

Supplemental Digital Appendix 1

Twenty-Two Studies of Maintenance of Certification (MOC) Processes Developed by the American Board of Medical Specialties Member Boards, 2000-2017

First author (year)	Specialty	MOC components examined	Outcomes source	Outcomes summary ^a
McIvor et al (2012) ¹⁹	Anesthesiology	KJS	Survey (self-report)	The Maintenance of Certification (MOC) for Anesthesiologists program incorporates mannequin-based simulation. Results from the first 2 years of experience suggest that 583 physician participants transferred knowledge and skills from their simulated experiences into real-world practice. Participants consistently found the experience educationally valuable and clinically relevant, and reported that it led to changes in practice.
Stratman et al (2017) ²⁰	Dermatology	IMP	Survey (self-report)	Of 289 dermatologists who completed focused Practice Improvement (fPI) activities, 103 (35.6%) identified practice gaps and implemented an intervention and a re-measurement phase. 283 (97.9%) assessed the activities as relevant. Most dermatologists (254 [87.9%]) reported that the modules reaffirmed their current practice, whereas 19 (6.6%) reported that the modules helped change their practice. Twenty-four (8.3%) changed their care documentation habits, 36 (12.5%) believed care improved, and 47 (16.3%) reported that at least 1 patient experienced better outcomes because they completed the fPI modules. Two hundred eighty (96.9%) recommended the fPI modules (range by module, 88.9%-100%).
Marco et al (2014) ²¹	Emergency medicine	KJS	Examination scores	American Board of Emergency Medicine Continuing Certification examination performance was compared among residency-trained emergency physicians over multiple examination cycles. There were

15,085 first-time testing episodes from 1989 to 2012 involving three examination cycles. The mean adjusted examination scores for all physicians taking the examination for a first cycle was 85.9 (95% confidence interval [CI] = 85.8 to 85.9), the second cycle mean score was 86.2 (95% CI = 86.0 to 86.3), and the third cycle was 85.4 (95% CI = 85.0 to 85.8). Using the first examination cycle as a reference score, the growth curve model analysis resulted in a coefficient of +0.3 for the second cycle ($p < 0.001$) and -0.5 for the third cycle ($p = 0.02$). Initial qualifying (written) examination scores were significant predictors for examination scores. The authors conclude that emergency physicians undergoing continuing certification including regular testing maintained their knowledge.

Jones et al (2013) ²²	Emergency medicine	LLSA	Survey (self-report)	1354 (47.7%) of 2841 physicians who participated in 2011 American Board of Emergency Medicine lifelong learning and self-assessment (LLA) readings participated in a survey. The LLSA readings were reported to be relevant to the overall clinical practice of Emergency Medicine (69.6% strongly relevant, 28.1% some relevance, and 2.3% little or no relevance), and provided information that would likely help them change their clinical practices (high likelihood 38.8%, some likelihood 53.0%, little or no change 8.2%).
Marco et al (2016) ²³	Emergency medicine	KJS	Survey (self-report)	A voluntary survey was administered in 2015 on emergency physicians' perceptions of the benefits of preparing for and taking the ABEM Continuous Certification examination and the career benefits of staying ABEM-

certified. Examination performance was compared to perceptions of learning and career benefits. 2,511 of 2,601 first-time test takers (96.5%) participated. The majority of participants (92.0%) identified a benefit to preparing for the examination, including reinforced medical knowledge (73.9%), increased knowledge (66.8%), and making them a better clinician (39.4%). 90.8% identified a career benefit of maintaining ABEM certification, including more employment options (73.8%), being more positively viewed by other physicians (56.8%), and better financial outcomes (29.8%). There was a statistically significant association between the perception of knowledge reinforcement and examination performance ($p < 0.001$). There was also a statistically significant association between the perception that staying certified created more career opportunities and examination performance ($p < 0.001$).

