of 3 064 (92%); IG: 160; Comparison-group: 2 663	/	Medical students	12
Madan et al. <sup>189</sup>	2005	America	Interventional (Laparoscopic Skills Course) (quantitative)	59 of / (/)	/	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	6
Madani et al. <sup>190</sup>	2019	Asia	Cross-sectional (quantitative)	519 of / (/)	/	Medical students (4 <sup>th</sup> year of study)	1, 6, 7, 11
Mahendran et al. <sup>191</sup>	2015	Asia	Longitudinal (quantitative)	100 of 30 (77%)	/	Medical students	1
Maiorova et al. <sup>192</sup>	2008	Europe	Longitudinal (quantitative)	pre: 852 of 923 (92%); post: 661 of 923 (72%); pre+post: 593 of 923 (64,2%)	/	Medical students	1, 7
Malikova et al. <sup>193</sup>	2010	America	Longitudinal (quantitative)	99 of 197 (50%)	/	Medical students	4, 11
Manassis et al. <sup>194</sup>	2006	America	Cross-sectional (quantitative)	30 of 125 (24%)	/	Residents (psychiatry)	1, 4, 6, 8
Markovic et al. <sup>195</sup>	2012	America	Application observation longitudinal - Endovascular Simulator Training (quantitative)	76 of 80 (95%)	/	Medical students	4, 6
Martin et al. <sup>196</sup>	2007	America	Interventional (Brief Presentation in Child-Psychiatry) (quantitative)	pre: 218 of 222 (98%); post: 177 of 222 (80%)	/	Medical students (3 <sup>rd</sup> year of study)	6

Martini et al. <sup>197</sup>	1994	America	Cross-sectional (quantitative)	University: MD-University: 111 of 121 (92%); DO-University: 14 of 15 (93%); Residents: MD-Residents: approx. 1 950 of 2 600 (75%); DO-Residents: approx. 320 of 355 (90%)	/	General practitioners, Internists, Pediatricians; medical universities	1, 7, 8
Matalon et al. <sup>198</sup>	2018	America	Cross-sectional (quantitative + qualitative)	488 of / (/)	/	Residents (radiology)	1, 4, 6, 7, 8
Matsos et al. <sup>199</sup>	2018	America	Cross-sectional (quantitative)	54 of / (/)	/	Residents (internal medicine)	1, 4
Matsumoto et al. <sup>200</sup>	2019	America	Cross-sectional (quantitative)	66 of 507 (13%)	/	Medical students	1
Matthews et al. <sup>201</sup>	2015	Australia	Application observation cross-sectional - Regional and Rural Immersion Program, Pūkawakawa (quantitative + qualitative)	45 of 72 (63%)	/	Medical students	1
Maudsley et al. <sup>202</sup>	2010	Europe	Cross-sectional + longitudinal (quantitative + qualitative)	Cross-sectional: 1999-2000: Start-Y1: 153 of 228 (67%), End-Y1: 137 of 224 (61%), Mid-Y3: 158 of 204 (77,5%); 2001: Start-Y1: 199 of 283 (70%), End-Y1: 196 of 279 (70%); 2001/02: Pre-Interviews: 962 of 1 064 (90%), Mid-Y5: 115 of 317 (36%); Longitudinal: Pairing of collected data	1999: 3 years, 2001: 1 year 2001: 5 years	Medical students	1, 12
Mayes et al. <sup>203</sup>	2016	Europe	Longitudinal (quantitative)	36 of 45 (80%)	/	Medical students (3 <sup>rd</sup> year of study)	1
Mazeh et al. <sup>204</sup>	2010	Asia	Cross-sectional (quantitative)	218 of 688 (32%)	/	Medical students (6 <sup>th</sup> year of study)	1, 11
McCaffrey <sup>205</sup>	2005	America	Cross-sectional (quantitative)	93 of 101 (92%)	/	Applicants ENT	4, 11
McCord et al. <sup>206</sup>	2009	America	Cross-sectional (quantitative)	83 of 99 (84%)	/	General surgeons	4
McDonald et al. <sup>207</sup>	2021	America	Longitudinal (quantitative)	374 of / (approx. 70%) – for each of the 3 graduating cohorts	7 years	Medical students	4
McHugh et al. <sup>208</sup>	2011	Europe	Cross-sectional + longitudinal (quantitative)	Quantitative survey: 381 of 381 (100%); Online- Survey: 418 of 1 609 (26%); Follow-up: 232 of 381 (61%)	5 years	Residents (general surgery)	1, 7
McKechnie et al. <sup>209</sup>	2021	America	Cross-sectional (quantitative + qualitative)	228 of (approx.) 1 493 (15%)	/	Residents (surgery)	1, 4, 8
McKee et al. <sup>210</sup>	2007	America	Application observation longitudinal - Family Medicine	18 of 60 (30%)	/	Medical students	6

			Interest Group (quantitative + qualitative)				
McLean <sup>211</sup>	2006	Africa	Cross-sectional (quantitative)	645 of 745 (87%)	2 years	Medical students	1, 7
McParland et al. <sup>212</sup>	2003	Europe	Longitudinal (quantitative)	379 of 450 (84%)	/	Medical students (4 <sup>th</sup> year of study)	1, 11
Mehmood et al. <sup>213</sup>	2012	Asia	Cross-sectional (quantitative)	550 of 590 (93%)	/	Medical students (1 <sup>st</sup> – 5 <sup>th</sup> year of study)	1, 7, 11
Mihalynuk et al. <sup>214</sup>	2006	America	Cross-sectional (quantitative + qualitative)	113 of 124 (91%)	/	Medical students (3 <sup>rd</sup> year of study)	1
Montgomery et al. <sup>215</sup>	2015	America	Cross-sectional (quantitative)	518 of 699 (74%)	/	Medical students	7
Moore et al. <sup>216</sup>	2017	Europe	Cross-sectional (quantitative + qualitative)	42 of 68 (62%); Interviews: 13 of 42 (31%)	/	Residents anesthesia	1, 2, 7
Morrison and Murray <sup>217</sup>	1996	Europe	Longitudinal (quantitative)	131 of 206 (64%)	2 years	Medical students (last year of study)	1
Mortlock et al. <sup>218</sup>	2017	Europe	Application observation longitudinal - One-Day Visit to a High Secure Forensic Psychiatric (quantitative + qualitative)	245 of 289 (88%)	/	Medical students (3 <sup>rd</sup> + 4 <sup>th</sup> year of study)	1
Mulcare et al. <sup>219</sup>	2011	America	Cross-sectional (quantitative)	23 of 32 (72%)	/	Clerkship-directors	1
Mutha et al. <sup>220</sup>	1997	America	Cross-sectional (quantitative + qualitative)	52 of / (70%)	/	Medical students (3 <sup>rd</sup> + 4 <sup>th</sup> year of study)	1, 4, 7
Nakhoul et al. <sup>221</sup>	2021	America	Cross-sectional (quantitative)	415 of 1 992 (21%)	/	Residents (internal medicine)	1, 4
Ndetei et al. <sup>222</sup>	2013	Africa	Cross-sectional (quantitative)	254 of 300 (85%)	/	Medical students (last year of study)	1, 7, 8
Nelson et al. <sup>223</sup>	2020	America	Cross-sectional (quantitative + qualitative)	244 of 268 (91%); Oncologists: 25 of 32 (78%)	/	Oncologists	6
Ng et al. <sup>224</sup>	2020	Asia	Cross-sectional (quantitative)	Up to 1 780 of 1 780 (89 - 100%)	3 years	Medical students (3 <sup>rd</sup> + 5 <sup>th</sup> year of study)	1, 7, 8, 11
Ng et al. <sup>225</sup>	2020	America	Cross-sectional (quantitative)	Residents: 78 of 2 031 (4%); Faculties: 44 of 188 (23%)	/	Residents (nuclear medicine and molecular imaging); Directors of teaching; Directors of training programs	1, 4, 6, 8
Ní Chróinín et al. <sup>226</sup>	2013	Europe	Application observation longitudinal - 6-week Medicine in the Community Module (quantitative)	pre: 167 of 336 (50%); post: 274 of 336 (82%)	2 years	Medical students (last year of study)	6
Noble <sup>227</sup>	2006	America	Cross-sectional (quantitative)	Ophthalmologists: 405 of 1 062 (38%); Non-Ophthalmologists: 20 891 of 58 337 (36%)	/	Physicians	4
Noble et al. <sup>228</sup>	2007	America	Cross-sectional (quantitative)	49 of 128 (38%)	/	Residents (ophthalmology)	4, 6
O'Donoghue et al. <sup>229</sup>	2015	Europe	Cross-sectional (quantitative + qualitative)	64 of 95 (66%)	/	Medical students	1, 7, 11

O'Herrin et al. <sup>230</sup>	2003	America	Cross-sectional (qualitative)	/	2 years	Medical students	1
Onyemaechi et al. <sup>231</sup>	2017	Africa	Cross-sectional (quantitative)	152 of 155 (98%)	/	Medical students (last year of study)	1, 7, 11
Osborn <sup>232</sup>	1993	America	Cross-sectional (quantitative)	102 of 142 (72%)	/	Medical students (last year of study)	1, 4, 8
Parekh et al. <sup>233</sup>	2021	Europe	Longitudinal (qualitative)	/	/	Medical students (last 2 years of study)	1, 7, 13
Parker et al. <sup>234</sup>	2014	Australia	Cross-sectional (qualitative)	/	/	Medical students (last year of study)	1, 7, 9, 11,13
Pearson and Westra <sup>235</sup>	2016	America	Application observation cross-sectional - Obstetrical Longitudinal Course (OBLC) (quantitative)	102 of 206 (50%)	/	Medical students (1 <sup>st</sup> year of study)	6
Pearson et al. <sup>236</sup>	2002	Australia	Cross-sectional (quantitative)	2 469 of 3 747 (66%)	/	Physicians	12
Peiffer-Smadja et al. <sup>237</sup>	2020	Europe	Cross-sectional (quantitative)	90 of 100 (90%)	/	Residents (infectious and tropical diseases)	1, 8
Phillips and Charnley <sup>238</sup>	2016	America	Longitudinal (quantitative)	92 of 150 (61%)	/	Medical students (3 <sup>rd</sup> year of study)	1
Pianosi et al. <sup>239</sup>	2016	Asia	Cross-sectional (qualitative)	70 of / (/)	5 years	Medical students (4 <sup>th</sup> year of study)	1, 6, 7, 9, 11, 13
Piccinato et al. <sup>240</sup>	2017	America	Cross-sectional (quantitative + qualitative)	64 of 96 (67%)	/	Residents (surgery)	7
Pointer et al. <sup>241</sup>	2017	America	Cross-sectional (quantitative)	61 of 112 (54%)	/	Residents (surgery)	1, 2, 4, 8, 11
Pokrzywko et al. <sup>242</sup>	2019	America	Interventional (Geriatric-Psychiatry Rotation) (quantitative)	84 of 105 (80%) - thereof IG: 44, KG: 40	2 years	Medical students (3 <sup>rd</sup> year of study)	1
Polsky and Werner <sup>243</sup>	2004	America	Cross-sectional (quantitative)	Specialists: 936 of 1432 (65%) – Use of 756; Residents: 80 of 152 (53%)	/	Specialists + Residents neuropsychiatric	1,4
Poole et al. <sup>244</sup>	2009	Australia	Cross-sectional (quantitative)	Start of study: 216 of 307 (70%); End of study: 115 of 130 (88%)	6 years	Medical students	1, 7, 8
Prud'homme et al. <sup>245</sup>	2020	Europe	Cross-sectional (quantitative)	139 of 171 (81%)	/	Applicants geriatrics	1
Pullen et al. <sup>246</sup>	2013	America	Application observation longitudinal - Video-Teleconferencing in Child and Adolescent Psychiatry (quantitative)	Start: 175 of 540 (32%); Follow-up: 43 v of 44 (97%)	/	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	6
Querido et al. <sup>247</sup>	2018	Europe	Cross-sectional (qualitative)	/	/	Medical students (last year of study)	1, 4, 6, 7
Rahbar et al. <sup>248</sup>	2010	America	Cross-sectional (quantitative)	179 of / (/)	/	Rheumatologists; Residents internal medicine; Medical students (3 <sup>rd</sup> year of study)	1, 7
Ramaswamy et al. <sup>249</sup>	2019	America	Cross-sectional (quantitative)	167 of / (/)	/	Medical students; Residents	1, 3, 4, 8, 11
Rao et al. <sup>250</sup>	2017	America	Cross-sectional (quantitative)	657 of 4721 (14%) – estimated	/	Medical students	1, 4

Ravindra et al. <sup>251</sup>	2013	Europe	Cross-sectional (quantitative)	204 of 312 (65%)	/	Medical students (last year of study)	1
Ravindra and Fitzgerald <sup>252</sup>	2011	Europe	Cross-sectional (quantitative)	208 of 320 (65%)	/	Graduates	2, 7, 8, 11
Ray et al. <sup>253</sup>	2018	America	Cross-sectional (quantitative)	793 of 1 372 (58%)	/	Applicants emergency medicine	1
Redman et al. <sup>254</sup>	1994	Europe	Cross-sectional (quantitative)	903 of 1 271 (71%)	/	Medical students (last year of study + practical year)	7, 11, 14
Rehman et al. <sup>255</sup>	2011	Asia	Cross-sectional (quantitative)	771 of 850 (91%)	1 years	Medical students	7
Retrouvey et al. <sup>256</sup>	2018	America	Application observation longitudinal - Radiology Faculty-Mentored Video Modules (quantitative)	Preparatory-Phase: 182 of 182 (100%); 3 <sup>rd</sup> Phase: 153 of 153 (100%)	/	Medical students (1 <sup>st</sup> year of study)	6
Roberts and Khursandi <sup>257</sup>	2002	Australia	Cross-sectional (quantitative + qualitative)	297 of 488 (61%)	/	Anesthesiologists	1, 7
Rojnic Kuzman et al. <sup>258</sup>	2013	Europe	Cross-sectional (quantitative)	122 of 200 (61%)	1,5 years	Medical students (last year of study)	1, 8
Roy et al. <sup>259</sup>	2020	America	Application observation longitudinal - Plastic Surgery Mini-elective (quantitative)	pre: 25 of / (/); post: 22 of / (/)	/	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	6
Rubeck et al. <sup>260</sup>	1995	America	Cross-sectional (quantitative)	336 of 704 (48%)	/	Physicians primary care; academic physicians	4, 7
Russo et al. <sup>261</sup>	2020	America	Cross-sectional (qualitative)	/	/	Residents (psychiatry)	1, 11, 13
Ryan et al. <sup>262</sup>	2018	Europe	Cross-sectional (quantitative + qualitative)	846 of 3 766 (22%) – Use of 231	/	Residents	1, 4, 7, 9, 11, 14
Saalwachter et al. <sup>263</sup>	2005	America	Cross-sectional (quantitative)	4 308 of / (/)	/	Medical students; Residents + specialists surgery	1, 11
Saberski et al. <sup>264</sup>	2015	America	Application observation longitudinal - Real-time Cadaveric Laparoscopy and Laparoscopic Video Demonstrations in Gross Anatomy (quantitative)	/	/	Medical students (1 <sup>st</sup> year of study)	12
Saigal et al. <sup>265</sup>	2007	Asia	Cross-sectional (qualitative)	/	/	Medical students (3 <sup>rd</sup> – 6 <sup>th</sup> year of study)	1, 4, 7, 11
Sammann et al. <sup>266</sup>	2007	America	Interventional (Elective Called "OR Assist") (quantitative + qualitative)	IG: 75 of 86 (87%); KG: /	/	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	6
Sanfey et al. <sup>267</sup>	2006	America	Cross-sectional (quantitative + qualitative)	1 300 of / (/)	/	Medical students	1, 7, 9, 11, 13, 14
Schnuth et al. <sup>268</sup>	2003	America	Cross-sectional (quantitative + qualitative)	203 of 402 (50%)	/	Medical students (1 <sup>st</sup> – 4 <sup>th</sup> year of study)	7, 8, 11
Schwartz et al. <sup>269</sup>	1995	America	Cross-sectional (quantitative)	1 244 of 1 635 (76%)	/	Graduates	1
Schwartz et al. <sup>270</sup>	2011	America	Cross-sectional (quantitative)	1990: 1 244 of 1 650 (75%); 2007:	/	Medical students	1, 2, 11

				1 177 of 1 439 (82%)			
Scott et al. <sup>271</sup>	2007	America	Longitudinal (quantitative)	1 <sup>st</sup> Survey: 1 188 of 1 321 (90%); 2 <sup>nd</sup> survey: 845 of 1 188 (71%)	5 years	Medical students	1, 2, 4, 8, 9, 11, 12
Scott et al. <sup>272</sup>	2007	America	Longitudinal (qualitative)	/	3 years	Medical students	1, 2, 7, 11, 13
Sedaghat et al. <sup>273</sup>	2012	Australia	Application observation cross-sectional - The Nepean Summer Vacation Surgical Program (quantitative + qualitative)	55 of 107 (51%)	3 years	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	6
Seo et al. <sup>274</sup>	2017	Asia	Application observation cross-sectional - One-Day Surgical-Skill Training Course (quantitative)	91 of 91 (100%)	/	Medical students (1 <sup>st</sup> – 4 <sup>th</sup> year of study)	6
Seow et al. <sup>275</sup>	2018	Asia	Cross-sectional (quantitative)	502 of / (/)	/	Medical students	1, 4, 5, 6, 8, 11
Shaikh et al. <sup>276</sup>	2016	Europe	Longitudinal (quantitative)	pre: 236 of 309 (76%); post: 157 of 309 (50%)	/	Medical students (4 <sup>th</sup> year of study)	12
Shelton et al. <sup>277</sup>	2019	America	Application observation longitudinal - Laparoscopic Box Trainer (quantitative)	64 of 64 (100%)	/	Medical students (1 <sup>st</sup> – 3 <sup>rd</sup> year of study)	6
Shen et al. <sup>278</sup>	2014	Asia	Longitudinal (quantitative)	325 of 368 (88%)	/	Medical students (4 <sup>th</sup> year of study)	1
Shepherd et al. <sup>279</sup>	2003	America	Cross-sectional (quantitative + qualitative)	411 of 2 852 (14%)	/	Medical students (2 <sup>nd</sup> year of study)	6
Shipper et al. <sup>280</sup>	2017	America	Application observation longitudinal - Technical and Nontechnical Skills Curriculum (quantitative)	pre: 30 of 30 (100%); post: 28 of 30 (93%)	/	Medical students (preclinical years)	6
Shipper et al. <sup>281</sup>	2018	America	Application observation cross-sectional - Technical and Nontechnical Skills Curriculum (qualitative)	/	/	Medical students; Teachers	6
Shrestha et al. <sup>282</sup>	2016	Asia	Cross-sectional (quantitative)	83 of 94 (87%)	/	Graduates	1, 7, 8
Siassakos et al. <sup>283</sup>	2009	Europe	Application observation longitudinal - O&G attachment (quantitative)	/ of 48 (/)	/	Medical students (4 <sup>th</sup> year of study)	1, 2, 8, 14
Simões et al. <sup>284</sup>	2018	America	Cross-sectional (quantitative)	276 of 363 (76%)	/	Medical students	6
Sinclair et al. <sup>285</sup>	2006	Europe	Longitudinal (quantitative + qualitative)	Year 1: 172 of 172 (100%), Year 2: 131 of 169 78%, Year 3: 116 of 165 (70%), Year 4: 108 of 168 (64%), Year 5: 105 of 161 (65%), 1 <sup>st</sup> PGY: 100 of 168 (60%); Start + End: 66 (38,4%); Start till	6 years	Medical students + Postgradual-Year 1	1, 8