Hagen et al (2006) ²⁴	Family medicine	LLSA	Survey (self-report)	As of April 2005, 2351 Family Physicians had successfully completed the American Board of Family Medicine Self-Assessment Module (SAM) in essential hypertension and 4648 successfully completed the type 2 diabetes mellitus SAM. (N = 4648). Likert-scale ratings indicated generally favorable responses (predominantly 5 to 6 on a 6-point scale) to the hypertension and diabetes SAMs. Over half (55% for hypertension and 54% for diabetes participants) of the respondents indicated that the experience would lead to changes in their practices. Navigation and system operation issues predominated in the free-text
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				comments offered for the diabetes and hypertension simulations.
Hagen (2012) ²⁵	Family medicine	LLSA	Summary of actions performed in an online simulation activity	A summary of the actions taken by physicians participating in the ABFM chronic heart failure simulation from 2006 - 2011 indicate guideline-concordant high use of angiotensin converting inhibitors (ACEInhibitors), ACE inhibitors and/or angiotensin receptor blockers (ACEInhibitorsARBS), but surprisingly low use of beta-adrenergic blocking agents (BetaBlockers.). These results suggest that the simulations can serve as a useful probe for identifying possible management gaps.
Hagen et al (2012) ²⁶	Family medicine	LLSA	Summary of actions performed in an online simulation activity	Evidence and guidelines such as the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure recommend chlorthalidone as the diuretic of choice in hypertension management. We evaluated diplomates' use of chlorthalidone and hydrochlorothiazide as first-choice diuretics in virtual patient simulations of hypertension in the American Board of Family Medicine Maintenance of Certification for Family Physicians self-assessment modules. Chlorthalidone use increased 0.7 percentage points per year (test for beta > 0, P < .0013), from approximately 1.3% of simulation prescriptions in 2004 to about 4.8% in 2010 and 2011, whereas hydrochlorothiazide prescriptions fell 2 percentage points per year (P = .035), from nearly 57% to 47%. As a fraction of all diuretic use, chlorthalidone increased 1.4 percentage points per year (P = .0006), from 2% to 9%.

O'Neill et al (2013) ²⁷	Family medicine	KJS	Examination scores	Performances of 10,801 ABFM examinees (2,440 seeking initial certification; 8,361 seeking maintenance of certification) on the summer 2009 American Board of Family Medicine (ABFM) certification examination were compared across 30 cohorts that represented recent residency program graduates and already-certified family physician diplomates with varying years of clinical experience. Family physicians who maintained certification performed better than recent graduates. They increased their examination scores by almost 17 points each successive time that they took the exam, with scores reaching their highest point 28 to 31 years after initial certification. Multiple comparison analyses confirmed that the trend was significant; however, subanalyses revealed that this trend remained significant only for U.S. medical graduates (USMGs) but not international medical graduates. Family physicians that did not maintain their certification performed significantly worse than recent graduates.
Elward et al (2014) ²⁸	Family medicine	LLSA	Surveys (self-report) on knowledge of guidelines and other aspects of asthma care; Change in quality metrics based on self-chart audits	We conducted a trial to determine whether group Self-Assessment Module (SAM) activities led by a facilitator and conducted as part of Maintenance of Certification for Family Physicians (MC-FP) would increase knowledge of and adherence to asthma guidelines. Thirty-eight physicians in Virginia completed the SAM and had complete data. Except for prescribing controller medications for persistent asthma, all other quality measures significantly improved 6 months after the group SAM. Diagnosis by severity

improved from 48.3% to 80.2%, and the use of action plans increased from 8.1% to 54.1%. Physicians' knowledge of guidelines improved immediately after the SAM and was sustained at 6 months. 30% of participants reported comfort with assessing control after the SAM, which increased to 97.5% 6 months after the SAM.

Peterson et al (2014) ²⁹	Family medicine	IMP	Change in quality metrics based on self-chart audits	From 2005 to October 2012, 7,924 Family physicians completed the Diabetes Performance in Practice Modules (PPM). Their mean age was 48.2 years, they had practiced a mean of 13.8 years, and three-fourths lived in urban areas (76.9%). Nearly one-half selected diabetic foot examination or eye examination as their quality improvement measure. Performance on all quality measures improved. Significant improvement was seen in rates of hemoglobin A(1c) control (< 7.0%; 57.4% to 61.3%), blood pressure control (< 130/ 90 mm Hg; 53.3% to 56.3%), foot examinations (68.0% to 85.8%); and retina examinations (55.5% to 71.1%). The most common interventions were standing orders (51.6%) and patient education (37.1%).
Peterson et al (2016) ³⁰	Family medicine	IMP	Survey (self-report), including commitment to change practice	Family Physician feedback data on intended practice changes after competing ABFM Performance in Practice modules from inception to April 2014 were analyzed. 29,755 diplomates completed 38,201 PPMs; median 1 interquartile range (1, 1). Nearly two-thirds (65.8%, n = 25,150) of PPMs had completed feedback surveys. 78.7% of respondents indicated that they would change patient care and 90.2% indicated that they would continue QI activities after

				<p>completing the PPM. Respondents endorsed high relevance to practice (90.5%), high currency of clinical information (86.4%), and high usefulness of clinical information (80.5%). 86.0% of respondents who said that they would change care provided examples.</p>
Duffy et al (2008) ³¹	Internal medicine, Cardiology	IMP	Change in quality metrics based on self-chart audits	<p>179 cardiologists and general internists completed the American Board of Internal Medicine (ABIM) Preventive Cardiology Practice Improvement Module (PIM) in 2004 and 2005. The mean rate for systolic blood pressure control was 48%, for diastolic blood pressure 84%, and for low-density lipoprotein (LDL) cholesterol at goal 65%. 61% of patients rated the quality of care as excellent and 58% rated the practices excellent at encouraging questions and answering them clearly. More than 85% of patients reported "no problem" obtaining a prescription refill, scheduling an appointment, reaching someone in the practice with a question, or obtaining lab results. Targets for improvement included increasing rates for LDL cholesterol or systolic blood pressure at goal, improving patients' physical activity, patient education, and accuracy of risk assessment. Improvement strategies included implementing chart forms, patient education, or care management processes. The Preventive Cardiology PIM provided a self-assessment of practice performance and helped identify areas and strategies for practice quality improvement.</p>
Caverzagie et al (2009) ³²	Internal medicine	IMP	Survey (self-report)	<p>This study explored the impact of the American Board of Internal Medicine (ABIM) Hospital-Based Practice Improvement Module (Hospital PIM) on 21 physicians</p>

				participating in hospital-based QI. Completers described new learning about QI principles and activities, added value to their practice, and enhanced QI experience.
Green et al (2009) ³³	Internal medicine	LLSA	Survey (self-report), including commitment to change practice	The authors developed, beta-tested and evaluated an Internet-based point of care (POC) learning portfolio as a method of meeting the Lifelong Learning and Self-Assessment component of the American Board of Internal Medicine (ABIM) Maintenance of Certification (MOC) program. 23 internists and 4 internal medicine residents participated. They found the instructions clear and navigated the module without difficulty. The majority preferred the POC portfolio to multiple-choice examinations, citing greater relevance to their practice, guidance in expanding their palette of information resources, opportunity to reflect on their learning needs, and "credit" for self-directed learning related to their patients. Participants entered a total of 543 clinical questions, of which 250 (46%) resulted in a planned practice change. 14 of 27 (52%) participants committed to at least 1 change in their POC learning strategies.
Hess (2009) ³⁴	Internal medicine	IMP	Peer survey followed by commitment to change practice	The authors evaluated the American Board of Internal Medicine Communication with Referring Physicians Practice Improvement Module Eight-hundred three consultants (internists and subspecialists) completed a practice system survey and were rated by 12,212 referring physicians on 13 communication processes using a six point scale. Consultants received an interactive performance report and selected targets for improvement. Consultants on average received

				high ratings from referring physicians (mean overall rating 5.53, SD 0.23, range 2.46–5.95). Ratings of consultants' communication were modestly associated with their gender, type of internal medicine subspecialty, and program director ratings obtained at the end of residency training. About half of the consultants selected specific communication processes for improvement.
Shen et al (2016) ³⁵	Neurology	KJS	Examination scores	Physicians who had recently completed residency training possessed clinical knowledge that was comparable to that of experienced physicians, and the experienced physicians' clinical knowledge was equivalent to that of recent residency graduates. Except for the neurology certification test items that addressed basic neurology concepts, the performance of the certification and MOC examinees was similar. This study shows that physicians who maintain their certification maintain their knowledge.
Wiggins et al (2016) ³⁶	Ophthalmology	IMP	Change in quality metrics based on self-chart audits; Survey (self-report)	A retrospective analysis was conducted on the performance of 1046 American Board of Ophthalmology diplomates on 1408 American Board of Ophthalmology Practice Improvement Modules between September 1, 2012, and December 31, 2014. When measures with participation by at least 20 diplomates were analyzed, there was improvement in 24 of 30 individual process measures (80.0%; 95% CI, 61.4%-92.3%) and in 7 of 18 individual outcome measures (38.9%; 95% CI, 17.3%-64.3%). Analysis of the mean results for each diplomate on process measures chosen for improvement showed gains