				End (all): 32 (18,6%)			
Singh and Alberti <sup>286</sup>	2020	Europe	Cross-sectional (qualitative)	/	/	Medical students (last year of study)	1, 7, 8, 9, 11, 13, 14
Skokauskas et al. <sup>287</sup>	2012	Europe	Cross-sectional (quantitative)	114 of 124 (92%)	/	Medical students (4 <sup>th</sup> year of study)	12
Skorus et al. <sup>288</sup>	2020	Europe	Cross-sectional (quantitative)	595 of / (/)	/	Medical students	1, 4, 9, 14
Smith et al. <sup>289</sup>	2017	America	Cross-sectional (qualitative)	/	6 years	Medical students (4 <sup>th</sup> year of study)	13, 14
Sobral <sup>290</sup>	2006	America	Longitudinal (quantitative)	578 of / (/)	10 years	Medical students	1, 4,
Solomon and DiPette <sup>291</sup>	1994	America	Cross-sectional (quantitative)	176 of 182 (97%)	/	Medical students (4 <sup>th</sup> year of study)	1, 7, 8
Sorouri et al. <sup>292</sup>	2021	America	Application observation longitudinal - Surgical Exploration and Discovery (SEAD) (qualitative)	/	/	Medical students (1 <sup>st</sup> year of study)	4, 7, 14
Sozio et al. <sup>293</sup>	2019	America	Cross-sectional (qualitative)	/	/	Teachers nephrology; Nephrologists	1, 4, 6, 7, 8, 12
Spiers et al. <sup>294</sup>	2019	Europe	Application observation longitudinal -1-Day Otolaryngology Course (quantitative + qualitative)	35 of 36 (97%)	/	Medical students (1 <sup>st</sup> – 5 <sup>th</sup> year of study)	6
Sripa et al. <sup>295</sup>	2020	Asia	Cross-sectional (quantitative)	259 of 390 (66%)	/	Residents	1, 8, 11
Stahn and Harendza <sup>296</sup>	2014	Europe	Cross-sectional (qualitative)	/	/	Residents + (senior) physicians	1, 2, 7, 10, 11
Stearns et al. <sup>297</sup>	1993	America	Cross-sectional (quantitative)	349 of 601 (58%)	/	Graduates	1
Stratton et al. <sup>298</sup>	2005	America	Cross-sectional (quantitative)	1 314 of 1 911 (69%)	/	Medical students (4 <sup>th</sup> year of study)	14
Strelzow et al. <sup>299</sup>	2017	America	Cross-sectional (quantitative)	Graduates: 23 of 26 (88%); Residents: 139 of 284 (49%)	/	Applicants + Residents Orthopedics	1
Süß et al. <sup>300</sup>	2019	Europe	Cross-sectional (quantitative)	101 of 344 (29%)	1 years	Residents (child and adolescent psychiatry; trauma surgery)	1, 7
Sutton et al. <sup>301</sup>	2014	Europe	Cross-sectional (quantitative + qualitative)	482 of / (/)	/	Medical students (last year of study)	1, 4, 7, 11, 13
Talbot and Ward <sup>302</sup>	2000	Australia	Application observation longitudinal - Alternative Curricular Options in Rural Networks (ACORNS) (quantitative)	103 of / (/)	2 years	Medical students (4 <sup>th</sup> year of study)	6
Teclessou et al. <sup>303</sup>	2021	Africa	Cross-sectional (quantitative)	251 of 358 (70%)	/	Medical students (last year of study)	1, 4, 8, 11
Tesche et al. <sup>304</sup>	2010	America	Application observation longitudinal - Mentored Instruction on High-Fidelity Cardiothoracic Simulators (quantitative)	44 of 44 (100%)	/	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	6

Thistlethwaite et al. <sup>305</sup>	2008	Australia	Cross-sectional (qualitative)	/	/	Medical students; Residents general medicine	1, 7, 13
Thivierge-Southidara et al. <sup>306</sup>	2022	America	Application observation longitudinal - Oversight- Program (quantitative + qualitative)	84 of 204 (42%)	/	Medical students (preclinical years)	6
Tolhurst and Stewart <sup>307</sup>	2005	Australia	Cross-sectional (qualitative)	/	/	Medical students (1 <sup>st</sup> year of study)	8, 9, 11, 13
Torrible et al. <sup>308</sup>	2006	America	Cross-sectional (quantitative)	253 of 530 (48%)	/	Medical students; Residents internal medicine+ geriatrics; Geriatricians	1, 4, 6, 7, 13
Turner et al. <sup>309</sup>	2006	Europe	Longitudinal (quantitative)	1 <sup>st</sup> Survey: 24 623 of 33 417 (74%); 2 <sup>nd</sup> Survey: 20 709 of 28 468 (73%)	Approx. 29 years	Postgradual training levels	1, 8
Urbina et al. <sup>310</sup>	2003	America	Longitudinal (quantitative)	IG: 213 of 249 (86%); KG: 576 of 684 (84%); total.: 789 of 933 (85%)	15 years	Graduates	12
Vaidya et al. <sup>311</sup>	2018	Europe	Cross-sectional (quantitative)	University: 27 of 31 (87%); Students: 2672 of 6752 (40%)	/	Curriculum- University; Foundation-Year Graduates	12
Vohra et al. <sup>312</sup>	2017	Australia	Cross-sectional (qualitative)	/	/	Training levels	7, 8
Walker et al. <sup>313</sup>	2019	Europe	Cross-sectional (quantitative)	394 of 774 (51%)	/	Medical students; Foundation-Year; Residents surgical specialties	1, 4, 7, 11
Wendel et al. <sup>314</sup>	2003	America	Cross-sectional (quantitative)	102 of 120 (85%)	/	Medical students (last year of study)	1, 8
Werwick et al. <sup>315</sup>	2017	Europe	Longitudinal (quantitative + qualitative)	258 of 373 (69%), 1 <sup>st</sup> Survey: 50 von 60 (83%), 2 <sup>nd</sup> Survey: 37 of 60 (62%), 3 <sup>rd</sup> Survey: 140 of 193 (73%), 4. Survey: 31 of 60 (52%)	/	Medical students	1, 10, 11
Whitaker et al. <sup>316</sup>	2020	America	Cross-sectional (quantitative)	205 of 628 (33%)	/	Medical students	1, 4, 7
Whittaker et al. <sup>317</sup>	2006	America	Cross-sectional (quantitative)	229 of / (/)	8 years	Medical students	1
Wiesenfeld et al. <sup>318</sup>	2014	America	Cross-sectional (quantitative)	60 of 111 (54%)	/	Applicants (psychiatry)	1, 8, 11, 13
Williamson et al. <sup>319</sup>	2003	Australia	Application observation longitudinal - Rural Health Curriculum (quantitative)	pre: 87 of / (88%); post: 79 of / (81%)	/	Medical students (5 <sup>th</sup> year of study)	12
Wimsatt et al. <sup>320</sup>	2016	America	Cross-sectional (quantitative)	94 of 111 (85%)	2 years	Curriculum of universities	1, 4, 5, 6, 7
Woodworth et al. <sup>321</sup>	2000	America	Cross-sectional (quantitative)	258 of 236 (67%)	/	Residents (surgery + primary care)	1, 11
Woolley et al. <sup>322</sup>	2019	Australia	Cross-sectional (quantitative + qualitative)	180 of 298 (60%); KG: 5 353	/	Residents	1, 4, 7, 8, 12
Wright et al. <sup>323</sup>	1997	America	Cross-sectional (quantitative)	136 of 146 (93%)	/	Medical students	2, 7
Wu and Greenberg <sup>324</sup>	2016	America	Application observation longitudinal - Self-Directed Preclinical Course in	/	/	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	6

			Ophthalmic Surgery (quantitative + qualitative)				
Xu et al. <sup>325</sup>	1999	America	Cross-sectional (quantitative)	1 561 of 2 600 (60%)	/	Physicians primary care	1, 6
Xu et al. <sup>326</sup>	1997	America	Cross-sectional (quantitative)	1 596 of 2 600 (61%)	/	Physicians primary care	1, 7
Yang et al. <sup>327</sup>	1994	America	Cross-sectional (quantitative)	Residents: 129 of 378 (34%); Curriculum: 16 of 16 (100%)	/	Residents anesthesia; Curriculum	1, 7, 8
Yong et al. <sup>328</sup>	2012	America	Application observation longitudinal - Preclinical course in ophthalmology and ophthalmic Virtual surgery (quantitative)	17 of 23 (74%)	/	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	6
Yoon et al. <sup>329</sup>	2018	America	Longitudinal (quantitative)	1 <sup>st</sup> Survey: 564 of 919 (61%); 2 <sup>nd</sup> Survey: 445 of 564 (79%); 3 <sup>rd</sup> Survey: 427 of 445 (96%)	5 years	Medical students (3 <sup>rd</sup> year of study)	7
Yu et al. <sup>330</sup>	2011	Australia	Cross-sectional (quantitative)	268 of 243 (69%)	/	Medical students (4 <sup>th</sup> year of study)	1
Zhang et al. <sup>331</sup>	2020	Asia	Application observation cross-sectional - Supplementary Regional Anatomy Teaching by Surgeons (quantitative)	71 of 71 (100%)	/	Medical students (3 <sup>rd</sup> year of study)	12
Ziegler et al. <sup>332</sup>	2019	America	Application observation cross-sectional - Surgical Exploration and Discovery Program (SEAD) (quantitative + qualitative)	25 of 30 (83%)	/	Medical students (1 <sup>st</sup> year of study)	6
Zuckerman et al. <sup>333</sup>	2016	America	Application observation longitudinal - Neurosurgery Elective (quantitative + qualitative)	35 of 35 (100%)	2 years	Medical students (1 <sup>st</sup> + 2 <sup>nd</sup> year of study)	6
Zuzuárregui <sup>334</sup>	2015	America	Application observation cross-sectional - Comprehensive Opportunities for Research and Teaching Experience (CORTEX) (quantitative)	/	/	Medical students (3 <sup>rd</sup> year of study)	4

**Note:** \*: All reference numbers refer to the numbering in [Additional file 2](#).

**Additional file 4: Quality assessment**

**Qualitative observational studies:**

Quality criterion	Alavi et al. [2019] <sup>9*</sup>	Albert et al. [2016] <sup>10</sup>	Appleton et al. [2017] <sup>16</sup>	Buddeberg-Fischer et al. [2002] <sup>44</sup>	Chan et al. [2020] <sup>51</sup>
<b>Research question</b>	Yes	Inaccurate	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Methods</b>	Yes; no rationale for the study design	Yes	Yes; measurement bias: different interview lengths	Yes; no rationale for the study design	Yes
<b>Recruitment strategy</b>	Yes; randomization: none; representativeness: none; selection bias: recruitment from population with general practice preference	Yes; randomization: none; representativeness: none; selection bias: no statements on gender ratio possible	Yes; randomization: none; representativeness: no assessment possible; selection bias: recruitment after quantitative survey	Yes; randomization: random selection with prior stratification; representativeness: no significant differences to the initial population, but no representativeness (authors' statement).	Yes; randomization: none; representativeness: no assessment possible; selection bias: invitation was made by the head of the study program; measurement bias: different focus group sizes; underrepresentation 3rd year of study, exclusion 1st year of study
<b>Follow-up</b>	/	/	/	/	/
<b>Data analysis / analysis process</b>	Yes; no pilot testing; bias: remuneration for participation; co-author is member of the review board that approved the study	Yes; piloted/validated questionnaires	Yes; pilot testing; bias: remuneration of participation	Yes; no pilot testing/validation	Yes; no pilot testing; questions were announced in advance
<b>Results and usefulness</b>	Qualitative approach was presented as a weakness	Yes; recall bias; low critical consideration of own study	Yes	Confirmation of the results can only be assessed in the further course of the respondents' professional development (snapshot); possible "trend" towards critical assessment of the work situation	Yes

Quality criterion	Cherry-Bukowiec et al. [2015] <sup>57</sup>	Daniels and Kassam [2011] <sup>72</sup>	Firth and Wass [2011] <sup>96</sup>	Kerfoot et al. [2005] <sup>156</sup>	Kozar et al. [2004] <sup>162</sup>
<b>Research question</b>	Yes	No clear formulation (only in the abstract)	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Methods</b>	No (socio-demographic) information on the study population; no justification of the study design.	Yes; measurement bias: different composition and size of focus groups	Yes; no exact description of the time of the survey	Yes	Yes; no justification of study design; measurement bias: different focus group sizes
<b>Recruitment strategy</b>	Yes; randomization: none; representativeness: none; selection bias: voluntary choice of acute surgical rotation (= primary interest)	Yes; randomization: none; representativeness: partly (subspecialties, gender - authors' statement), but small sample	Yes; randomization: no; representativeness: none; selection bias: voluntary participation (= primary interest),	Yes; randomization: none; representativeness: no assessment possible	Yes; randomization: none; Representativeness: none

			different proportions of the individual universities		
<b>Follow-up</b>	/	/	/	/	/
<b>Data analysis / analysis process</b>	Yes; no pilot testing; reporting bias: statements on 2009-2010 cannot be described as impact of rotation, no mention of waste after 2011	Yes; no pilot testing	Yes; no pilot testing	Yes; No pilot testing; "comparison group" did not receive the opposite questions, so that they could relate the questions to further surgical subjects (not only urology) and came from only one specialty (emergency medicine) (possible confounding)	Yes; no pilot testing; no listing of all influencing factors mentioned
<b>Results and usefulness</b>	Yes	Yes	Yes; tendency to positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties)	Yes	Yes; no critical consideration of own study

<b>Quality criterion</b>	<b>O'Herrin et al. [2003]<sup>230</sup></b>	<b>Parekh et al. [2021]<sup>233</sup></b>	<b>Parker et al. [2014]<sup>234</sup></b>	<b>Pianosi et al. [2016]<sup>239</sup></b>	<b>Querido et al. [2018]<sup>247</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Methods</b>	Yes; performance bias: allocation to different hospitals and different surgical specialties	Yes	Yes; performance bias: different support	Yes	Yes
<b>Recruitment strategy</b>	Yes; randomization: random allocation to the specialties of the surgical rotation; representativeness: none	Yes; randomization: none; representativeness: none (authors' statement)	Yes; randomization: none; representativeness: partly (age, ethnicity); selection bias: Overrepresentation of female participants	Inaccurate; randomization: none; representativeness: no assessment possible; selection bias: voluntary participation (= primary interest)	Yes; randomization: none; representativeness: none; selection bias: recruitment during a lecture, overrepresentation of female participants
<b>Follow-up</b>	/	10 month (choice of specialty not included)	/	/	/
<b>Data analysis / analysis process</b>	Yes; no pilot testing (logbook entries)	Yes; no pilot testing (daily logbook entries); susceptibility to interpretation	Yes; no pilot testing; no application of the principle of data saturation (possibly overlooking influential factors)	Yes; pilot testing	Yes; pilot testing
<b>Results and usefulness</b>	Yes	Yes	Yes; interview questions aimed the question "What influences your view", but in the Conclusion part presented as "Influence on career choice"	Yes	Yes; answer according to social desirability: one of the main authors works as a "medical educator" at the included university

<b>Quality criterion</b>	<b>Russo et al. [2020]<sup>261</sup></b>	<b>Saigal et al. [2007]<sup>265</sup></b>	<b>Scott et al. [2007b]<sup>272</sup></b>	<b>Shipper et al. [2018]<sup>281</sup></b>	<b>Singh and Alberti [2020]<sup>286</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes

<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Methods</b>	Yes; no socio-demographic information on the sample; measurement bias: no uniform implementation/study clarification	Yes	Yes; measurement bias: different survey times, different survey types (focus group discussions vs. individual interviews)	Yes	Yes
<b>Recruitment strategy</b>	Yes; randomization: none; representativeness: none; selection bias: only inclusion of training programs of home institutions of members of the research committee of the Association of Directors of Medical Student Education in Psychiatry (ADMSEP), different response rates of the individual included universities, exclusion of international residents	Yes; randomization: none; representativeness: none; selection bias: overrepresentation of clinical students	Yes; randomization: none; representativeness: none (authors' statement); selection bias: recruitment on the basis of a previous quantitative survey on career preference, over-representativeness of female participants, recruitment of different years of study from different universities	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest)	Yes; randomization: none; representativeness: none; selection bias: over-representativeness of female participants
<b>Follow-up</b>	/	/	Up to 4 years (choice of specialty not included)	/	/
<b>Data analysis / analysis process</b>	Yes; no pilot testing; strict structured approach according to "Career Construction Theory" may have led to overlooking of important influencing factors	Yes; pilot testing	Yes; no pilot testing	Yes; pilot testing	Yes; no pilot testing
<b>Results and usefulness</b>	Yes	Yes; conflict of interest/response by social desirability: the participating faculty plays a leading role in establishing family medicine in Japan, volunteer participants may have been aware of faculty bias towards primary care	Yes	Yes; response according to social desirability: interview conducted by the course instructors	Yes

<b>Quality criterion</b>	<b>Smith et al. [2017]<sup>289</sup></b>	<b>Sorouri et al. [2021]<sup>292</sup></b>	<b>Sozio et al. [2019]<sup>293</sup></b>	<b>Stahn and Harendza [2014]<sup>296</sup></b>	<b>Thistlethwaite et al. [2008]<sup>305</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Methods</b>	Yes; no justification of the study design; measurement bias: different focus group discussion duration	Yes; no justification of the study design	Yes; no socio-demographic information on the sample; no justification of the study design	Yes; no justification of the study design	Yes
<b>Recruitment strategy</b>	Imprecise (reference to qualitative survey already conducted); randomization: none; representativeness: none	Yes; randomization: none; representativeness: none; selection bias: participation on the basis of a letter of application and primary interest	Yes; randomization: none; representativeness: none; selection bias: Inclusion based on the training universities of the best-certified nephrologists (Top10 faculties)	Imprecise; randomization: none; representativeness: none	Yes; randomization: none; representativeness: none (authors' statement); selection bias: recruitment via selective media, individual institutions/persons and programs