				occurring in 9 of 12 modules and, for outcomes chosen for improvement, in 6 of 12 modules with at least 20 participants. A total of 826 of 1115 modules (74.1%) assessed by diplomates were rated from good to excellent; positive comments outnumbered negative ones by a ratio of 5:1.
Chung et al (2011) ³⁷	Plastic surgery	IMP	Comparison of guideline recommendations with physician self-reported data entered in practice assessment modules.	The American Board of Plastic Surgery Maintenance of Certification program includes the submission of 10 consecutive cases in one of 20 tracer modules for Performance in Practice evaluation. This study found that diplomates are adhering to guidelines regarding age of cosmetic breast augmentation patients, use of prophylactic antibiotics and deep venous thrombosis prophylaxis in abdominoplasty patients, and use of carpal tunnel release in the treatment of carpal tunnel syndrome. Half the diplomates, however, are using splints following carpal tunnel release, despite recommendations to the contrary. Only half the diplomates are following guidelines recommending mammography before breast augmentation, and 90 percent of diplomates are not following recommendations against the use of deep venous thrombosis prophylaxis for patients with acute lower limb trauma. This study highlights the role of MOC in identifying practice gaps for follow-up quality improvement work.
Arvanitis et al (2017) ³⁸	Pediatrics	IMP	Change in quality metrics based on physician or parent entered data	Of 50,433 pediatricians who completed American Board of Pediatrics Part 4 MOC from 2010-2014, 22% completed practice-developed, and 78% organization-developed (ABP PIMs and non-ABP organization-developed online

modules) activities. The majority (73%) of pediatricians who completed organization-developed activities completed ABP online Performance Improvement Modules (PIMs). Amongst pediatricians who completed ABP PIMs, almost three-quarters completed one or more of the following four PIMs: ADHD, Asthma, Hand Hygiene, or Influenza. The most frequently completed was Hand Hygiene, which was completed by 49% (14, 277) of pediatricians who chose ABP PIMs for Part 4 MOC. PIM completion was associated with improvement on nearly all pediatrician- and parent reported quality measures.

Byrne et al (2017) ³⁹	Pediatrics	LLSA, IMP	Survey (self-report)	We surveyed 866 pediatricians in 2014 who graduated from residency 10 to 12 years previously on their understanding, attitudes, barriers, and needs specific to MOC part 2 (self-assessment/continued learning activities) and part 4 (quality improvement projects). 77.8% completed the survey. Comparing part 4 to part 2, there was less understanding of requirements (59.9%, 72.9%, P <.001), more agreement that relevant available activities is a barrier (67.6%, 44.0%, P < .001), stronger agreement that more choices would be helpful (72.8%, 53.8%, P < .001), and less perceived impact on patient care or lifelong learning (12.5%, 47.2%, P <.001). Participants reporting that part 4 improves care were less likely to agree that time to fulfill requirements (adjusted odds ratio ¼ 0.30, 95% confidence interval 0.18–0.51) and relevant available activities (adjusted odds ratio 0.22, 95% confidence interval 0.13–0.39)
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				were barriers. Qualitative analysis revealed themes including time, cost, and relevance.
Juul et al (2016) ⁴⁰	Psychiatry	KJS	Examination scores	This study compared performance in response accuracy and testing time on specific test items administered to candidates for certification and MOC in a psychiatric subspecialty, forensic psychiatry, and to examine the relationship between age and performance on certification and MOC examinations. Performance on items administered to certification and MOC examinees did not differ significantly, and the mean amount of time spent on each item was similar for the two groups. Examination performance for those younger than 50 was similar to those 60 and older, and diplomates recertifying for the second time outperformed those doing so for the first time. These results indicate that in this subspecialty, there is no clear evidence of an age-related decline in knowledge as assessed by multiple-choice items and MOC examinations.

Abbreviations: KJS indicates assessment of knowledge, judgment, and skills; IMP, improvement in medical practice; LLSA, lifelong learning and self-assessment.