<b>Follow-up</b>	/	/	/	/	/
<b>Data analysis / analysis process</b>	Yes; pilot testing; gender-specific approach, but not every gender of the participants was surveyed	Yes; no pilot testing	Yes; no pilot testing	Yes; no pilot testing	Yes; no pilot testing
<b>Results and usefulness</b>	Yes; conflict of interest/response according to social desirability: one of the two authors belongs to the group under consideration ("women in medical school")	Yes; response according to social desirability: interview conducted by the author herself; tendency to positive evaluation by preclinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties)	Yes; response according to social desirability/tendency to positivity: through competitive behavior between faculty at individual universities; university selection based on absolute number of graduates (later certified nephrologists), not on percentage share	Yes	Yes; Conflict of interest: study was funded by a grant from the "Australian Primary Health Care Research Institute"; Recall bias: increasing bias with increasing time distance from the end of the study

<b>Quality criterion</b>	<b>Tolhurst and Stewart [2005]<sup>307</sup></b>	<b>Vohra et al. [2019]<sup>312</sup></b>			
<b>Research question</b>	No clear formulation (only in the abstract)	No clear formulation (only in the abstract)			
<b>Preregistration</b>	No statement	No statement			
<b>Methods</b>	Yes; measurement bias: different sizes, discussion duration and gender composition (moderators) of the focus group discussions; no justification of the study design	Yes; measurement bias: different survey forms: telephone, web-based or "face-to-face", no uniform data collection; no justification of the study design			
<b>Recruitment strategy</b>	Yes; randomization: none; representativeness: none; selection bias: partly recruitment from a student conference on the topic of "Rural Conference" (primary interest), no information on group composition	Yes; randomization: none; representativeness: none; confounding: mainly general practitioners and residents from private group practices in regional and urban areas			
<b>Follow-up</b>	/	/			
<b>Data analysis / analysis process</b>	Yes; no pilot testing	Yes; no pilot testing			
<b>Results and usefulness</b>	Yes; no critical consideration of own study	Yes; no critical consideration of own study			

**Quantitative and quantitative + qualitative observational studies:**

Quality criterion	Abendroth et al. [2014] <sup>1</sup>	Admani et al. [2014] <sup>2</sup>	Ahsin and Saeed [2016] <sup>3</sup>	Al Salehi et al. [2019] <sup>4</sup>	Al-Asnag and Jan [2002] <sup>5</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; low representation of the recruitment strategy; randomization: none; representativeness: none (authors' statement); selection bias: response rate <50%, possible differences between "responders" and "non-responders"	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample; recruitment at a national professional congress	Yes; randomization: none; representativeness: none; selection bias/confounding: overrepresentation of the last year of study	Yes; randomization: no assessment possible; representativeness: none; selection bias: different response rates/proportions of graduates from the individual universities; no precise description of the recruitment strategy;	Yes; randomization: none; representativeness: none
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes	Yes	Yes	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing	Yes; no pilot testing	Yes; pilot testing	Yes; no pilot testing	Yes; no pilot testing
<b>Follow-up</b>	/	/	/	/	Start to end of rotation (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes	Only indication of absolute and relative frequencies	Only indication of absolute and relative frequencies; no critical consideration of own study	Only indication of absolute and relative frequencies	Yes; only a small proportion of the pre- and post-survey groups contained the same participants: low significance; the methodology mentions the statistical evaluation using the OR and the corresponding AI, but the OR is missing from the text

Quality criterion	Al-Jaeed et al. [2021] <sup>6</sup>	Al-Mendalawi [2010] <sup>7</sup>	Al-Nuaimi et al. [2008] <sup>8</sup>	Alberti et al. [2017] <sup>11</sup>	Alkatout et al. [2021] <sup>12</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: partly (necessary sample size was calculated beforehand); selection bias: >50% of the participants from the 2nd and 3rd year of the study	Yes; randomization: none; representativeness: none (authors' statement)	Yes; randomization: none; representativeness: given (authors' statement); selection bias: 1/3 of the participants from the 1st year of the study	Yes; randomization: none; representativeness: given; selection bias: possibly universities that are known to produce many general practitioners attract more students who already show a strong interest in general practice at the beginning	Yes; randomization: none; representativeness: none; selection bias: over-representativeness of female participants, voluntary participation (= primary interest)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes	Yes	Yes; no precise description of what was captured by the questionnaire for the	Yes

				universities; no definition given for "authentic teaching" (= susceptibility to interpretation)	
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing	No detailed presentation of the measuring instrument; no pilot testing	Yes; no pilot testing	Yes; no pilot testing	Yes; no pilot testing
<b>Follow-up</b>	/	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes; confounding: Results linked to curricular requirements of the respective study years (overrepresentation 2nd study year)	Yes	Yes; no critical consideration of own study	Yes	Yes; tendency to positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties)

<b>Quality criterion</b>	<b>Amalba et al. [2016]<sup>13</sup></b>	<b>Ambrozy et al. [1997]<sup>14</sup></b>	<b>Andlauer et al. [2012]<sup>15</sup></b>	<b>Are et al. [2018]<sup>17</sup></b>	<b>Arleo et al. [2016]<sup>18</sup></b>
<b>Research question</b>	Ja	Ja	Ja	Ja	Ja
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none; selection bias: higher proportion 4 <sup>th</sup> year of study	Yes; randomization: none; representativeness: no assessment possible; no precise description of the recruitment strategy (reference to another study); selection bias: no socio-demographic information on the sample	Yes; randomization: none; representativeness: none; selection bias: research objective was announced before the survey, so that more students with a primary interest in the subject area may have felt addressed	Yes; randomization: none; representativeness: given (authors' statement); selection bias: 1st university higher proportion of female participants each year, 2nd university higher proportion of male participants each year, higher response rates for the 1st and final year of study	Yes; randomization: none; representativeness: given (authors' statement); selection bias: only inclusion of universities listed in the "Alliance of Medical Student Educators in Radiology"
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes	Yes	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: differences between the included universities with regard to supervision
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing	Yes; pilot testing	Yes; no pilot testing, and use of an already validated test (ATP-30) and "International English Big Five Mini-Markers"	Yes; multiple interviews: 4 times; pilot testing	Yes; no pilot testing
<b>Follow-up</b>	/	/	/	4 years (1 <sup>st</sup> – 4 <sup>th</sup> year of study) (choice of specialty included)	/
<b>Statistical analysis and limitations</b>	Yes	Yes	Yes	Only indication of absolute and relative frequencies; no critical consideration of own study	Yes

<b>Quality criterion</b>	<b>Asaad et al. [2020]<sup>19</sup></b>	<b>Atalabi et al. [2013]<sup>20</sup></b>	<b>Azizzadeh et al. [2003]<sup>21</sup></b>	<b>Balogun and Adebayo [2019]<sup>22</sup></b>	<b>Barat et al. [2019]<sup>23</sup></b>
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<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none (authors' statement)	Yes; randomization: random selection 10 of 12 "classrooms"; representativeness: none	Yes; randomization: none; representativeness: none; selection bias: no statements on gender ratio possible, since 32 without gender data	Yes; randomization: none; representativeness: no assessment possible; selection bias: recruitment of participants in the lecture hall (primarily more committed students)	Yes; randomization: none; representativeness: partly; selection bias: no socio-demographic information on the sample
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes; no exact listing of the surveyed influencing factors	Yes	Yes	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing	Yes; no pilot testing	Yes; no pilot testing	Yes; use of a questionnaire from a previous study (no information on possible pilot testing)	Yes; no pilot testing; multiple surveys: 1st, 3rd and 5th postgraduate year, as well as after 10 years
<b>Follow-up</b>	/	/	/	/	Up to 10 years (choice of specialty included)
<b>Statistical analysis and limitations</b>	Yes	Yes	Yes; low critical consideration of own study	Yes	Yes

<b>Quality criterion</b>	<b>Barber et al. [2018]<sup>24</sup></b>	<b>Bauer et al. [2016]<sup>26</sup></b>	<b>Bédard et al. [2006]<sup>27</sup></b>	<b>Beier et al. [2015]<sup>28</sup></b>	<b>Berger et al. [2017]<sup>29</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible; selection bias: no information on the proportions of the two included study years	Yes; randomization: none; representativeness: no assessment possible; no information on recruitment strategy; selection bias: no socio-demographic information on the sample, voluntary participation (= primary interest)	Yes; randomization: none; representativeness: none; selection bias: differences in the response rate of the individual included universities, no information on the gender ratio, different settings for data collection (in part, few academic events attended)	Yes; randomization: none; Representativeness: no assessment possible; Selection bias: "Classical (macro) suture course as a prerequisite for participation (= primary interest), overrepresentation of the clinical phase	Yes; randomization: none; representativeness: none; no statements on recruitment strategy (reference to another study); no mention of the included university (only in the final part)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes; performance bias: no uniform implementation (differences in the order of the workshop stations)	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias: no uniform implementation (different supervision)	Yes; performance bias: possible differences between the included universities
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing; measurement bias: differences in the time interval between general practice block and survey	Yes; no pilot testing; multiple interviews: before and after "intervention"	Yes; pilot testing; multiple interviews: after pre-clinic and at the end of the internship	Yes; no pilot testing	Yes; no pilot testing
<b>Follow-up</b>	/	/	2 years (choice of specialty included)	/	3 years (choice of specialty included)
<b>Statistical analysis and limitations</b>	Yes; possible distortion of the results, due to temporal proximity of the general medical block and the survey for some participants	Yes; low critical consideration on own study	Yes; significant difference between "responders" and "non-responders"	Yes; recall bias: survey on "attitude" or subject area preference before the course was subsequently collected after the course; subjective	Yes; Confounding: Curriculum change over the course of the study in one cohort

				assessment of the increase in competence; no critical consideration of the own study	
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Quality criterion	Bhat et al. [2012] <sup>30</sup>	Bhutta et al. [2016] <sup>31</sup>	Bien et al. [2019] <sup>32</sup>	Blatt et al. [2022] <sup>33</sup>	Blue et al. [1996] <sup>34</sup>
<b>Research question</b>	No clear formulation (only in the abstract)	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: random selection from the register of assistants; representativeness: none	Yes; randomization: none; representativeness: no assessment possible; selection bias: recruitment on 5 different events (= primary interest); no indication of gender ratio	Yes; randomization: none; representativeness: no assessment possible; selection bias: differences in the proportions and response rates of the individual included universities	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest), no indication of gender ratio	Yes; randomization: none; representativeness: no assessment possible; overrepresentation of general practice
<b>Exposition and outcome</b>	Yes (short in methods)	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; no presentation/listing of all investigated influencing factors	Yes; performance bias: differences in study careers	Yes; no description of the individual university general medicine courses; performance bias: possible differences between the included universities	Yes	Yes; performance bias: due to possible curricular changes, changes in the teaching staff
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; no presentation/listing of all subject areas examined	Yes; pilot testing	Yes; pilot testing; measurement bias: no uniform implementation	Yes; no pilot testing	Yes; no pilot testing
<b>Follow-up</b>	/	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes; no critical consideration of own study	Yes	Yes; answering according to social desirability: announcement of the study objective before the interview	Only indication of absolute and relative frequencies; no critical consideration of own study	Yes; recall bias: increases with the number of years between the end of the study and the survey

Quality criterion	Bobo et al. [2009] <sup>35</sup>	Bolger et al. [2015] <sup>36</sup>	Bonura et al. [2016] <sup>37</sup>	Borges et al. [2009] <sup>38</sup>	Boyd et al. [2009] <sup>39</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: administrative allocation of students to the individual psychiatric rotation areas; representativeness: none; selection bias: over-representativeness of male participants (decrease in participants over the 5 years)	Yes; randomization: none; representativeness: no assessment possible; selection bias: no information on recruitment strategy, clinical phase only	Yes; randomization: none; representativeness: given (authors' statement); multiple stratification levels; selection bias: differences in response rates for spring and autumn; significantly higher proportion of participants from the north-east region	Little information on the sample and methodology; randomization: none; representativeness: none	Yes; randomization: none; representativeness: partial; selection bias: underrepresentation of emergency medicine, cluster effect due to different proportions from different universities
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes	Yes; performance bias: differences in training programs	Yes	Yes

<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing and use of existing questionnaires/test forms: performance data consisted of standardized NBME (National Board of Medical Examiners) examination results; measurement bias: no uniform data collection	Yes; use of an already piloted/validated questionnaire	Yes; no pilot testing	Yes; no pilot testing; measurement bias: no uniform data collection (different survey times and settings)	Yes; use of already piloted/validated questionnaires (Graduation Questionnaire (GQ) of the Association of American Medical Colleges = AAMC); measurement bias: differences in the surroundings of the universities
<b>Follow-up</b>	/	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes; changes in NBME scoring system over time, results before 1999/2000 had to be partially standardized using z-scores, NBME standard scores and means and standard deviations (SD)	Yes; no critical consideration of own study	Yes; confounding and influence of different training programs: showed no significance; limitation: spring cohort may already have had a final career plan, while the autumn cohort did not until later, size of graduating class estimated; recall bias: increased with the interval between the end of studies and the survey; conflict of interest: support from the Infectious Diseases Society of America	Yes; bias/confounding: setting of data collection (e.g. following final exams); low critical consideration of one's own study	Yes; bias: categorically collected data were numerically coded in this secondary analysis of the data; insufficient definition of the influencing factor: "controllable lifestyle"

Quality criterion	Boyle et al. [2014] <sup>40</sup>	Briggs et al. [2006] <sup>41</sup>	Brooks et al. [2016] <sup>42</sup>	Brown et al. [2015] <sup>43</sup>	Burack et al. [1997] <sup>45</sup>
<b>Research question</b>	Yes	No clear formulation (only in the abstract)	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Low; randomization: none; representativeness: no assessment possible; no precise description of the recruitment strategy	Yes; randomization: none; representativeness: no assessment possible; selection bias: no indication of gender ratio	Yes; randomization: none; representativeness: none; selection bias: recruitment through selection interviews, voluntary participation (= primary interest), high participation fee of course	Yes; randomization: none; representativeness: none; selection bias: in Swansea, study is only possible after previous psychology-associated training or study	Yes; randomization: none; representativeness: given (authors' statement)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes; no exact representation/listing of all influencing factors examined	Yes	Yes	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing	Yes; no pilot testing	Yes; valid information on the choice of specialist doctor	Yes; pilot testing of quantitative measurement instrument	Yes; pilot testing/validation of quantitative measurement instrument
<b>Follow-up</b>	/	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes	Only indication of absolute and relative frequencies; no agreement of calculated	Only indication of absolute and relative frequencies	Yes; bias: one participant took part in the focus group discussions (qualitative data), which served to prepare the	Yes; possible bias of the examiner, as well as freedom of interpretation

		response rate with the indicated response rate		questionnaire, without having any experience of the "short learning opportunities in the clinical setting" (LOCS)	
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Quality criterion	Calligaro and Dougherty [2006] <sup>46</sup>	Campos-Outcalt et al. [2004] <sup>47</sup>	Carmichael et al. [2020] <sup>48</sup>	Celenza et al. [2012] <sup>49</sup>	Chan et al. [2016] <sup>50</sup>
Research question	Yes	Yes	Yes	Yes	Yes
Preregistration	No statement	No statement	No statement	No statement	No statement
Study-population	Yes; randomization: none; representativeness: none (authors' statement); selection bias: no information on gender ratio, higher proportion of medical participants	Yes; randomization: none; representativeness: partly; selection bias: inclusion of the first 12 universities with increasing or decreasing numbers of applicants for general practice; differences in the response rates of the individual included universities	Yes; randomization: none; representativeness: none	Yes; randomization: none; representativeness: none; selection bias: primary interest in the subject studied, differences in sex ratios among groups	Yes; randomization: none; representativeness: no assessment possible; selection bias: overrepresentation of male participants
Exposition and outcome	Yes	Yes	Yes	Yes	Yes
Exposure measure(s), exposure levels	Yes	Yes; performance bias/confounding: possible differences between included universities	Yes	Yes	Yes
Definition of result, result measurement, number of measurements	Yes; no pilot testing	Yes; pilot testing	Yes; no pilot testing	Yes; pilot testing/validation; different questionnaires and number of data collection for the different groups (questionnaire of students significantly larger)	Yes; pilot testing
Follow-up	/	/	/	/	/
Statistical analysis and limitations	Yes	Low; no information on the included years	Yes; tendency to positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties)	Yes; answer according to social desirability, as some of the participants were colleagues of the authors	Yes; answering according to social desirability: negative statements are not common in the culture and are undesirable

Quality criterion	Chang et al. [2006] <sup>53</sup>	Chang et al. [2019] <sup>52</sup>	Chapman et al. [1999] <sup>54</sup>	Chaudhuri et al. [2013] <sup>55</sup>	Cheng et al. [2017] <sup>56</sup>
Research question	Yes	Yes	Yes	No clear formulation	Yes
Preregistration	No statement	No statement	No statement	No statement	No statement
Study-population	Yes; randomization: none; representativeness: no assessment possible; selection bias: different proportions and response rates of the individual included universities;	Yes; randomization: none; representativeness: none; selection bias: recruitment based on a selection process with presentations	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest)	Yes; randomization: none; representativeness: partly; selection bias: partly no indication of gender ratio, differences in recruiting countries	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest)

	overrepresentation of male participants				
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes; Confounding: differences in performance level and extent of teaching due to participation of different semesters	Yes	Yes	Yes; performance bias: possible changes over the course of time under consideration
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing	Yes; no pilot testing	Yes; no pilot testing; multiple interviews: before and after the course	Yes; no pilot testing; questionnaire adaptation to the individual training levels	Yes; no pilot testing
<b>Follow-up</b>	/	/	4 months (start to end of course – choice of specialty not included)	/	/
<b>Statistical analysis and limitations</b>	Yes; no critical consideration of own study	Low; only indication of absolute and relative frequencies	Yes; no pairing of pre- and post-data (limited evidence of preference change); significant increase in emergency medicine preference may be due to an additional group of students (preference change) or due to a complete change in group composition	Low; only indication of absolute and relative frequencies; no critical consideration of own study	Yes; answering according to social desirability: conducting the survey of instructors of the clinical traineeship; bias: mainly answering by participants with more positive experiences and better impression

<b>Quality criterion</b>	<b>Chew et al. [2018]<sup>58</sup></b>	<b>Chew et al. [2011]<sup>59</sup></b>	<b>Chung et al. [2016]<sup>60</sup></b>	<b>Cichon and Feldman [2014]<sup>61</sup></b>	<b>Clayton et al. [2010]<sup>62</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	No clear formulation
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible Selection bias: overrepresentation 4 <sup>th</sup> year of study, underrepresentation 5 <sup>th</sup> year of study, inclusion of only one of the teaching hospitals	Yes; randomization: none; representativeness: none; selection bias: only inclusion of study years 4 and 5, higher proportion of study year 4	Yes; randomization: none; representativeness: given for both universities (authors' statement), not for a generally valid statement for medical students (research objective); selection bias: different proportions of included universities, different recruitment strategies	Yes; randomization: none; representativeness: none - no agreement with the data of the "Accreditation Council for Graduate Medical Education" in the same year (gender); selection bias: overrepresentation of female participants	Yes; randomization: none; representativeness: no assessment possible; selection bias: only inclusion of members of the "British Association of Dermatologists (BAD)", no socio-demographic information on the sample
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes, confounding: differences in the level of performance and the extent of teaching due to the participation of different semesters	Yes	Yes; performance bias/confounding: possible (curricular) differences between included universities	Yes; performance bias/confounding: possible (curricular) differences in university education; no presentation/listing of the investigated influencing factors	Yes; performance bias/confounding: possible (curricular) differences in university education as well as training programs
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing; measurement bias: no uniform implementation	Yes; pilot testing; measurement bias: no uniform implementation	Yes; pilot testing; measurement bias: no uniform implementation	Yes; use of a previously used questionnaire ("National Survey of Factors Influencing Career Choice"), different	Yes; no pilot testing

				questionnaires for the groups studied	
<b>Follow-up</b>	/	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes	Yes	Yes; bias: remuneration for participation (lottery pool); low response rate when conducting the pilot study, participants in the pilot study were not excluded from the final survey	Low; only indication of absolute and relative frequencies	Low; only indication of absolute and relative frequencies; no critical consideration of own study

<b>Quality criterion</b>	<b>Clayton and Trotter [2013]<sup>63</sup></b>	<b>Cochran et al. [2005]<sup>64</sup></b>	<b>Codsi et al. [2019]<sup>65</sup></b>	<b>Corbett et al. [2002]<sup>66</sup></b>	<b>Correia Lima de Souza et al. [2015]<sup>67</sup></b>
<b>Research question</b>	Yes	Yes	Yes	No clear formulation	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: partly; selection bias: different proportions of the individual included universities, inclusion of only English-speaking Canadian universities, no socio-demographic information on the sample	Yes; randomization: none; representativeness: partly (demographic factors); selection bias: inclusion only of institutions that could be reached by e-mail contact	Yes; randomization: none; representativeness: given (authors' statement for Quebec/Canada) - none for the research objective; selection bias: over-representativeness of female participants	Yes; randomization: none; representativeness: no assessment possible	Yes; randomization: none; representativeness: partly (gender, distribution in private and state universities)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between included general medicine institutions	Yes; performance bias/confounding: possible differences between included general medicine institutions	Yes; performance bias/confounding: possible differences between included universities
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing	Yes; no pilot testing	Yes; pilot testing	Yes; no pilot testing; multiple interviews: before and after the internship	Yes; pilot testing
<b>Follow-up</b>	/	/	/	1 week (start to end of internship - choice of specialty not included)	/
<b>Statistical analysis and limitations</b>	Yes	Yes; bias: remuneration of participation	Yes	Yes; comparison with career planning after the end of studies	Yes; authors indicated a possible selection bias due to the 20.8% "non-responders".

<b>Quality criterion</b>	<b>Coyan et al. [2020]<sup>68</sup></b>	<b>Croghan and Baker [2020]<sup>69</sup></b>	<b>Cronin et al. [2019]<sup>70</sup></b>	<b>Dallas et al. [2019]<sup>71</sup></b>	<b>de Gates et al. [2019]<sup>75</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: partly (demographic factors for the institution - authors' statement) - but not for the research objective; selection bias: under-	Yes; randomization: none (quantitative), random sample for the focus groups; representativeness: no assessment possible; selection bias: different recruitment strategy, over-	Yes; randomization: none; representativeness: no assessment possible; selection bias: different proportions and response rates of the included universities and years of study	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest) overrepresentation of male participants, overrepresentation of 1 <sup>st</sup> year students; no	Yes; randomization: none; representativeness: none; no socio-demographic information on the sample

	representativeness of the 5 <sup>th</sup> year of study	representativeness of male participants in the focus groups		recruitment from the same population	
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes; performance bias/confounding: possible differences between included universities	Yes	Yes; performance bias/confounding: possible differences between the included universities, different number of sessions	Yes; performance bias/confounding: possible differences between included universities
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing	Yes; no pilot testing, but based on the questionnaire of the "Association for Medical Education in Europe (AMEE)"	Yes; no pilot testing	Yes; no pilot testing; multiple interviews: before and after the course	Yes; validated measuring instrument (quantitative date)
<b>Follow-up</b>	/	/	/	Start to end of course (choice of specialty not included)	/
<b>Statistical analysis and limitations</b>	Yes	Yes; answering according to social desirability: conducting the focus group discussions by the first author	Yes	Yes; tendency to positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); no verification of attendance	Yes; bias: compensation for participation, announcement of a change of course before the interview

<b>Quality criterion</b>	<b>DeBolle et al. [2019]<sup>76</sup></b>	<b>Deutsch et al. [2014]<sup>77</sup></b>	<b>Deutsch et al. [2013]<sup>78</sup></b>	<b>Deutsch et al. [2015]<sup>79</sup></b>	<b>Dever et al. [2001]<sup>80</sup></b>
<b>Research question</b>	No clear formulation	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	No; randomization: no assessment possible; representativeness: no assessment possible; selection bias: no socio-demographic and numerical information on the sample	Yes; randomization: none; representativeness: given (authors' statement); selection bias: different proportions and response rates for the individual survey cohorts	Yes; randomization: none; representativeness: partly (age - authors' statement) - but not for the study objective; selection bias: voluntary participation (= primary interest), over-representativeness of female participants	Yes; randomization: none; representativeness: given (authors' statement); selection bias: different proportions and response rates for the individual survey cohorts	Yes; Randomization: none; Representativeness: no assessment possible; Selection bias: no socio-demographic information on the sample
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes; performance bias: different numbers of perceived general practice services	Yes; performance bias/confounding: possible differences between the different practices	Yes; performance bias: different numbers of perceived general practice services	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; use of valid data from databases	Yes; pilot testing; measurement bias: different survey times	Yes; no pilot testing; multiple interviews: before and after elective subject	Yes; pilot testing; measurement bias: no uniform implementation (different survey times)	Yes; no pilot testing
<b>Follow-up</b>	/	/	Start to end of elective (choice of specialty not included)	/	11 years (choice of specialty included)
<b>Statistical analysis and limitations</b>	Low; only indication of annual applicant numbers; high	Yes; no significant difference between "responders" and "non-	Yes; tendency to positive evaluation by pre-clinical	Yes; no significant difference between "responders" and "non-	Yes; reporting bias: the influence of rotation in the last

	susceptibility to biases and distortions	responders"; 24% had not yet completed their studies at the time of the survey	participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties)	responders"; 24% had not yet completed their studies at the time of the survey	year, as a strong influencing factor for the non-primary care specialties, was not investigated
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Quality criterion	Dewey and Agostini [2010] <sup>81</sup>	Dogbey et al. [2018] <sup>82</sup>	Doucet et al. [1999] <sup>83</sup>	Dunkley et al. [2008] <sup>85</sup>	Ek et al. [2005] <sup>86</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample	Yes; randomization: none; representativeness: none; selection bias: higher proportion of students; differences in recruitment strategy	Yes; randomization: none; representativeness: none	Yes; randomization: none; representativeness: partly; selection bias: different proportions of years of further education and of regions	Yes; randomization: none; representativeness: no assessment possible; selection bias: different proportions of included universities
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias: differences in the clinical rotation wards and the implementation dates of the clinical clerkship/internship	Yes; performance bias/confounding: possible differences between included universities	Yes	Yes; performance bias/confounding: possible differences between the training programs	Yes; performance bias/confounding: possible differences between included universities
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing	Yes; pilot testing (no information on the sample of the pilot study, selection bias not excluded)	Yes; no pilot testing	Yes; pilot testing	Yes; no pilot testing
<b>Follow-up</b>	/	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes; simple blinding; matching with the choice of specialist according to the result of the "Residency Matching"	Yes	Yes	Yes; recall bias: increasing with the number of years between the end of the study and the survey; no critical consideration on own study	Yes; only indication of absolute and relative frequencies

Quality criterion	Ekenze et al. [2013] <sup>87</sup>	Ellsburly et al. [1996] <sup>88</sup>	Ellsburly et al. [1998] <sup>89</sup>	Erraji et al. [2015] <sup>90</sup>	Erzurum et al. [2000] <sup>91</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible	Yes; randomization: none; representativeness: none; selection bias: selection of two universities that produce a high rate of primary care physicians in a national comparison	Yes; randomization: none; representativeness: none; selection bias: inclusion of universities that produce a large number of general practitioners in a national comparison	Yes; randomization: none; representativeness: none; selection bias: over-representativeness of group 1, response only by male participants	Yes; randomization: none; representativeness: none
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes; performance bias/confounding: possible differences between included universities	Yes	Yes; performance bias/confounding: possible differences between included institutions	Yes

<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing	Yes; no pilot testing	Yes; no pilot testing; measurement bias: no uniform implementation	Yes; no pilot testing	Yes; no pilot testing; measurement bias: no uniform implementation
<b>Follow-up</b>	/	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes; interview directly on the last day of the clerkship; low critical consideration on own study	Yes; reporting bias: exclusion of influencing factors named by less than 5% of the participants; bias in the interpretation of qualitative data	Yes	Low; only absolute and relative frequencies are given, according to the authors' statement, the results were not made significant; recall bias increases with the number of years between the end of studies and the survey	Yes; low critical consideration of own study

<b>Quality criterion</b>	<b>Farooq et al. [2014]<sup>92</sup></b>	<b>Fehlmann et al. [2019]<sup>93</sup></b>	<b>Feit [1994]<sup>94</sup></b>	<b>Fereydooni et al. [2021]<sup>95</sup></b>	<b>Fitzgerald et al. [2013]<sup>97</sup></b>
<b>Research question</b>	Yes	Yes	Yes	No clear formulation	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: partly (some regions not represented); selection bias: differences in the response rates of the individual countries (overrepresentation of German medical students, underrepresentation of Brazil, Hong Kong, Chile, etc.)	Yes; randomization: none; representativeness: partly (choice of continuing education in the investigated field and its gender ratio) - rest not assessable; selection bias: differences in the survey dates or in the years of data collection	Yes; randomization: none; representativeness: no assessment possible; selection bias; different recruitment strategies, no socio-demographic information on the sample	Yes; randomization: none; representativeness: none; selection bias: application process for the further education position simultaneously constituted the application process for study participation	Yes; randomization: none; representativeness: no significant difference of the sample to the total population - but none for the research objective; selection bias: overrepresentation of the standard 5-year curriculum
<b>Exposition and outcome</b>	Yes	Yes	Low	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between the included universities of the different countries	Yes	Yes; performance bias/confounding: possible differences between the included universities	Yes; performance bias/confounding: possible (curricular) differences in university education	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing and use of already validated questionnaires; measurement bias: no uniform implementation	Yes; no pilot testing; measurement bias: no uniform implementation	Yes; no pilot testing; measurement bias: no uniform implementation	Yes; no pilot testing; questionnaires prepared by authors who participated in the study themselves	Yes; pilot testing
<b>Follow-up</b>	/	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes; bias: transfer of 5-point Likert scale results to a binary outcome; data not available from all countries on all questionnaires; missing data from American and Australian regions	Yes	Yes; response according to social desirability: author is himself a student at one of the included universities; no indication of a response rate; division of the subject areas into different categories, but no indication of the definitions of the individual categories and their associated subject areas	Yes; bias: remuneration of participation (lottery pool); bias: participation of two authors	Yes

<b>Quality criterion</b>	<b>Fogarty et al. [2003]<sup>98</sup></b>	<b>Ford [2005]<sup>100</sup></b>	<b>Ford et al. [2018]<sup>99</sup></b>	<b>Foster [1994]<sup>101</sup></b>	<b>Frey et al. [2021]<sup>102</sup></b>
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<b>Research question</b>	Yes	No clear formulation	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none; missing data (gender data)	Yes; randomization: none; Representativeness: partly (English-speaking universities); Selection bias: Inclusion of English-speaking universities only; Different recruitment strategies	Yes; randomization: none; representativeness: no assessment possible; no socio-demographic information on the sample populations; selection bias: voluntary participation (= primary interest), recruitment of participants based on applications	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest)	Yes; randomization: none; representativeness: no assessment possible; selection bias: voluntary participation (= primary interest), no socio-demographic information on the sample
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias: in the course of study Changes in the curriculum	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias: different curricular/university requirements compared to the comparison group	Yes	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing	Yes; no pilot testing and use of validated/valid Canadian Resident Matching Service (CaRMS) data	Yes; pilot testing of the intervention; questionnaire development based on already validated questionnaires	Yes; no pilot testing; measurement bias: questionnaire based on letters to participants (64% answered)	Yes; no pilot testing; multiple interviews: before and after the course
<b>Follow-up</b>	/	/	/	/	Start to end of course (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; no critical consideration of own study	Yes; no definition of PBL given; purely subjective data output by the representatives of the universities; choice of subject area in the CaRMS may have been influenced by factors such as "popularity of individual subject areas"	Low; only indication of absolute and relative frequencies; no temporal correlation of the compared data, data of the comparison group from previous years	Yes; inclusion of questionnaires from participants who completed the program; tendency to positivity: participants showed significantly higher academic success	Yes; no pairing of pre- and post-data (limited statement on preference change); no critical consideration of own study

Quality criterion	Gami and Howe [2020] <sup>103</sup>	Gawad et al. [2013] <sup>104</sup>	Gebhard and Müller-Hilke [2019] <sup>105</sup>	Glasbey et al. [2017] <sup>106</sup>	Goldacre et al. [2013] <sup>107</sup>
<b>Research question</b>	No clear formulation	No clear formulation	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: given (authors' statement); selection bias: university produces more general practitioners in national comparison	Low methodological and recruitment representation; randomization: none; representativeness: no assessment possible; selection bias: voluntary participation (= primary interest)	Yes; randomization: none; representativeness: no assessment possible; selection bias: significantly higher proportion of 4 <sup>th</sup> and 5 <sup>th</sup> year students, overrepresentation of female participants	Yes; randomization: none; representativeness: partly; selection bias: overrepresentation clinical phase, overrepresentation UK sites; very large age range, course cost	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample; little description of the recruitment strategy (reference to other study)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes; performance bias: differences in subject order	Yes; no presentation/listing of all investigated influencing factors	Yes; performance bias: course costs only for participants who are not members of the Association of Surgeons in	Yes; performance bias/confounding: possible differences between university

				Training (ASiT), no uniform implementation at the different venues	education and training programs (also over time)
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing, based on already used questionnaires	Yes; study itself is the pilot study of the program; multiple interviews: before and after the program	Yes; no pilot testing; questionnaire compiled on the basis of focus group discussions: 84% female participants	Yes; no pilot testing; multiple interviews: before and after the course	Yes; no pilot testing; multiple interviews: End of study, 1 <sup>st</sup> , 3 <sup>rd</sup> and 5 <sup>th</sup> postgraduate year; measurement bias: no uniform implementation
<b>Follow-up</b>	/	Start to end of program (choice of specialty not included)	/	Start to end of course (choice of specialty not included)	each cohort at least 5 years (choice of specialty included)
<b>Statistical analysis and limitations</b>	Yes; absolute and relative frequencies only; conflict of interest: second author is a staff member at the included university	Yes; bias: pre- and post-survey were the same	Yes	Yes; bias: participation was necessary to receive the course certificate, the best ratings came from Association of Surgeons in Training (ASiT) members; no critical consideration of own study	Yes; recall bias eliminated by prospective approach; reporting bias: data gaps and outstanding data