^aThe comments in this column are summary qualitative outcomes (“improved,” “modestly associated,” etc.) or terms used by the authors of the cited studies.

Supplemental Digital Appendix 2

Seventeen Studies of Maintenance of Certification (MOC) Interventions Developed by Entities Other than an American Board of Medical Specialties Member Board, 2000-2017

First author (year)	Specialty	MOC components examined	Outcomes source	Outcomes summary ^a
Steadman et al (2015) ⁴¹	Anesthesiology	IMP	Self-reported changes in practice	This study describes anesthesiologists' practice improvements undertaken during the first 3 yr of simulation activities for the Maintenance of Certification in Anesthesiology Program. A stratified sampling of 3 yr (2010-2012) of participants' practice improvement plans was coded, categorized, and analyzed. 634 of 1,275 participants in Maintenance of Certification in Anesthesiology Program simulation courses were evaluated from the following practice settings: 41% (262) academic, 54% (339) community, and 5% (33) military/other. 1,982 plans were analyzed for completion, target audience, and topic. On follow-up, 79% (1,558) were fully completed, 16% (310) were partially completed, and 6% (114) were not completed within the 90-day reporting period. Plans targeted the reporting individual (89% of plans) and others (78% of plans): anesthesia providers (50%), non-anesthesia physicians (16%), and non-anesthesia non-physician providers (26%). 2,453 improvements were categorized as work environment or systems changes (33% of improvements), teamwork skills (30%), personal knowledge (29%), handoff (4%), procedural skills (3%), or patient communication (1%). 94% of anesthesiologists participating in a Maintenance of Certification in Anesthesiology Program simulation course successfully implemented

				some or all of their planned practice improvements.
Gist et al (2015) ⁴²	Dermatology	IMP	Self-reported changes in practice	A Performance Improvement Continuing Medical Education activity on physician practice patterns for patients with psoriasis was developed, implemented, and evaluated by the American Academy of Dermatology, in part to assist dermatologists in fulfilling Part IV of their Maintenance of Certification requirements. We found a statistically significant improvement in the advisement of patients with psoriasis regarding their increased risk for cardiovascular disease, to contact their primary care provider for cardiovascular risk assessment, and in shared decision making regarding the treatment plan. We also found an overall statistically significant improvement in history taking per the guidelines.
Newton (2010) ⁴³	Family Medicine, Internal Medicine, Pediatrics	IMP	Electronic Health Record or Registry	This paper describes the operationalization of improvement strategies across different areas of North Carolina as part of the Improving Performance in Practice (IPIP) effort. Almost all clinical and process measures for diabetes improved by the second measurement period, with improvement continued through the second year. Blood pressure control measures improved by the third time period, the magnitude of change was moderate; by 9 months, it was clinically significant. Asthma measures also showed significant improvement across all measures except hospitalization by the second measurement period. MOC was available but only few providers initially asked for the credit; more became interested as the project spread.
Meyer (2013) ⁴⁴	Family Medicine	IMP	Registry	The authors describe efforts of the North Carolina Southeast AHEC,

				consisting of registry development and multiple PDSA cycles, that resulted in improvement in 11 of 17 diabetes care goals. As part of the Improving Performance in Practice (IPIP) initiative, these efforts were eligible for MOC Part IV credit.
Donahue (2013) ⁴⁵	Family Medicine, Internal Medicine, Pediatrics	IMP	Registry	One year after implementing a model for practice transformation, almost 40% of initial practices achieved substantial improvements in 3 or more measures of clinical quality. MOC Part IV credit was an incentive for several practices that transformed.
Halladay (2014) ⁴⁶	Family Medicine, Internal Medicine	IMP	Electronic Health Record or Registry	The authors analyzed whether clinical and Key Drivers Implementation Scale Scores from 42 practices at year 1 of participation were associated with improved diabetes measures (proportion of patients with hemoglobin A1C values <9%, blood pressure values <130/80 mmHg, and low-density lipoprotein (LDL) levels <100 mg/dL) during year 2. Physicians in participating practices in the North Carolina Improving Performance in Practice initiative could receive MOC credit for participation. Statistically significant improvements in the proportion of patients who met the LDL threshold were noted with higher "registry" and "protocol" KDIS scores. For hemoglobin A1C and blood pressure values, none of the odds ratios were statistically significant.
Majka et al (2013) ⁴⁷	Internal medicine	IMP	Pre/post-tests; self-reported practice changes	A unique quality improvement (QI) curriculum was implemented within the Division of General Internal Medicine at the Mayo Clinic to improve QI knowledge through multidisciplinary, team-based education, which also met the QI requirement for the American Board of Internal Medicine (ABIM) Maintenance of Certification (MOC). Participants completed up to 4 QI learning modules, including pretest