Quality criterion	Goldacre et al. [2010] <sup>108</sup>	Golden et al. [2010] <sup>109</sup>	Golden et al. [2014] <sup>110</sup>	Goldenberg et al. [2017] <sup>111</sup>	Goldman et al. [2019] <sup>112</sup>
<b>Research question</b>	Yes	Yes	Yes	No clear formulation	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Low; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample; little description of the recruitment strategy (reference to other study)	Yes; randomization: none; representativeness: none	Yes; randomization: none; Representativeness: none; Selection bias: overrepresentation of Chicago students	Yes; randomization: none; Representativeness: partly; Selection bias: no socio-demographic information on the sample	Yes; randomization: none; representativeness: none; selection bias: overrepresentation of male participants
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; Performance bias/confounding: possible differences between university education and training programs (also over time)	Yes	Yes; performance bias: no uniform implementation	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between included institutions
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; multiple interviews: End of study, 1 <sup>st</sup> , 3 <sup>rd</sup> and 5 <sup>th</sup> postgraduate year, as well as in the further course; measurement bias: no uniform implementation	Yes; no pilot testing	Yes; study itself was a pilot study; multiple interviews: before and after clerkship	Yes; using the results of validated questionnaires (Matriculating Student Questionnaire (MSQ), end: Medical School Graduation Questionnaire (GQ), the AAMC)	Yes; no pilot testing; measurement bias: no uniform implementation (differences in survey time points)
<b>Follow-up</b>	each cohort at least 5 years (choice of specialty included)	/	Start to end of clerkship (choice of specialty not included)	/	/
<b>Statistical analysis and limitations</b>	Yes; recall bias eliminated by prospective approach; reporting bias: data gaps and outstanding data	Low; only absolute and relative frequencies given; bias due to possible previous geriatric exposures	Yes; reporting bias: only listing of qualitative responses that agreed, no attention paid to individual responses; little	Yes; if a later specialization was indicated, a subject area preference had to be stated, even if it was still undecided;	Yes; the data of the comparison group come from a previous survey (changes over time)

			critical consideration of own study	significance level was set at p<0.0017	
<b>Quality criterion</b>	<b>Greene et al. [2015]<sup>114</sup></b>	<b>Grimm et al. [2017]<sup>115</sup></b>	<b>Guilloux et al. [2019]<sup>116</sup></b>	<b>Guraya and Almaramhy [2018]<sup>117</sup></b>	<b>Gutiérrez-Cirlos et al. [2019]<sup>118</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible; selection bias: recruitment based on applications (= primary interest)	Yes; randomization: none; representativeness: partly (gender ratio)	Yes; randomization: none; representativeness: given (mathematical adjustment to ensure representativeness of responses across all demographic groups); selection bias: differences in response rates between regions	Yes; randomization: none; representativeness: no assessment possible; selection bias: overrepresentation of female participants	Yes; randomization: none; representativeness: none (for the research objective)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes	Yes; performance bias/confounding: possible differences between included universities	Yes	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; use of previously used questionnaires (University of Ottawa Skills and Simulation Centre (uOSSC) evaluation sheet); multiple interviews: before and after the program; measurement bias: specification of a restricted subject area preference selection	Yes; no pilot testing	Yes; validation of survey	Yes; no pilot testing	Yes; validation of measuring instrument
<b>Follow-up</b>	Start to end of program (choice of specialty not included)	/	/	/	Start to end of study (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; subjective evaluation; tendency to positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties)	Yes; aim of a gender-specific survey (however, significantly lower proportion of female participants, which is nevertheless representative for the field)	Yes; significance level was set at p<0.009; identified significant influencing factors could only explain 6.3% of the variance	Low; only presentation of absolute and relative frequencies	Yes
<b>Quality criterion</b>	<b>Gutmann et al. [2019]<sup>119</sup></b>	<b>Hagopian et al. [2015]<sup>120</sup></b>	<b>Halaas et al. [2008]<sup>121</sup></b>	<b>Hammoud et al. [2006]<sup>122</sup></b>	<b>Harris et al. [2005]<sup>123</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: partly (allopathic universities); selection bias: no inclusion of	Yes; randomization: none; representativeness: partly; selection bias: different participant rates per year	Yes; randomization: none; representativeness: partly; selection bias: voluntary participation (= primary interest),	Yes; randomization: none; representativeness: partly (gender) - none for the research objective; selection bias:	Yes; randomization: none; representativeness: partly (authors' statement) - none for the research objective

	osteopathic universities and international physicians		little information on the study population	overrepresentation of Asian students, underrepresentation of Hispanic students, different proportions of included universities	
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias: no uniform implementation	Yes; performance bias: no uniform implementation, changes in the course of studies	Yes; performance bias/confounding: possible differences between included universities	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; using the results of validated questionnaires (start: Matriculating Student Questionnaire (MSQ), end: Medical School Graduation Questionnaire (GQ), the AAMC)	Yes; use of valid data („Residency Matching“ data)	Yes; no pilot testing and use of valid data (database); multiple survey: continuously every 3 years	Yes; no pilot testing; multiple interviews: before and after the internship	Yes; pilot testing
<b>Follow-up</b>	Start to end of study (choice of specialty not included)	Comparison with Residency Matching data	Up to 36 years (choice of specialty included)	Start to end of clerkship (choice of specialty not included)	/
<b>Statistical analysis and limitations</b>	Yes	Only absolute and relative frequencies are given; subject preference may already have existed before the internship; no objective verification of subjective statements; often retrospective entry of data (recall bias); confounding: due to other influencing factors within the framework of the internship (supervision, number of operations)	Yes; missing definitions; recall bias: increasing with the number of years between program and survey	Yes; possible difference between "responders" and "non-responders"; overestimation of the effect for "Hispanics"	Yes; OR data without indication of the CI; reporting bias: exclusion of the specialty "dermatology"

Quality criterion	Hassoulas et al. [2017] <sup>124</sup>	Hauer et al. [2008a] <sup>125</sup>	Hauer et al. [2008b] <sup>126</sup>	Hawthorne and Dinh [2017] <sup>127</sup>	Henderson et al. [1996] <sup>130</sup>
<b>Research question</b>	No clear formulation	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible; selection bias: no description of the recruitment strategy, no socio-demographic information on the sample	Yes; randomization: none; representativeness: given (authors' statement); selection bias: different proportions and response rates of the individual universities included	Yes; randomization: none; representativeness: partly	Yes; randomization: none; representativeness: none	Yes; randomization: none, simple blinding; Representativeness: none; Selection bias: Recruitment after a lecture or examination
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between included universities	Yes	Yes; performance bias: no uniform implementation

<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing	Yes; pilot testing	Yes; validation	Yes; no pilot testing; multiple interviews: before and after the course	Yes; no pilot testing; measurement bias: no uniform implementation; multiple survey: before and after internship
<b>Follow-up</b>	/	/	/	Start to end of course (choice of specialty not included)	Start to end of clerkship (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Only indication of absolute and relative frequencies; so far, investigation of the effect of only one CBL case	Yes; bias: remuneration of participation; significance level was set at $p < 0.01$	Yes; indirect data collection; response according to social desirability/wishful thinking: effect may have been overestimated by the directors themselves; confounding: factor analysis identified influencing factors that explain only about 50% of the variance	Yes; Confounding: possible previous general medical internships/exposure	Yes; bias: time of measurement (final exam)

<b>Quality criterion</b>	<b>Henderson et al. [2002]<sup>129</sup></b>	<b>Higgins and Thomson [2019]<sup>133</sup></b>	<b>Histing et al. [2013]<sup>134</sup></b>	<b>Hofhansl and Körmöczí [2014]<sup>135</sup></b>	<b>Holm-Petersen et al. [2007]<sup>136</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: partly (for the included universities) - none for the research objective; different information on the sample in abstract and methodology	Low; randomization: none; representativeness: no assessment possible; selection bias: 16% missing sex information	Yes; randomization: none; representativeness: partly (gender) for the included university, but no target group specification in the research objective; selection bias: voluntary participation (= primary interest); only clinical students	Yes; randomization: none; representativeness: no assessment possible; no socio-demographic data available for the year of data collection; selection bias: voluntary participation (= primary interest)	Yes; randomization: none; representativeness: given (authors' statement); selection bias: no indication of response rates and proportions of individual included universities
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between the included universities (according to the authors' statement, the curricula are the same)	Yes	Yes	Yes; performance bias: no uniform implementation	Yes; performance bias/confounding: possible differences between included universities
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; measurement bias: no uniform implementation	Yes; no pilot testing; multiple interviews: before and after the course	Yes; no pilot testing; multiple interviews: before and after the course	Yes; no pilot testing	Yes; no pilot testing; measurement bias: no uniform implementation; multiple interviews: Baseline and post-internship
<b>Follow-up</b>	/	Start to end of course (choice of specialty not included)	Start to end of course (choice of specialty not included)	/	Baseline to end of clerkship (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; answering according to social desirability: distribution of questionnaires by known general practitioners	Yes; gender-specific statements with 16% "missing" data	Only indication of absolute and relative frequencies; no critical consideration of own study	Only submission of absolute and relative frequencies; bias: free mentor selection (already	Yes

				existing friendships, acquaintances, etc.)	
<b>Quality criterion</b>	<b>Holt et al. [2019]<sup>137</sup></b>	<b>Hon et al. [2021]<sup>138</sup></b>	<b>Hor et al. [2019]<sup>139</sup></b>	<b>Howe and Ives [2001]<sup>140</sup></b>	<b>Hunt et al. [1995]<sup>141</sup></b>
<b>Research question</b>	Yes	Yes	Yes	No clear formulation	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none; selection bias: recruitment of participants on the basis of applications (= primary interest)	Yes; randomization: none, but random selection from the applicant pool; representativeness: none; selection bias: voluntary participation (= primary interest) Overrepresentation 2 <sup>nd</sup> year of study	Yes; randomization: none; representativeness: given (authors' statement); selection bias: recruitment after a teaching unit	Yes; randomization: none; representativeness: no assessment possible (authors' statement)	Yes; Randomization: none; Representativeness: no assessment possible; Selection bias: no socio-demographic information on the sample
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between supervisors	Yes	Yes	Yes	Yes; performance bias/confounding: possible differences between supervisors
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing and use of validated questionnaires (ATP-30); multiple interviews: Baseline, 1, 2 and 3 years later	Yes; no pilot testing	Yes; no pilot testing and use of validated questionnaires (ATP-30); multiple survey: before and after rotation, as well as end of 5 <sup>th</sup> year of study	Yes; pilot testing; measurement bias: no uniform implementation; multiple interviews: before and after the program	Yes; no pilot testing; multiple interviews: before and after the course
<b>Follow-up</b>	3 years (choice of specialty not included)	/	2 years (choice of specialty not included)	1 year (choice of specialty not included)	Start to end of course (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; data gaps; confounding/bias: further psychiatric exposures (independent of the program studied) during the course, insufficient adherence of students/no execution of the program as intended	Yes; recall bias: specialist preference before the course was assessed by post-course questionnaire; social desirability response: subjective assessment of knowledge gain and surgical skills	Yes	Yes; incorrect presentation of the results in the tables; conflict of interest: first author is designer/coordinator of the "new" curriculum	Yes; significance level was set at p<0.1

<b>Quality criterion</b>	<b>Huntington et al. [2014]<sup>142</sup></b>	<b>Ibrahim et al. [2016]<sup>143</sup></b>	<b>Ibrahim et al. [2014]<sup>144</sup></b>	<b>Jagadeesan et al. [2014]<sup>145</sup></b>	<b>Jayakumar et al. [2016]<sup>146</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none; selection bias: consideration of applicants to only one training program	Yes; randomization: none; representativeness: given (authors' statement: regarding gender ratio)	Yes; randomization: none; representativeness: given (authors' statement: gender distribution, proportion of graduates), none (proportion of students in their final year of study, low response rate); selection bias: no representation of the different response rates and proportions	Yes; randomization: none; representativeness: none; selection bias: only use of questionnaires from allopathic universities	Yes; randomization: none; representativeness: partly

<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between university education	Yes; performance bias/confounding: possible differences between university education	Yes; performance bias/confounding: possible differences between university education	Yes; performance bias/confounding: possible differences between university education	Yes; performance bias/confounding: possible differences between included universities; curricular changes in the course
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing	Yes; pilot testing	Yes; pilot testing	Yes; no pilot testing; measurement bias/information bias: only indication of up to 4 clerkships possible	Yes; no pilot testing
<b>Follow-up</b>	/	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes; bias: remuneration of participation (lottery pool); susceptibility to interpretation of items	Yes; low critical consideration of own study	Yes	Yes	Yes

<b>Quality criterion</b>	<b>Johnson et al. [2012]<sup>147</sup></b>	<b>Joiner et al. [2017]<sup>148</sup></b>	<b>Kaderli et al. [2011]<sup>149</sup></b>	<b>Kahn et al. [2011]<sup>150</sup></b>	<b>Kansayisa et al. [2018]<sup>151</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none; selection bias: only inclusion of 4 <sup>th</sup> year of study	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample	Yes; randomization: none; representativeness: no assessment possible	Yes; randomization: none; representativeness: none; selection bias: no information on response rate and gender ratios of the individual universities	Yes; randomization: none; representativeness: given (authors' statement: gender ratio); selection bias: recruitment during university courses (no compulsory attendance)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between included universities and university education/training programs	Yes; performance bias/confounding: possible differences between included institutions	Yes; performance bias: no uniform implementation	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between included institutions
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing	Yes; no pilot testing; multiple interviews: start, 2 <sup>nd</sup> week and 3 <sup>rd</sup> week or end	Yes; pilot testing; multiple interviews: before and after the internship	Yes; no pilot testing	Yes; no pilot testing
<b>Follow-up</b>	/	4 months (choice of specialty not included)	Start to end of clerkship (choice of specialty not included)	/	/
<b>Statistical analysis and limitations</b>	Yes; concentration on trend information, not on significance; different total numbers for different questions (incomplete questionnaires were also included); weak significance for the group of female orthopedic applicants	Only indication of absolute and relative frequencies	Yes	Yes; conflict of interest/response according to social desirability: one of the authors lectures in burn surgery at one of the included universities	Yes; bias: no exposure to all subject areas yet (only the "core areas")

<b>Quality criterion</b>	<b>Kapoor and Smith [2014]<sup>152</sup></b>	<b>Karmali et al. [2018]<sup>153</sup></b>	<b>Kassebaum et al. [1996]<sup>154</sup></b>	<b>Keepes [1995]<sup>155</sup></b>	<b>Khader et al. [2008]<sup>157</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes

<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none; selection bias: as an introductory question, question about the existence of a radiology curriculum (universities without a radiology curriculum were discouraged from participating)	Yes; randomization: none; representativeness: none; selection bias: course costs, voluntary participation (= primary interest)	Yes; randomization: none; representativeness: given	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample	Yes; randomization: none; representativeness: no assessment possible; selection bias: recruitment of 2 <sup>nd</sup> , 4 <sup>th</sup> and 6 <sup>th</sup> year students due to their availability
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between the included universities, possible curricular changes in the course of studies	Yes	Yes; performance bias/confounding: possible differences between the included universities	Yes	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing and use of valid data from databases (Electronic Residency Application Service (ERAS))	Yes; no pilot testing; multiple interviews: before and after the course	Yes; use of a validated, national survey	Yes; no pilot testing	Yes; no pilot testing
<b>Follow-up</b>	/	Start to end of course (choice of specialty not included)	Start to end of study (choice of specialty not included)	/	/
<b>Statistical analysis and limitations</b>	Yes; response according to social desirability: tendency towards positivity, subjective statements of the directors about their radiology curriculum; examination of the total number of radiology applicants over 5 years (per university), no annual analysis of possible correlations with curricular changes	Yes; survey of specialist preference only after the course; bias: identical pre- and post-questionnaire; to assess the acquisition of technical skills, only one of 8 stations was assessed	Yes; no critical consideration of own study	Yes; no critical consideration of own study	Yes; no critical consideration of own study

<b>Quality criterion</b>	<b>Khater-Menassa and Major [2005]<sup>158</sup></b>	<b>Knox et al. [2008]<sup>159</sup></b>	<b>Kolasinski et al. [2007]<sup>160</sup></b>	<b>Kost et al. [2019]<sup>161</sup></b>	<b>Kozar et al. [2003]<sup>163</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible	Yes; randomization: none; representativeness: no assessment possible; selection bias: no precise socio-demographic information on the sample; overrepresentation of one university	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample; only recruitment of members of the "American Academy of Family Physicians (AAFP)" (= primary interest)	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest); missing gender-specific data
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes

<b>Exposure measure(s), exposure levels</b>	Yes	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between included institutions	Yes; performance bias/confounding: possible differences between included universities	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing	Yes; no pilot testing	Yes; no pilot testing	Yes; no pilot testing; measurement bias: only if the intention of further training in general medicine is stated further questioning regarding faculty support and mentoring	Yes; no pilot testing; multiple interviews before and after the course
<b>Follow-up</b>	/	/	/	/	Start to end of course (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; bias: time of survey (final exam)	Yes; bias: time of survey (final examination); response according to social desirability: study conducted by employees of one of the universities included in the survey	Only indication of absolute and relative frequencies; no critical consideration of own study	Yes; identified influencing factors explain approx. 50% of the variance	Yes; tendency to positive evaluation by preclinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); no critical consideration of own study

<b>Quality criterion</b>	<b>Kraft et al. [2018]<sup>164</sup></b>	<b>Kreykes et al. [2020]<sup>165</sup></b>	<b>Kuhnigk et al. [2009]<sup>166</sup></b>	<b>Kumar and Dhaliwal [2011]<sup>167</sup></b>	<b>Kumar et al. [2019]<sup>168</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible; selection bias; no socio-demographic information on the sample	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest), recruitment through social networks and word of mouth	Yes; randomization: none; representativeness: given (authors' statement) - none with regard to the population stated in the research objective	Yes; randomization: none; representativeness: no assessment possible; selection bias: recruitment at university event, voluntary participation (= primary interest)	Yes; randomization: none; representativeness: no assessment possible; selection bias: voluntary participation (= primary interest), overrepresentation preclinical phase
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes	Yes	Yes	Yes; performance bias/confounding: possible differences between included universities
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; multiple interviews: before and after the course	Yes; pilot testing (and study is itself a pilot study); multiple interviews: before and after the course	Yes; no pilot testing + use of validated questionnaires (ATP-30); measurement bias: no uniform implementation	Yes; pilot testing	Yes; no pilot testing; multiple interviews: before and after the elective
<b>Follow-up</b>	Start to end of course (choice of specialty not included)	Start to end of course (choice of specialty not included)	/	/	Start to end of elective (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; bias: compulsory pre-questionnaire, voluntary completion of post-questionnaire; tendency to	Yes; bias: boarding, identical pre- and post-questionnaire, no pairing of pre- and post-data (limited statement on preference	Yes; answering according to social desirability: presence of the study director	Yes	Yes; decrease of participants in the course (by 54%); tendency to positive evaluation by preclinical participants, (possibly

	positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); no pairing of pre- and post-data (limited statement on change in preference)	change); tendency to positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated, euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties)			first encounter with a clinical field, associated with this, euphoria/enthusiasm for the first clinical experience, no competition from other clinical fields); partly only average statement
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Quality criterion	Kurlandsky et al. [1994] <sup>169</sup>	Kurowecki et al. [2021] <sup>170</sup>	Kuteesa et al. [2021] <sup>171</sup>	Kutikov et al. [2011] <sup>172</sup>	Lampe et al. [2010] <sup>173</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	No clear formulation
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic statements on the sample, different proportions of the individual universities included	Yes; randomization: none; Representativeness: partial; Selection bias: slight deviation from the predominant gender distribution	Yes; randomization: none; representativeness: no assessment possible; selection bias: recruitment at university event	Yes; randomization: none; representativeness: no assessment possible; selection bias: only inclusion of applicants who were accepted, allopathic universities and universities with at least 1 applicant for urology	Yes; randomization: none; representativeness: none; selection bias: no indication of gender ratio
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between university education	Yes	Yes; performance bias/confounding: possible differences between included universities	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; examination results and inclusion of subjective assessments; measurement bias: no uniform implementation	Yes; pilot testing	Yes; pilot testing	Ja, no pilot testing; use of valid data (Residency-Matching-Data)	Yes; measurement bias: no uniform implementation
<b>Follow-up</b>	/	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes; community assignment by lottery or own decision	Yes; response according to social desirability: knowledge about the implementation of the study by the radiology institute; influence factor analysis only on the basis of the questionnaires with radiology specialty preference; recall bias: increasing with the number of years between the end of the study and the survey	Yes; no indication whether participation in quantitative survey excluded participation in qualitative survey or vice versa	Yes	Yes; recall bias: retrospective survey of specialist preference before the course in the questionnaire after the course.

Quality criterion	Lau et al. [2015] <sup>174</sup>	Lawal and Afolabi [2013] <sup>175</sup>	Lebastchi et al. [2018] <sup>176</sup>	Lee et al. [1995] <sup>177</sup>	Lee et al. [2022] <sup>178</sup>
<b>Research question</b>	Yes	Yes	Yes	Inaccurate/low	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement

<b>Study-population</b>	Yes; randomization: none; representativeness: given	Yes; randomization: given (authors' statement); representativeness: none	Yes; randomization: none; representativeness: no assessment possible; selection bias: no information on the different proportions of the included universities	Yes; randomization: none; representativeness: none; selection bias: only inclusion of students with concrete specialist preference and interest in psychiatry	Yes; randomization: none; representativeness: no assessment possible
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between included universities and specialties	Yes; performance bias/confounding: possible differences between university education	Yes; performance bias/confounding: possible differences between included universities	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing and use of valid data (residency matching data); measurement bias: no uniform implementation	Yes; no pilot testing	Yes; no pilot testing	Yes; no pilot testing; study itself is a pilot study	Yes; use of previously used questionnaires; multiple interviews: before and after the psychiatric curriculum
<b>Follow-up</b>	/	/	/	/	4 years (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; answer according to social desirability: tendency to positivity of the leaders; only average data	Yes; overall evaluation of all 5 years, no consideration of individual years; bias: more positive impression of specialties with high additional income (lucrative private practices)	Yes; no precise indication of a response rate possible (blinding); response according to social desirability: survey after application, but before final selection of further education applicants; double participation not excluded	Yes; no critical consideration of own study	Yes; ceiling effect: dichotomisation of categories; studied effect can only be evaluated for the entire psychiatric curriculum and not for individual components

<b>Quality criterion</b>	<b>Lee et al. [2011]<sup>179</sup></b>	<b>Lefevre et al. [2010]<sup>180</sup></b>	<b>Leong et al. [2005]<sup>181</sup></b>	<b>Lindeman et al. [2013]<sup>182</sup></b>	<b>López-García et al. [2019]<sup>183</sup></b>
<b>Research question</b>	Yes	Yes	Inaccurate/low	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible; selection bias: voluntary participation (= primary interest), no indication of study year proportions	Yes; randomization: none; representativeness: given (authors' statement); selection bias: only those enrolled in the National Ranking Practice Examination (NRPE)	Yes; randomization: none; representativeness: no assessment possible; selection bias: voluntary participation (= primary interest), lack of gender-specific data	Yes; randomization: none; Representativeness: none; Selection bias: no socio-demographic information on the sample	Yes; randomization: none; representativeness: no assessment possible
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between the curricular and university experiences until the follow-up survey	Yes; performance bias/confounding: possible differences between included universities	Yes	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias: no uniform implementation
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing and use of validated questionnaires (Global Endovascular Ratings Scale (GERS)); no uniform implementation	Yes; use of validated survey	Yes; pilot testing	Yes; pilot testing	Yes; exam results and already validated questionnaire (Calculation of Attitudes Towards and Knowledge of Family Medicine Questionnaire (CAMF)); multiple interviews:

					before and after the course, as well as at the end of the study; measurement bias: no uniform implementation
<b>Follow-up</b>	Up to 3 years (choice of specialty not included)	/	/	/	4 years (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; no use of simulator possible before, but ability assessment on it; indication of overall result (despite different time intervals); tendency to positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated, euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); conflict of interest: research and funding funds	Yes; bias: time of survey (before application result for further education)	Yes	Yes; no indication of an exact response rate possible (different recruitment strategies)	Yes; low comparability; bias: different time distance from the general medicine course; response according to social desirability: questionnaire handed out by teachers

<b>Quality criterion</b>	<b>Lukas et al. [2017]<sup>185</sup></b>	<b>Lyons et al. [2015]<sup>186</sup></b>	<b>Lyons and Janca [2015]<sup>187</sup></b>	<b>MacDowell et al. [2013]<sup>188</sup></b>	<b>Madani et al. [2018]<sup>190</sup></b>
<b>Research question</b>	No clear formulation (only in the abstract)	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none; selection bias. Recruitment at a national conference; different proportions of the individual training levels (19% missing data), predominance of neurosurgical participants	Yes; randomization: none; representativeness: no assessment possible; selection bias: voluntary participation (= primary interest), different proportions of included universities	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest)	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest)	Yes; randomization: random sample; representativeness: no assessment possible; no exact representation of the recruitment strategy
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between individual training levels	Yes; performance bias/confounding: possible differences between included universities	Yes	Yes	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; use of a previously used questionnaire	Yes; no pilot testing; multiple interviews: before and after the program; measurement bias: changes in the questionnaire in the course of the study, no uniform implementation	Yes; use of validated questionnaires (Balon Attitudes Towards Psychiatry (Balon), Mental Illness Clinicians Attitudes (MICA)); multiple interviews: before and after clerkship	Yes; use of valid data (databases)	Yes; validation/pilot testing
<b>Follow-up</b>	/	1-6 years (choice of specialty included)	Start to end of clerkship (choice of specialty not included)	/	/

<b>Statistical analysis and limitations</b>	Yes	Yes; recall bias: increasing with the number of years between program participation and survey	Yes; no pairing of pre- and post-data (limited statement on preference change)	Yes; no consideration of the time before program initiation	Yes; no critical consideration of own study
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Quality criterion	Mahendran et al. [2015] <sup>191</sup>	Maiorova et al. [2008] <sup>192</sup>	Malikova et al. [2010] <sup>193</sup>	Manassis et al. [2006] <sup>194</sup>	Markovic et al. [2012] <sup>195</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none; no exact representation of the recruitment strategy; selection bias: low sample representation, different gender ratios for the individual clerkships	Yes; randomization: none; representativeness: none	Yes; randomization: none; representativeness: none	Yes; randomization: none; representativeness: none	Yes; randomization: none, random allocation of applicants to the two application branches; representativeness: none; selection bias: voluntary participation (= primary interest), significant differences between both groups
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes; performance bias: no uniform implementation	Yes	Yes; performance bias/confounding: possible differences between included universities	Yes; different intervention branches/application branches
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing and use of validated questionnaires (Attitudes to Psychiatry Scale; Dundee Ready Educational Environment Measure); multiple interview: before and after rotation	Yes; pilot testing; measurement bias: no uniform implementation	Yes; use of validated questionnaires (the Vascular Surgery Knowledge Questionnaire (VSKQ)); multiple interviews: before and after clerkship; extended questionnaire in case of elective participation	Yes; no pilot testing	Yes; no pilot testing; multiple interviews: depending on application group
<b>Follow-up</b>	Start to end of rotation (choice of specialty not included)	Start to end of clerkship (choice of specialty not included)	Start to end of clerkship (choice of specialty not included)	/	Start to 3 months after simulation (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; no critical consideration of own study	Yes; analysis of variance	Yes; response according to social desirability: questionnaires handed out by the traineeship supervisors and before the evaluation; information on knowledge gain and skills learned purely subjective; for the identification of influencing factors, only questionnaires of those with participation in a vascular surgery elective were evaluated (= primary interest)	Yes	Yes; bias: remuneration for participation, equating "interest in vascular surgery" and "interest in further training in vascular surgery/specialty choice"; analysis of variance

Quality criterion	Martini et al. [1994] <sup>197</sup>	Matalon et al. [2019] <sup>198</sup>	Matsos et al. [2018] <sup>199</sup>	Matsumoto et al. [2019] <sup>200</sup>	Matthews et al. [2015] <sup>201</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes

<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: given (for America) - low generalizability	Yes; randomization: none; representativeness: none; selection bias: different recruitment strategies	Yes; randomization: none; representativeness: no assessment possible; selection bias: different proportions of individual regions, different gender ratios	Yes; randomization: none; representativeness: none; selection bias: recruitment from "Midwest IR Medical Student Symposium (MIRMSS)" (= primary interest), different proportions of included universities	Yes; randomization: none; representativeness: given (authors' statement); selection bias: recruitment on the basis of an application procedure (= primary interest)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias: consideration of different years	Yes; performance bias/confounding: possible differences between university education	Yes; performance bias/confounding: possible differences between university education and training programs	Yes; performance bias: no uniform implementation	Yes; performance bias: no uniform implementation
<b>Definition of result, result measurement, number of measurements</b>	Yes; validation/pilot testing and use of valid data from databases	Yes; no pilot testing	Yes; no pilot testing	Yes; no pilot testing; measurement bias: no uniform implementation	Yes; no pilot testing
<b>Follow-up</b>	/	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes; bias: estimated data; graduates survey and curriculum survey not for the same year: possible curricular changes, so that the curriculum of the graduates surveyed differs from that of the surveyed; no critical consideration of own study	Yes; answering according to social desirability: questionnaire partly handed out by further education directors; no exact response rate possible	Yes; no exact response rate possible; response according to social desirability: questionnaires partly handed out by directors of continuing education	Yes; the lecture "Women in IR (WIR)" was organized exclusively for female medical students for reasons of space and funding, although 57% of the male participants would also have been interested in it	Yes; bias: no definition for "rural" vs. "urban"

<b>Quality criterion</b>	<b>Maudsley et al. [2010]<sup>202</sup></b>	<b>Mayes et al. [2016]<sup>203</sup></b>	<b>Mazeh et al. [2010]<sup>204</sup></b>	<b>McCaffrey [2005]<sup>205</sup></b>	<b>McCord et al. [2009]<sup>206</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible; selection bias: recruitment based on application interviews (= primary interest)	Yes; randomization: none; representativeness: none	Yes; randomization: none; representativeness: no assessment possible; selection bias: different proportions/response rates of included universities	Yes; randomization: none; representativeness: none; selection bias: recruitment on the basis of application interviews (= primary interest), different proportions/response rates of included universities, overrepresentation of male participants	Yes; randomization: none; representativeness: no assessment possible; selection bias: missing gender-specific data
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between university education
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; measurement bias: no uniform implementation	Yes; pilot testing; multiple interviews: before and after rotation	Yes; no pilot testing; different questionnaires	Yes; no pilot testing	Yes; no pilot testing

<b>Follow-up</b>	1 to 5 years (choice of specialty not included)	Start to end of rotation (choice of specialty not included)	/	/	/
<b>Statistical analysis and limitations</b>	Yes	Yes; mainly absolute and relative frequencies; low critical consideration of own study	Yes; no critical consideration of own study	Yes; different information about the participants; little critical consideration of the own study	Yes; recall bias: increases with the number of years between the end of the study and the survey

<b>Quality criterion</b>	<b>McDonald et al. [2021]<sup>207</sup></b>	<b>McHugh et al. [2011]<sup>208</sup></b>	<b>McKechnie et al. [2021]<sup>209</sup></b>	<b>McKee et al. [2007]<sup>210</sup></b>	<b>McLean [2006]<sup>211</sup></b>
<b>Research question</b>	Yes	Yes	Yes	No clear formulation	No clear formulation
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none	Yes; randomization: none; representativeness: no assessment possible; selection bias: recruitment via the database of the "Royal College of Surgeons in Ireland (RCSI)" and a surgical training website	Yes; randomization: none; representativeness: given (authors' statement) - partly	No; randomization: none; representativeness: none; no selection bias: no socio-demographic information on the sample, voluntary participation (= primary interest)	Yes; randomization: none; representativeness: no assessment possible; no information on recruitment strategy (reference to a previous study)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes; performance bias: possible changes in the curriculum/training programs in the course of the period under consideration	Yes; performance bias/confounding: possible differences between university education	Yes; performance bias: no uniform implementation	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing and valid data; multiple interviews: Start of study, 2 <sup>nd</sup> , end of 4 <sup>th</sup> year of study and residency matching	Yes; no pilot testing and valid data from a database	Yes; pilot testing	Yes; no pilot testing; multiple interviews: before and after the club	Yes; no pilot testing
<b>Follow-up</b>	Start to end of study (choice of specialty included)	5 years (choice of specialty included)	/	Start to end of club (choice of specialty not included)	/
<b>Statistical analysis and limitations</b>	Yes; no indication of an exact response rate	Yes; recall bias: increasing with the number of years between the end of the study and the survey; follow-up possible for only 61%	Yes; bias: remuneration of participation (lottery pool), estimation of response rate	Yes	Yes; no critical consideration of own study

<b>Quality criterion</b>	<b>McParland et al. [2003]<sup>212</sup></b>	<b>Mehmood et al. [2012]<sup>213</sup></b>	<b>Mihalynuk et al. [2006]<sup>214</sup></b>	<b>Montgomery et al. [2015]<sup>215</sup></b>	<b>Moore et al. [2016]<sup>216</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none	Yes; randomization: none; representativeness: no assessment possible; no exact representation of the recruitment strategy	Yes; randomization: none; representativeness: none; no exact representation of the recruitment strategy	Yes; randomization: none; representativeness: none; selection bias: missing demographic data of 10.8 %	Yes; randomization: none; representativeness: no assessment possible
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes	Yes	Yes	Yes; performance bias/confounding: possible differences between university education and training programs

<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing, audit results and use of validated questionnaires (ATP-30); multiple interview: before and after exposure	Yes; pilot testing	Yes; no pilot testing	Yes; no pilot testing	Yes; no pilot testing
<b>Follow-up</b>	Start to end of exposition (choice of specialty not included)	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes; no critical consideration of own study	Yes	Yes; absolute and relative frequencies only; response according to social desirability: submission of qualitative reflection papers to supervising directors	Yes; bias: remuneration of participation (lottery pool)	Yes; conflict of interest/responsibility according to social desirability: authors involved in training in anesthesia themselves

<b>Quality criterion</b>	<b>Morrison and Murray [1996]<sup>217</sup></b>	<b>Mortlock et al. [2017]<sup>218</sup></b>	<b>Mulcare et al. [2011]<sup>219</sup></b>	<b>Mutha et al. [1997]<sup>220</sup></b>	<b>Nakhoul et al. [2021]<sup>221</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible	Yes; randomization: none; representativeness: none; selection bias: none Information on the proportions of included universities and years of study	Yes; randomization: none; representativeness: partly	Yes; randomization: none; representativeness: partial (gender, ethnicity); selection bias: recruitment based on availability, no information on the distribution of participants in general and in the group discussions	Yes; randomization: none; representativeness: partial (gender, ethnicity); selection bias: different proportions/response rates of included universities
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias: no uniform implementation	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between university education and training programs
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; multiple interviews: before and after exposure, and 1 year after graduation	Yes; no pilot testing, audit results and use of validated questionnaires (ATP-30); multiple interview: before and after the course	Yes; pilot testing; measurement bias: no uniform implementation	Yes; pilot testing; measurement bias: no uniform implementation	Yes; pilot testing
<b>Follow-up</b>	16-26 months (choice of specialty not included)	Start to end of course (choice of specialty not included)	/	/	/
<b>Statistical analysis and limitations</b>	Yes; no critical consideration of own study	Yes; bias: use of same questionnaires in pre- and post-survey	Yes; response according to social desirability/propensity for positivity: subjective information on the curriculum, by the respective directors; no consideration of further/other emergency medical exposures	Yes; answer according to social desirability: presence of the study leaders	Yes; bias: remuneration for participation (lottery pool); response according to social desirability: questionnaires handed out by the directors of continuing education

<b>Quality criterion</b>	<b>Ndetei et al. [2013]<sup>222</sup></b>	<b>Nelson et al. [2020]<sup>223</sup></b>	<b>Ng et al. [2020]<sup>224</sup></b>	<b>Ng et al. [2021]<sup>225</sup></b>	<b>Ni Chróinín et al. [2013]<sup>226</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes

<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible; selection bias: recruitment in a lecture	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample, voluntary participation (= primary interest)	Yes; randomization: none; representativeness: given (authors' statement)	Yes; randomization: none; representativeness: none; selection bias: recruitment of participants from databases (only residents listed there)	Yes; randomization: none; representativeness: partly given for the university under consideration, but not for the research objective described; selection bias: voluntary participation (= primary interest)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes; performance bias: possible curricular changes in the period under consideration	Yes; performance bias/confounding: possible differences between education institutions	Yes; performance bias/confounding: possible differences between university education and training programs	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing and use of validated questionnaires (ATP-30, Standardized Assessment of Personality (SAP), etc.)	Yes; no pilot testing and use of valid data (database)	Yes; no pilot testing	Yes; pilot testing	Yes; no pilot testing; multiple interviews: before and after the module
<b>Follow-up</b>	/	/	/	/	Start to end of module (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; no exact interrogation as an influencing factor on specialist preference, but presentation as such; no critical consideration of own study	Yes; tendency to positive evaluation by preclinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); no critical consideration of own study	Yes; acquisition bias; recall bias: survey on "attitude" or subject area preference before the course was subsequently collected after the course	Yes; response according to social desirability/tilt towards positivity: subjective information about the curriculum, by the respective directors; different total number for individual items; recall bias: increasing with the number of years between the end of the study and the survey	Yes; no pairing of pre- and post-data (limited statement on preference change)

<b>Quality criterion</b>	<b>Noble [2006]<sup>227</sup></b>	<b>Noble et al. [2007]<sup>228</sup></b>	<b>O'Donoghue et al. [2015]<sup>229</sup></b>	<b>Onyemaechi et al. [2017]<sup>231</sup></b>	<b>Osborn [1993]<sup>232</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample, no representation of the recruitment strategy	Yes; randomization: none; representativeness: no assessment possible	Yes; randomization: none; representativeness: no assessment possible	Yes; randomization: none; representativeness: none; selection bias: recruitment at a retreat, overrepresentation of male participants, significant age differences between genders	Yes; randomization: none; representativeness: no assessment possible; selection bias: different recruitment strategy
<b>Exposition and outcome</b>	Low	Low	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between university education and training programs	Yes; performance bias/confounding: possible differences between university education and training programs	Yes; performance bias/confounding: possible differences between teaching institutions and supervision	Yes	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; use of previously used questionnaires (National Physician Survey (NPS))	Yes; no pilot testing	Yes; pilot testing	Yes; pilot testing	Yes; no pilot testing

<b>Follow-up</b>	/	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes; recall bias: increasing with the number of years between the end of the study and the survey; no critical consideration on own study	Yes; no critical consideration of own study	Yes; little critical consideration of own study; response according to social desirability/approval tendency	Yes	Yes; answering according to social desirability: partly recruitment/survey at residency matching program (influence on selection); no definitions for similar items; no critical consideration of own study