				and posttest assessments. 33 of 62 individuals invited to participate (53%) completed all 4 modules and corresponding pretests and posttests. Participants substantially improved knowledge in all 4 quality modules. Study group participants' pretest scores averaged 71.0%, and their posttest scores averaged 92.7%. Initial assessments showed substantial knowledge improvements and successful implementation of staff-developed QI projects.
Dela Cruz et al (2015) ⁴⁸	Internal medicine, pediatrics, (pulmonary, critical care, sleep medicine)	LLSA	Pre/post-tests; participant curricula evaluations	In 2013, the Education Committee of the American Thoracic Society (ATS) launched a four-part Core Curriculum in pulmonary, critical care, sleep, and pediatric pulmonary medicine. Multiple course-based learning opportunities for American Board of Internal Medicine and American Board of Pediatrics MOC credit were created. Participants seeking MOC credit in 2013 and 2014 completed an average of thirty patient-based questions in one or more of the core curricula series before and immediately after the courses. Although a pre-test was not required for participation in MOC, a number of participants completed both offerings allowing for an assessment of change in knowledge. In 2013, 153 pre- and post-course assessments were completed among all four content areas with improved mean scores from 70% pre- to 89% post-course ($p < .0001$). The number of participants more than doubled in 2014 to 319, and their mean scores improved from 58% pre- to 89% post-course ($p < 0.0001$). Improvement in knowledge occurred after each year in all four content areas. All core curriculum sessions received positive evaluations.
Sheehan et al (2013) ⁴⁹	Neurosurgery	LLSA	Examination scores	The Self-Assessment in Neurological Surgery (SANS) General

Examination and Spine Examination are online educational tools for lifelong learning and maintenance of certification. From 2008 to 2010, 165 spinal neurosurgeons completed the 243 available questions of the SANS Spine Examination and 993 general neurosurgeons completed the SANS General Spine Examination. The mean overall examination score was $87.4\% \pm 7.5\%$ for spinal neurosurgeons and $71.5\% \pm 8.9\%$ for general neurosurgeons ($P < 0.001$). Of the 18 major knowledge categories in SANS, spinal neurosurgeons ($n = 165$) answered questions incorrectly 15% or greater of the time in five of the categories: cerebrovascular, anesthesia and critical care, general clinical, tumor, and trauma. For general neurosurgeons ($n = 993$), the five knowledge categories with lowest performance were cerebrovascular, epilepsy, peripheral nerve, trauma, and radiosurgery. Spine neurosurgeons relatively underperformed in general clinical, anesthesia and critical care, and tumor. This study identifies gaps in knowledge that can be addressed as part of maintenance of certification.

Hamling (2011) ⁵⁰	Pediatrics	IMP	Chart review (externally conducted)	Increase in BMI screenings occurred during the quality improvement (MOC Part IV qualifying) intervention period for all four participating physicians, but a return to baseline screenings was seen as soon as the intervention concluded.
Gorzkowski et al (2014) ⁵¹	Pediatrics	IMP	Enrollment/participation rates	This study evaluated recruitment of pediatricians into a practice-based study, before and after the development and addition of a quality improvement (QI) curriculum approved for American Board of Pediatrics Maintenance of Certification (MOC) Part 4 Credit. An average of 3.5 practices enrolled