<b>Quality criterion</b>	<b>Pearson and Westra [2016]<sup>235</sup></b>	<b>Pearson et al. [2002]<sup>236</sup></b>	<b>Peiffer-Smadja et al. [2020]<sup>237</sup></b>	<b>Phillips and Charnley [2016]<sup>238</sup></b>	<b>Piccinato et al. [2017]<sup>240</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest), no indication of gender ratio, different proportions and response rates of the individual training levels	Yes; randomization: creation of comparable groups through random allocation after categorization; representativeness: no assessment possible	Yes; randomization: none; representativeness: no assessment possible	Yes; randomization: none; representativeness: none (authors' statement)	Yes; randomization: none; representativeness: none; selection bias: 2/3 of participants from general surgery, vascular surgery and visceral surgery
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias: possible curricular changes to the course in the period under consideration	Yes	Yes; performance bias/confounding: possible differences between university education and training programs	Yes; performance bias: no uniform implementation	Yes; performance bias/confounding: possible differences between university education and training programs
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; measurement bias: no uniform implementation	Yes; pilot testing; measurement bias: no uniform implementation	Yes; pilot testing	Yes; no pilot testing; multiple interviews: before and after the clerkship, as well as in the 4th year of study	Yes; no pilot testing
<b>Follow-up</b>	/	/	/	Up to 1 year (choice of specialty not included)	/
<b>Statistical analysis and limitations</b>	Yes; tendency to positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); recall bias: increasing with the number of years between course end and survey	Yes; creation of comparable groups by random assignment, after categorization; dichotomization of subject area preference; recall bias: increasing with the number of years between the end of studies and the survey, as well as influence of the work environment/field of work	Yes; inclination to positive/interest increase: survey 2 years after recognition of the specialty of "infectious diseases and tropical diseases	Yes; dichotomization of the 4 response categories; no pairing of the pre- and post-data (limited statement on preference change)	Yes; answering according to social desirability: personal address and presence of the authors; susceptibility to interpretation for the qualitative data, as there is no definition of the answers

<b>Quality criterion</b>	<b>Pointer et al. [2017]<sup>241</sup></b>	<b>Polsky and Werner [2004]<sup>243</sup></b>	<b>Poole et al. [2008]<sup>244</sup></b>	<b>Prud'homme et al. [2020]<sup>245</sup></b>	<b>Pullen et al. [2013]<sup>246</sup></b>
<b>Research question</b>	Yes	Yes	Yes	No clear formulation	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement

<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible; selection bias: no indication of gender ratio	Yes; randomization: none; representativeness: none; selection bias: significant difference between "responders" and "non-responders"	Yes; randomization: none; representativeness: none; selection bias: different gender ratios	Yes; randomization: none; representativeness: no assessment possible; selection bias: recruitment from application portal	Yes; randomization: none; representativeness: no assessment possible; selection bias: no indication of gender ratio, voluntary participation (= primary interest)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias: no uniform implementation	Yes; performance bias/confounding: possible differences between university education and training programs	Yes; no pilot testing	Yes; performance bias/confounding: possible differences between university education	Yes; performance bias/confounding: possible differences between included universities
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; measurement bias: no uniform implementation	Yes; no pilot testing	Yes; no pilot testing; measurement bias: no uniform implementation	Yes; no pilot testing; measurement bias: no uniform implementation	Yes; no pilot testing and study was itself a pilot study; multiple interviews: Beginning and end of study year (measurement bias: no uniform implementation)
<b>Follow-up</b>	/	/	/	/	Partial start to end of the academic year (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; recall bias: increases with the number of years between the end of the study and the survey	Yes; answering according to social desirability: questionnaire handed out by the directors of continuing education	Yes; no pairing of pre- and post-data (limited significance)	Yes; only indication of absolute and relative frequencies; response according to social desirability: survey after application, but before selection result; inclination to positivity/interest increase: survey 1 year after recognition of the specialty of "geriatrics"	Yes; follow-up survey only with regular participation

Quality criterion	Rahbar et al. [2010] <sup>248</sup>	Ramaswamy et al. [2019] <sup>249</sup>	Rao et al. [2017] <sup>250</sup>	Ravindra et al. [2013] <sup>252</sup>	Ravindra and Fitzgerald [2011] <sup>251</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none; selection bias: different proportions/response rates of the individual included education levels	Yes; randomization: none; representativeness: no assessment possible (significant differences to data in the literature); selection bias: different proportions of the individual training levels	Yes; randomization: none; representativeness: partial; selection bias: different proportions/response rates for the individual study years and ethnicities	Yes; randomization: none; representativeness: partial (authors' statement); selection bias: recruitment in a university event	Yes; randomization: none; representativeness: given (authors' statement) - none for the stated research objective
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between the included education levels	Yes; performance bias/confounding: possible differences between university education and training programs	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias: no uniform implementation	Yes; performance bias: no uniform implementation

<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; measurement bias: no uniform implementation	Yes; no pilot testing	Yes; pilot testing	Yes; pilot testing; measurement bias: no uniform implementation	Yes; pilot testing
<b>Follow-up</b>	/	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes; comparison of a ("large") heterogeneous group with a ("small") homogeneous group of another educational level; no indication of a response rate	Yes	Yes; no precise indication of a response rate possible	Yes	Yes

<b>Quality criterion</b>	<b>Ray et al. [2018]<sup>253</sup></b>	<b>Redman et al. [1994]<sup>254</sup></b>	<b>Rehman et al. [2011]<sup>255</sup></b>	<b>Retrouvey et al. [2018]<sup>256</sup></b>	<b>Roberts and Khursandi [2002]<sup>257</sup></b>
<b>Research question</b>	Yes	Yes	Yes	No clear formulation	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none (authors' statement); selection bias: not all geographical regions represented	Yes; randomization: none; representativeness: none; selection bias: recruitment in a university event, significant differences between the "responders" and "non-responders", different response rates of the included groups	Yes; randomization: none; representativeness: partial (gender); selection bias: recruitment on campus	Yes; randomization: none; Representativeness: no assessment possible; Selection bias: no socio-demographic information on the sample	Yes; randomization: only for male members; representativeness: no assessment possible; selection bias: recruitment from the Australian Society of Anesthetists, different proportions and response rates for gender and included regions, one region not represented
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between university education and training programs	Yes	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias: no uniform implementation	Yes; performance bias/confounding: possible differences between university education and training programs
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing	Yes; no pilot testing	Yes; pilot testing	Yes; no pilot testing; multiple interviews: before and after the course; measurement bias: no uniform implementation	Yes; no pilot testing
<b>Follow-up</b>	/	/	/	Start to end of course (choice of specialist not included)	/
<b>Statistical analysis and limitations</b>	Yes; response according to social desirability: survey after application, but before final selection of further education applicants	Yes	Yes	Yes; tendency to be positively evaluated by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); answering according to social desirability: videos were developed and shot at inclusive university;	Yes; recall bias: increasing with the number of years between the end of the study and the survey; randomization only for the male participants; low critical consideration of own study

				participation "compulsion": exam questions from the videos	
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Quality criterion	Rojnic Kuzman et al. [2013] <sup>258</sup>	Roy et al. [2021] <sup>259</sup>	Rubeck et al. [1995] <sup>260</sup>	Ryan et al. [2018] <sup>262</sup>	Saalwachter et al. [2005] <sup>263</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: given (authors' statement); selection bias: recruitment of contact addresses in a university event	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest), different proportions of years of study	Yes; randomization: none; representativeness: none	Yes; randomization: none; representativeness: partly (gender)	Yes; randomization: none; representativeness: no assessment possible; selection bias: different proportions and response rates of the individual groups
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes	Yes; performance bias: possible curricular changes in the period under consideration	Yes; performance bias/confounding: possible differences between university education and training programs	Yes; performance bias/confounding: possible differences between university education and training programs
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing and use of validated questionnaires (Attitude to Psychiatry Scale (ATP-18), International English Mini-Markers)	Yes; no pilot testing; multiple interviews: before and after the course	Yes; no pilot testing	Yes; no pilot testing	Yes; pilot testing
<b>Follow-up</b>	/	Start to end of course (choice of specialty not included)	/	/	/
<b>Statistical analysis and limitations</b>	Yes; questionnaire in English, not in mother tongue	Yes; tendency to positive evaluation by preclinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); subjective statements on knowledge gain and skills; no critical reflection on own study	Yes; recall bias: increasing with the number of years between the end of the study and the survey; no critical consideration of own study	Yes; recall bias: increasing with the number of years between the end of studies and the survey; participants included in the list of all participants, but not listed in the individual groups	Yes; no indication of a response rate possible; recall bias: increasing with the number of years between the end of the study and the survey; bias: study time: implementation of the 80h-rule

Quality criterion	Saberski et al. [2015] <sup>264</sup>	Sanfey et al. [2006] <sup>267</sup>	Schnuth et al. [2003] <sup>268</sup>	Schwartz et al. [1995] <sup>269</sup>	Schwartz et al. [2011] <sup>270</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample	Yes; randomization: none; representativeness: no assessment possible; selection bias: different proportions and response rates of the individual studies	Yes; randomization: none; representativeness: given for the included university, but not with regard to the research objective; selection bias: different proportions of years of study	Yes; randomization: yes; representativeness: given (authors' statement); selection bias: only inclusion of universities with at least 150 students	Yes; randomization: none; representativeness: partial (year considered) (authors' statement)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes

<b>Exposure measure(s), exposure levels</b>	Yes; performance bias: possibly no uniform implementation over the study period	Yes; performance bias/confounding: possible differences between included universities	Yes	Yes	Yes; performance bias/confounding: possible differences between university education and training programs
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; multiple interviews: before and after the course	Yes; pilot testing	Yes; pilot testing	Yes; pilot testing	Yes; use of already collected data (piloted questionnaire)
<b>Follow-up</b>	Start to end of course (choice of specialty not included)	/	/	/	/
<b>Statistical analysis and limitations</b>	Yes; only absolute and relative frequencies; subjective assessment of the increase in knowledge and understanding; tendency to positive assessment by preclinical participants, (possibly first encounter with a clinical specialty, associated with this, euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); no critical consideration of the own study	Yes; university of the pilot study also included for the study; no indication of a response rate possible; no critical consideration of own study	Yes; no naming of the included university	Yes; deviations of figures in the text from those in the tables; no critical consideration of own study	Yes; dichotomization of the 5-Likert scale; bias: remuneration of participation in an included study

<b>Quality criterion</b>	<b>Scott et al. [2007a]<sup>271</sup></b>	<b>Sedaghat et al. [2012]<sup>273</sup></b>	<b>Seo et al. [2017]<sup>274</sup></b>	<b>Seow et al. [2018]<sup>275</sup></b>	<b>Shaikh et al. [2015]<sup>276</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none; selection bias: exclusion of international students	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest), different proportions and response rates of the individual study years, cohorts, etc	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest), no socio-demographic information on the sample, different proportions of years of study	Yes; randomization: none; representativeness: no assessment possible; selection bias: different proportions and response rates of the study years	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias: no uniform implementation	Yes; performance bias: no uniform implementation, possible changes in the price in the period under consideration	Yes; performance bias: different implementation for study years 1 + 2 and 3 + 4	Yes; performance bias/confounding: possible differences between included universities	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing; multiple survey: 1 <sup>st</sup> year of study, 4 <sup>th</sup> year of study	Yes; no pilot testing	Yes; no pilot testing and OSCE assessment; multiple interviews: before and after the course	Yes; use of validated questionnaires (ATP-18, Opening Minds Stigma Scale for Healthcare Providers (OMS-HC), Mini-International Personality Item Pool (mini-IPIP)	Yes; no pilot testing; multiple interviews: before and after the curriculum

<b>Follow-up</b>	3 years (choice of specialty not included)	/	Start to end of course (choice of specialty not included)	/	Start to end of curriculum (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; bias: in 2 <sup>nd</sup> survey submission of the top 3 subjects mentioned in the 1st survey	Yes; tendency to positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties)	Yes; better performance in the pre-test due to more clinical experience, thus small increase in the post-test; recall bias: subject preference before the course was only asked in the post-questionnaire; no critical consideration of own study	Yes; no information on response rate possible; bias: dichotomization of the 5 categories	Yes; identical pre- and post-questionnaire; subjective assessment of knowledge gain; bias: no pairing of pre- and post-data (limited statement on preference change)

<b>Quality criterion</b>	<b>Shelton et al. [2019]<sup>277</sup></b>	<b>Shen et al. [2014]<sup>278</sup></b>	<b>Shepherd et al. [2003]<sup>279</sup></b>	<b>Shipper et al. [2017]<sup>280</sup></b>	<b>Shrestha et al. [2016]<sup>282</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest)	Yes; randomization: none; representativeness: limited (authors' statement)	Yes; randomization: none; representativeness: no assessment possible; selection bias: voluntary participation (= primary interest), no socio-demographic information on the sample	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest)	Yes; randomization: none; representativeness: none; no precise description of the recruitment strategy
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes	Yes; performance bias: no uniform implementation, curricular changes to the elective in the period under consideration	Yes	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing and use of valid data (Association of American Medical Colleges' Medical School Graduation Questionnaire); multiple interview: before and after the course	Yes; pilot testing of validated questionnaires translated into Chinese (ATP-30, Attitudes Towards Mental Illness (AMI)); multiple interviews: before and after clerkship	Yes; no pilot testing	Yes; pilot testing; multiple interviews: before and after the course	Yes; no pilot testing; measurement bias: no consideration of non-clinical specialties
<b>Follow-up</b>	Start to end of course (choice of specialty not included)	Start to end of clerkship (choice of specialty not included)	up to 24 years after elective graduation (choice of specialist included)	Start to end of course (choice of specialty not included)	/
<b>Statistical analysis and limitations</b>	Yes; tendency to positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties)	Yes; little critical consideration of own study	Yes; recall bias: increasing with the number of years between the end of studies and the survey; bias: significantly increased percentage of radiologists compared to graduates Data from Chicago Medical School (CMS)	Yes; subjective assessment of the proficiency of specific skills	Yes

Quality criterion	Siassakos et al. [2009] <sup>283</sup>	Simões et al. [2017] <sup>284</sup>	Sinclair et al. [2006] <sup>285</sup>	Skokauskas et al. [2012] <sup>287</sup>	Skorus et al. [2020] <sup>288</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Low; randomization: none; representativeness: none; selection bias: no socio-demographic information on the sample, voluntary participation (= primary interest), no information on the recruitment strategy	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest)	Yes; randomization: none; representativeness: no assessment possible	Yes; randomization: none; representativeness: none	Yes; randomization: none; representativeness: none (authors' statement); selection bias: different proportions of universities and years of study no precise information on recruitment strategy
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes	Yes	Yes	Yes; performance bias/confounding: possible differences between included universities
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; multiple interviews: before and after exposure	Yes; no pilot testing; measurement bias: no uniform implementation (survey up to 20 years after the camp)	Yes; no pilot testing; multiple interviews: 1 <sup>st</sup> , 2 <sup>nd</sup> , 3 <sup>rd</sup> , 4 <sup>th</sup> , 5 <sup>th</sup> academic year and 1 <sup>st</sup> postgraduate year	Yes; pilot testing	Yes; no pilot testing
<b>Follow-up</b>	Start to end of exposition (choice of specialist not included)	/	Start to end of curriculum (choice of specialty not included)	/	/
<b>Statistical analysis and limitations</b>	Yes; no indication of the response rate	Yes; recall bias: increasing with the number of years between the end of the study and the survey; no critical consideration of own study	Yes; total number changed for the individual years; low critical consideration of own study	Yes; differing numerical data in text and tables	Yes; no indication of the response rate

Quality criterion	Sobral [2006] <sup>290</sup>	Solomon and DiPette [1994] <sup>291</sup>	Spiers et al. [2019] <sup>294</sup>	Sripa et al. [2020] <sup>295</sup>	Stearns et al. [1993] <sup>297</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	No clear formulation
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none;	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample	Yes; randomization: none; representativeness: none; selection bias: Selection bias: voluntary participation (= primary interest), paid participation, hardly any socio-demographic information on the sample, different proportions of years of study	Yes; randomization: none; representativeness: no assessment possible	Low; randomization: none; representativeness: no assessment possible; low sample description
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes	Yes	Yes	Yes; performance bias/confounding: possible differences between included universities and programs	Yes

<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing Multiple surveys: begin of study, end of 1 <sup>st</sup> year, end of 3 <sup>rd</sup> year and end of study	Yes; no pilot testing	Yes; no pilot testing Multiple surveys: before and after the course	Yes; pilot testing	Yes; no pilot testing
<b>Follow-up</b>	Start to end of study (5 years - choice of specialty included)	/	Start to end of course (choice of specialty not included)	/	/
<b>Statistical analysis and limitations</b>	Yes;	Yes; no critical consideration of own study	Yes; Subjective assessment of the ability of specific techniques; no critical consideration of own study	Yes; Yes; answer according to social desirability/positivity: support of the study program by one of the included universities, subjective information on the curricular requirements by the faculties	Yes; Yes; no information on which year(s) were considered; no critical consideration of own study

Quality criterion	Stratton et al. [2005] <sup>298</sup>	Strelzow et al. [2017] <sup>299</sup>	Süß et al. [2020] <sup>300</sup>	Sutton et al. [2014] <sup>301</sup>	Talbot and Ward [2000] <sup>302</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none; selection bias: no socio-demographic information on the sample, no precise description of the recruitment strategy	Yes; randomization: none; representativeness: no assessment possible; selection bias: no indication of gender ratio per study year	Yes; randomization: none; representativeness: none; selection bias: recruitment based on the presence of a contact person, gender ratio does not correspond to the actual ratio	Yes; randomization: none; representativeness: partial; selection bias: the questionnaire was sent out by the Royal College of Surgeons of England, with a disproportionately high number of students interested in surgery	Yes; randomization: none; representativeness: no assessment possible; selection bias: voluntary participation (= primary interest)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between the individual training levels	Yes; performance bias/confounding: possible differences between included institutions	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias: no uniform implementation
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing	Yes; no pilot testing	Yes; no pilot testing	Yes; pilot testing	Yes; pilot testing; multiple interviews: before and after the internship
<b>Follow-up</b>	/	/	/	/	Start to end of placement (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; different total numbers for the individual items; no statement about individual items possible, as always examined together	Yes; bias: remuneration of participation (lottery pool)	Yes; significant differences, with regard to socio-demographic factors, reduce comparability	Yes; only indication of absolute and relative frequencies; no indication of a response rate	Yes; no indication of a response rate; no critical consideration of own study

Quality criterion	Teclessou et al. [2021] <sup>303</sup>	Tesche et al. [2010] <sup>304</sup>	Thivierge-Southidara et al. [2022] <sup>306</sup>	Torrible et al. [2006] <sup>308</sup>	Turner et al. [2006] <sup>309</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement

<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest), all participants members of a surgical interest group	Yes; randomization: none; representativeness: no assessment possible; selection bias: voluntary participation (= primary interest), different proportions of years of study	Yes; randomization: none; representativeness: none; selection bias: recruitment at a large group academic event, recruitment of residents only if email address available, no inclusion of French-speaking regions, all participating geriatric residents were female	Yes; randomization: none; representativeness: partial; selection bias: indication of general ratios, no indication of ratios in individual cohorts/years, inclusion only of those licensed in the UK
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between the individual training levels	Yes	Yes; performance bias: no uniform implementation	Yes; performance bias/confounding: possible differences between the individual training levels	Yes; performance bias/confounding: possible differences between university education and training programs, possible curricular changes in the period under consideration
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing	Yes; no pilot testing; multiple interviews: before and after the course	Yes; no pilot testing; multiple interviews: before and after the observer-ship	Yes; pilot testing; measurement bias: no uniform implementation	Yes; no pilot testing; multiple interviews: 1 year, 3 years and further time intervals after the end of the study
<b>Follow-up</b>	/	Start to end of course (choice of specialty not included)	Start to end of observer-ship (choice of specialty not included)	/	Up to 10 (choice of specialty included)
<b>Statistical analysis and limitations</b>	Yes; summarized statement for both groups, despite different levels of education	Yes; tendency to positive evaluation by preclinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); summarized statement for both specialties, despite actual effect in only one specialty; no consideration of the influence of mentors/supervisors	Yes	Yes; recall bias: increases with the number of years between the end of the study and the survey	Yes; only 2 cohorts considered to investigate the influencing factors

<b>Quality criterion</b>	<b>Urbina et al. [2003]<sup>310</sup></b>	<b>Vaidya et al. [2019]<sup>311</sup></b>	<b>Walker et al. [2019]<sup>313</sup></b>	<b>Wendel et al. [2003]<sup>314</sup></b>	<b>Werwick et al. [2017]<sup>315</sup></b>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none - random selection from the pool of applicants; representativeness: no assessment possible; selection bias: no socio-demographic	Yes; randomization: none; representativeness: partly; selection bias: no naming of included universities; only inclusion of those who start	Yes; randomization: none; representativeness: given (authors' statement); selection bias: recruitment from a conference of the "Association of Surgeons in Training (ASiT)"	Yes; randomization: none; representativeness: none	Yes; randomization: none; representativeness: none; selection bias: mainly recruitment at special "preparatory seminars" there

	information on the sample, voluntary participation (= primary interest)	further education directly after FY2 (only 50%)			voluntary participation (= primary interest)
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias: possible curricular changes in the period under consideration	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between the individual training levels	Yes	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing and use of valid data (database); multiple survey: annual survey	Yes; no pilot testing; measurement bias: no uniform implementation	Yes; no pilot testing	Yes; no pilot testing	Yes; no pilot testing; multiple survey: before and after the first clinical traineeship, in the 4 <sup>th</sup> year of study and before the start of the PJ
<b>Follow-up</b>	No exact time specifications (choice of specialty included)	/	/	/	Before first clerkship to practical year (choice of specialty not included)
<b>Statistical analysis and limitations</b>	Yes; lack of follow-up data; no critical consideration of own study	Yes; no temporal correlation of the training curriculum and the FY2 cohort studied; no consideration of weeks completed in "unknown" subject areas (voluntary participation); highly competitive application procedure (choice of subject areas with higher chance of being hired); positives: partly subjective information on the curricula	Yes; certificate of attendance of the conference was handed out after answering the questionnaire; summarized statement for all disciplines, no individual consideration	Yes; no critical consideration of own study	Yes

Quality criterion	Whitaker et al. [2020] <sup>316</sup>	Whittaker et al. [2006] <sup>317</sup>	Wiesenfeld et al. [2014] <sup>318</sup>	Williamson et al. [2003] <sup>319</sup>	Wimsatt et al. [2016] <sup>320</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none (representative for the included university, not with regard to the research objective)	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample	Yes; randomization: none; representativeness: no assessment possible; selection bias: missing data on origin	Yes; randomization: none; representativeness: partial (allopathic universities); selection bias: only inclusion of universities that submitted data to the American Academy of Family Physicians, no inclusion of osteopathic universities
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias: not all participating students already had contact with the subject area under investigation	Yes; performance bias: no uniform implementation	Yes	Yes	Yes; performance bias/confounding: possible differences between included universities
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing	Yes; no pilot testing and use of valid data (database)	Yes; pilot testing	Yes; no pilot testing; multiple interviews: before and after the program	Yes; pilot testing

<b>Follow-up</b>	/	/	/	Start to end of program (choice of specialty not included)	/
<b>Statistical analysis and limitations</b>	Yes; reduction of the 5-point to a 3-point Likert scale for the analysis; the included university is the only one with a "Level I Trauma Centre", which possibly increases the attractiveness for students interested in surgery	Yes; program changes in the period under consideration; no comparison with assessment before the introduction of this course; bias: highlighting of a clearly positive value; low critical consideration of own study	Yes; response according to social desirability: survey after application, but before final selection of further education applicants; no critical consideration of own study	Yes; reduction of the 5-point to a 3-point Likert scale for the analysis; missing definitions of terms (susceptibility to interpretation); no indication of a response rate; no critical consideration of own study	Yes; response according to social desirability/tilt towards positivity: subjective information (self-reporting) on university curricula

<b>Quality criterion</b>	<b>Woodworth et al. [2000]<sup>321</sup></b>	<b>Woolley et al. [2019]<sup>322</sup></b>	<b>Wright et al. [1997]<sup>323</sup></b>	<b>Wu and Greenberg [2016]<sup>324</sup></b>	<b>Xu et al. [1999]<sup>325</sup></b>
<b>Research question</b>	Yes	Yes	Yes	No clear formulation	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: no assessment possible; selection bias: exclusion of international residents	Yes; randomization: none; representativeness: partly (gender, partly choice of subject area); selection bias: existing interest in the subject area under consideration, no precise information on the gender ratio, no contact data available for 111 participants	Yes; randomization: none; representativeness: none	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest), no indication of gender ratio; no uniform recruitment strategy	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample, only inclusion of allopathic universities
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between university education and training programs	Yes; performance bias/confounding: possible differences between university education and training programs, possible curricular changes in the period under consideration	Yes	Yes	Yes; performance bias/confounding: possible differences between university education and training programs
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing	Yes; no pilot testing	Yes; pilot testing	Yes; no pilot testing; multiple interviews: before and after the course	Yes; no pilot testing
<b>Follow-up</b>	/	/	/	Start to end of course (choice of specialty not included)	/
<b>Statistical analysis and limitations</b>	Yes; no critical consideration of own study	Yes; no fully comparable data sets, as different data were collected in some cases; no coding for the qualitative data	Yes	Yes; tendency towards positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); no statement on whether pre- and post-questionnaire corresponded to each other	Yes; only absolute and relative frequencies are given; recall bias: retrospective questioning of specialist preference before studies

Quality criterion	Xu et al. [1997] <sup>326</sup>	Yang et al. [1994] <sup>327</sup>	Yong et al. [2012] <sup>328</sup>	Yoon et al. [2018] <sup>329</sup>	Yu et al. [2011] <sup>330</sup>
<b>Research question</b>	Yes	Yes	No clear formulation	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Study-population</b>	Yes; randomization: none; representativeness: none	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample, only inclusion of students who participated in the "Canadian medical graduates participated in a national match (CIMS)"	Yes; randomization: none; representativeness: no assessment possible; selection bias: voluntary participation (= primary interest), no socio-demographic information on the sample	Yes; randomization: none; representativeness: no assessment possible; selection bias: only inclusion of allopathic universities, partly missing socio-demographic data, no information on individual shares of the included universities	Yes; randomization: none; representativeness: no assessment possible; selection bias: no socio-demographic information on the sample
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	Yes
<b>Exposure measure(s), exposure levels</b>	Yes; performance bias/confounding: possible differences between university education and training programs	Yes; performance bias/confounding: possible differences between university education and training programs	Yes	Yes; performance bias/confounding: possible differences between included universities	Yes; performance bias/confounding: possible differences between included universities
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing	Yes; no pilot testing	Yes; no pilot testing; multiple interviews: before and after the course	Yes; pilot testing; multiple survey: 3 <sup>rd</sup> and 4 <sup>th</sup> year of study	Yes; no pilot testing, use of test results and logbook entries
<b>Follow-up</b>	/	/	Start to end of course (choice of specialty not included)	5 years (choice of specialty included – matching-data)	/
<b>Statistical analysis and limitations</b>	Yes; significance level was set at $p < 0.003$ ; no critical consideration of own study	Yes; response according to social desirability/tendency to positivity: subjective information (self-reporting) on the university curricula; little critical consideration of own study; no compelling correlation of the curricula queried with the curricula of the PGY1 applicants surveyed	Yes; tendency to positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); quizzes in the pre- and post-questionnaire corresponded; grading according to participation and not according to performance/skill	Yes; dichotomization of the 4 categories (3 positive statements, 1 negative coupled with slightly positive); assessment of the influencing factors only by a smaller subgroup	Yes; subjective evaluation of the students; clear differences in results for the included institutes

Quality criterion	Zhang et al. [2020] <sup>331</sup>	Ziegler et al. [2020] <sup>332</sup>	Zuckerman et al. [2016] <sup>333</sup>	Zuzuárregui and Hohler [2015] <sup>334</sup>	
<b>Research question</b>	Yes	Yes	Yes	Yes	
<b>Preregistration</b>	No statement	No statement	No statement	No statement	
<b>Study-population</b>	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest)	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest)	Yes; randomization: none; representativeness: none; selection bias: voluntary participation (= primary interest), no precise information on the proportions of study years,	Yes; randomization: none; representativeness: no assessment possible; selection bias: voluntary participation (= primary interest), no socio-demographic information of the sample	

			underrepresentation of female participants		
<b>Exposition and outcome</b>	Yes	Yes	Yes	Yes	
<b>Exposure measure(s), exposure levels</b>	Yes	Yes; performance bias: no uniform implementation	Yes	Yes; performance bias: development and changes of the program in the course of study	
<b>Definition of result, result measurement, number of measurements</b>	Yes; pilot testing	Yes; pilot testing; measurement bias: no uniform implementation; multiple interviews: before and after the course	Yes; no pilot testing; multiple interviews: before and after the elective subject	No, no measuring instrument stated	
<b>Follow-up</b>	/	Start to end of course (choice of specialty not included)	Start to end of elective (choice of specialty not included)	/	
<b>Statistical analysis and limitations</b>	Yes; subjective assessment of the increase in knowledge; no critical consideration of own study	Yes; tendency to positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); attractiveness through crediting as compulsory hours; bias: formation of focus groups with the same level of interest	Yes; no critical consideration of own study	Yes; no critical consideration of the own study; inclusion of data that cannot be attributed to an effect of the program (no temporal correlation of the collected data); no verification of whether the choice of further training in neurology was part of the program under study	

**Interventional studies:**

Quality criterion	Barron et al. [2012] <sup>25</sup>	Davis et al. [2010] <sup>73</sup>	Day et al. [2016] <sup>74</sup>	Drolet et al. [2014] <sup>84</sup>	Grayson et al. [2001] <sup>113</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes
<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Blinding</b>	No	No	No	No	No
<b>Study-population(s)</b>	Yes; selection bias: IG - only inclusion of participants of the "Summer Institute for Medical Students (SIMS)" with available e-mail addresses, voluntary participation (= primary interest), KG - only inclusion of physicians who graduated a short time ago; differences in curricular/university requirements due to inclusion of different universities; significant differences between the groups; no uniform treatment; no recruitment from the same total population	Yes; selection bias: IG - voluntary participation (= primary interest); no uniform treatment; no recruitment from the same total population; selection bias: IG - recruitment on the basis of application letters	Yes; no socio-demographic data on both groups	Yes; selection bias: IG - voluntary participation (= primary interest), KG - no information on the proportions of the individual study years; equal treatment of both groups; recruitment from the same total population	Yes; selection bias: primary interest in the subject under consideration in both the IG and one of the two KGs by applying for the course; equal treatment of the groups; recruitment from the same total population
<b>Randomization and representativeness</b>	Randomization: yes; representativeness: none	Randomization: none; representativeness: no assessment possible	Randomization: none; representativeness: none	Randomization: none - only random selection from the pool of applicants; representativeness: none	Randomization: none - only random selection from the pool of applicants; representativeness: limited
<b>Intervention</b>	Yes	Yes	Yes	Yes; performance bias: no uniform implementation in the course of study	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; measurement bias: differences in questionnaire size	Yes; no pilot testing; multiple interviews: before and after the course	Yes; no pilot testing	Yes; pilot testing of the intervention, no pilot testing of the measurement instrument; multiple interviews: before and after the elective subject	Yes; no pilot testing
<b>Statistical analysis and limitations</b>	Yes; confounding: many other confounding factors responsible for differences between the two groups	Yes; no critical consideration of own study; strongly differing baseline conditions of both groups; no indication of response rate of KG	Yes; only applied to students with primary surgical interest; no indication of response rate of the KG; bias: disappointment of the KG not to have been selected	Yes; no indication of KG response rate; tendency to positive evaluation by preclinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties)	Yes; formation of 3 groups, 2 groups have a primary interest in the subject area under consideration
Quality criterion	Head et al. [2016] <sup>128</sup>	Herold et al. [1993] <sup>131</sup>	Hicks et al. [2019] <sup>132</sup>	Lou et al. [2013] <sup>184</sup>	Madan et al. [2005] <sup>189</sup>
<b>Research question</b>	Yes	Yes	Yes	Yes	Yes

<b>Preregistration</b>	No statement	No statement	No statement	No statement	No statement
<b>Blinding</b>	No	No	No	No	No
<b>Study-population(s)</b>	Yes; selection bias: differences in gender distribution, IG - voluntary participation (= primary interest); equal treatment of both groups; recruitment from the same total population	Yes; equal treatment of the groups; recruitment from the same total population	Yes; equal treatment of the groups; recruitment from the same total population	Yes; equal treatment of the groups; recruitment from the same total population	Yes; equal treatment of the groups; recruitment from the same total population
<b>Randomization and representativeness</b>	Randomization: none - only for the KG; representativeness: none	Randomization: none - only random recruitment from the applicant pool; representativeness: none	Randomization: none; representativeness: none	Randomization: yes; representativeness: none	Randomization: not specified; representativeness: none
<b>Intervention</b>	Yes; performance bias: no uniform implementation	Yes	Yes	Yes	Yes
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; measurement bias: no uniform implementation (between groups)	Yes; no pilot testing and use of valid data (database)	Yes; no pilot testing; measurement bias: no uniform implementation (between groups); multiple interviews: before and after the program	Yes; no pilot testing; multiple interviews: pre-intervention, post-simulation but pre-training, post-simulation and post-training	Yes; no pilot testing; multiple interviews: before and after the course
<b>Statistical analysis and limitations</b>	Yes; bias: inclusion of students who were not selected for the IG in the KG; confounding: KG answered the questionnaire at home; bias (more positive results): pre- and post-questionnaire corresponded; no indication of the KG response rate	Low, only indication of absolute and relative frequencies	Yes; bias: compensation for participation: credit for participation hours and inclusion in a lottery pool; confounding: KG answered the questionnaire at home, influence of other electives for KG; bias (more positive results): pre- and post-questionnaire were almost the same	Yes; tendency to positive evaluation by preclinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); 2nd and 3rd questionnaires corresponded; confounding/bias: possibly more negative evaluation for discouragement and demoralization if there were no practice opportunities for handling	Yes; tendency to positive evaluation by preclinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); bias: no pairing of pre- and post-data (limited statement on preference change); no critical consideration of own study

<b>Quality criterion</b>	<b>Martin et al. [2007]<sup>196</sup></b>	<b>Pokrzywko et al. [2019]<sup>242</sup></b>	<b>Sammann et al. [2007]<sup>266</sup></b>		
<b>Research question</b>	Yes	Yes	Yes		
<b>Preregistration</b>	No statement	No statement	No statement		
<b>Blinding</b>	No	No	No		
<b>Study-population(s)</b>	Yes; selection bias: IG - participation only from students who were in the vicinity; equal treatment of the two groups; recruitment from the same population	Yes; equal treatment of the two groups; recruitment from the same total population	Yes; selection bias: IG - voluntary participation (= primary interest); significant differences between groups; equal treatment of both groups;		

			recruitment from the same total population		
<b>Randomization and representativeness</b>	Randomization: none; representativeness: none	Randomization: none-via the alphabetical order; representativeness: none	Randomization: none; representativeness: none		
<b>Intervention</b>	Yes	Yes; performance bias: no uniform implementation, possible differences between included universities	Yes; performance bias: no uniform implementation		
<b>Definition of result, result measurement, number of measurements</b>	Yes; no pilot testing; multiple interviews: before and after clerkship	Yes; no pilot testing; multiple interviews: Start and end of rotation	Yes; no pilot testing; multiple interviews: before and after the course		
<b>Statistical analysis and limitations</b>	Yes; the control group was always the proportion of the group that did not receive the respective intervention; no information on the respective proportions of intervention and non-intervention participants	Yes; bias: remuneration of participation	Yes; tendency to positive evaluation by pre-clinical participants, (possibly first encounter with a clinical specialty, associated euphoria/enthusiasm for the first clinical experience, no competition from other clinical specialties); bias: subjective indication of increase in knowledge and skills of specific procedures/techniques		

**Note:** \*: All reference numbers refer to the numbering in [Additional file 2](#).

## **Additional file 5:** Elaborated questions of quality assessments

### 1) Study design qualitative observational studies

Clear formulation of the research question and the research objective?

Was there pre-registration through a study protocol?

Clear description of methods (setting and data collection) and justification of the qualitative approach?

Sufficient description of the recruitment strategy, was randomization carried out, is representativeness given?

Is there a sufficient length of follow-up?

Sufficient description of the data analysis/analysis process?

Has a clear statement been made about the results and the value/usefulness/meaningfulness of the research? Limitations?

### 2) Study design quantitative or quantitative + qualitative observational studies:

Clear formulation of the research question and the research objective?

Was there pre-registration through a study protocol?

Description of the study population, participant recruitment and sample size, was randomization conducted, is representativeness given?

Sufficient description of the relationship between exposure and outcome of interest?

Sufficient description of exposure measure(s), exposure levels (if any) and consistent implementation across participants?

Have outcomes, the conduct of outcome measurement and the number of measurements been described/defined and implemented consistently across all participants?

Is there sufficient follow-up length?

Has an adequate statistical analysis been carried out and, if necessary, confounding factors measured and eliminated? Limitations?

### 3) Study design Intervention studies:

Clear formulation of the research question and the research objective?

Was there pre-registration through a study protocol?

Was there blinding?

Adequate description of the study population, participant recruitment and sample size? Was the treatment of both groups (apart from the intervention) the same, recruited from the same total population?

Are randomization and representativeness given?

Adequate description of the intervention?

Were outcomes, the implementation of outcome measurement and the number of measurements described/defined and these implemented consistently?

Has adequate statistical analysis been carried out and, if necessary, confounding factors measured and removed? Limitations?