				per month pre-MOC, compared with 13.1 per month post-MOC ($P < .001$). Clinicians in pre- and post-MOC groups were similar in age, gender, race, and time spent on patient care; practices enrolled post-MOC were more likely to be located in federally designated Medically Underserved Areas than those enrolled pre-MOC (28.6% vs 12%, $P = .03$).
Macklin et al (2016) ⁵²	Pediatrics	IMP	Self-report of data using a standardized collection tool	Physicians received Maintenance of Certification Part IV credit for participation in a 12 month QI effort assessing the change in infant safe sleep practices within 6 Ohio children's hospitals. "Safe sleep teams" were formed in each institution. Teams used a standardized data tool to collect information on the infant's age and sleep position/environment, and were required to implement at least 3 Plan-Do-Study-Act cycles. At baseline, only 279 (32.6%) of 856 of the sleeping infants were observed to follow AAP recommendations, compared with 110 (58.2%) of 189 ($P < .001$) at the project's conclusion. The presence of empty cribs was the greatest improvement (38.1% to 67.2%) ($P < .001$). Removing loose blankets (77.8% to 50.0%) ($P < .001$) was the most common change made. Audits also showed an increase in education of families about safe sleep practices from 48.2% to 75.4% ($P < .001$).
Jennings et al (2017) ⁵³	Pediatrics	IMP	CT scan ordering rates	The authors evaluated a MOC-approved, quality improvement (QI) project in a community emergency department aimed at decreasing the use of head CT scans in children by implementing a validated head trauma prediction rule for traumatic brain injury. The baseline period (February 2013-July 2014) included 695 patients with a CT scan rate of 29.2% (95% confidence interval,

				25.8%32.6%). The postintervention period (August 2014-October 2015) included 651 patients with a CT scan rate of 17.4% (95% confidence interval, 14.5%-20.2%, P <.01).
Chiodo et al (2012) ⁵⁴	Physical Medicine and Rehabilitation	IMP	Admission times and initiation of therapy	Lean management techniques were used at a University Hospital inpatient rehabilitation unit to manage throughput of patients into and out of the inpatient rehabilitation unit. At the start of this process, the average admission time to the rehabilitation unit was 5:00 p.m., with a median time of 3:30 p.m., and no patients received therapy on the day of admission. Within 8 mos, the mean admission time was 1:22 p.m., 50% of the patients were on the rehabilitation unit by 1:00 p.m., and more than 70% of all patients received therapy on the day of admission. Negative variance from this performance was evaluated, the identification of inefficient discharges holding up admissions as a problem was identified, and a Lean workshop was initiated. Afterwards the prime objective of 70% of patients receiving therapy on the date of admission was consistently met. MOC credit was available for participation in this effort.
Takahashi et al (2016) ⁵⁵	Radiology	IMP	Radiation dose	Utilizing a stepwise quality improvement approach approved for MOC credit, the effective radiation dose for thoracic CT scans was reduced by 23.62 and 43.63 % in quarters two and four, respectively, compared to our initial standard protocol, with no perceived difference in diagnostic quality.
Kim et al (2015) ⁵⁶	Radiology	IMP	Survey (self-report)	The authors evaluated a model for a collaborative performance improvement project between resident and attending physicians that met requirements for ACGME next accredit system and American Board

				of Radiology MOC. A formal sign-out policy was implemented. Six resident and nine attending physicians completed surveys evaluating the project. Perception of the sign-out process improved by 20% after the formal training. Three attendings and one resident received credit for the MOC PQI and ACGME quality improvement projects.
Kim et al (2016) ⁵⁷	Radiology	IMP	Survey (self-report)	A clinical transition of care quality improvement project for radiology residents was developed, with American Board of Radiology MOC credit for participating faculty. One hundred percent of surveyed residents completed the pre-intervention (n = 6), post-intervention 1 (n = 7), and post-intervention 2 (n = 8) surveys. In the pre-intervention, post-intervention 1, and post-intervention 2 surveys, 71.4%, 57.1%, and 57.1% of questions were answered with <= 1 unfavorable response, respectively. The number of questions with >= 75% favorable response was 7 (50%), 7 (50%), and 11 (78.5%) in the pre-intervention, post-intervention 1, and post-intervention 2 surveys, respectively (P = .13). A written sign-out template and monthly protected sign-out meetings were instituted. One resident and 3 attending physicians received credit for Accreditation Council of Graduate Medical Education NAS quality improvement and American Board of Radiology MOC PQI projects, respectively.

Abbreviations: IMP indicates improvement in medical practice; LLSA, lifelong learning and self-assessment.

^aThe comments in this column are summary qualitative outcomes ("improved," "modestly associated," etc.) or terms used by the authors of the cited studies.