

Supplemental Digital Appendix for Kashani KB, Ramar K, Farmer JC, Lim KG, Moreno-Franco P, Morgenthaler TI, Dankbar GC, Hale CW. Quality Improvement Education Incorporated as an Integral Part of Critical Care Fellows Training at the Mayo Clinic. Acad Med.

Supplemental Digital Appendix 1

Critical Care Fellowship Quality Improvement Curriculum Development

The initial goal was to collaborate with the Mayo Quality Academy (MQA) to customize and deliver the existing Mayo Quality Fellows (MQF) curriculum as an integral component of the Critical Care Fellows (CCF) program. The MQF program was established February 2010 as part of the MQA, which initially began in August 2006 to provide a broad based quality management curriculum for all Mayo Clinic staff. Participants learn to identify, measure, and improve healthcare quality within a DMAIC (Define, Measure, Analyze, Improve, and Control) framework using Lean, Six Sigma, and other quality methods. Quality Fellowship consists of three levels of internal certification: Bronze, Silver, and Gold (Table A). As candidates progress to higher competency levels, the required scholarly activity increases dramatically. Exams, project work, teaching assignments, oral presentations and publishing are all part of the academic aspects of the MQF program.

The target goal of the CCF pilot was for all the fellows to achieve both the Bronze and Silver Quality Fellowship prior to graduation. The Bronze level was targeted for achievement during the first months of the academic year as a precedent for the Silver level. The Silver level had two requirements: (1) successfully passing four written exams with a score of 80% or better and (2) performing and submitting a healthcare quality improvement project for review and approval. The course objectives for each required course: Quality Management Tools, Selecting Quality Improvement Methods, Applied Quality Essentials, and Champions are summarized in Table B,

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and are the basis for the four comprehensive exams. Our pilot required the customized delivery of the existing four distinct courses into the fellows' curriculum and medical rotation schedules (Figure A) in addition to completing a project.

Applying the learned quality skills to complete an actual QI team-based quality improvement project was, from the beginning, considered the capstone and most important aspect of our education pilot. It integrates improving physicians' skills in a number of important areas necessary for QI, including: applying quality methods to real healthcare issues, teamwork, communication, project management, change management, leadership, and giving and receiving mentorship or feedback. The combination of coursework and project work as a group of similar students in a cohort also touches all the Bloom's Taxonomy of Cognitive Levels for effective learning¹, as well as providing the advantages of peer, specific, and just in time (JIT) learning which are not usually present in standard quality courses with unrelated participants possessing different levels of understanding, ability, and application. There is also excellent alignment to two of the important core competencies promoted by the ACGME which are "Practice Based Learning and Improvement" and "Systems Based Practice". One theme that was continually reinforced during the project process was that it was an iterative and learning experience often incorporating PDSA (Plan, Do, Study, Act) cycles and sometimes accompanied by periods of failure or little progress. This is often a significant paradigm shift for medical students and residents as QI projects are not always related to the extensive academic or research requirements and methods normally experienced in medical school/residency/fellowship training programs' projects, studies, or publications. According to Donald Berwick, one of the changes that would help accelerate the improvement of healthcare is for physicians and healthcare professionals to embrace a wider range of scientific methodologies.²

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References:

1. Bloom BS, Engelhart MD, Furst EJ, Hill WH, Krathwohl DR. *Taxonomy of educational objectives: the classification of educational goals; Handbook 1: Cognitive Domain*: New York, Longmans, Green; 1956.
2. Berwick DM. The science of improvement. *JAMA*. 2008;299(10):1182-1184.

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Table A: Quality Fellows Program Levels

Level	Focus	Audience	Expected role/function	# of QI projects	Process improvement/ Project requirements	Scholarly activity requirements	Mayo written exam requirements	External certification alignment (not required)
Bronze	Understand Mayo value equation. Recognize Mayo's quality improvement framework (DMAIC). Suggest process improvements & function as an active QI team member.	Consultants, residents, fellows, supervisors, managers	QI team member	None	None	None	Multiple choice Questions, open book/notes	QI associate
Silver	Knowledgeable in core QI methods. Select, initiate & prioritize QI projects. Commission teams' project to impact Mayo value equation. Support, coordinate and monitor QI teams. Conduct project review. Receives guidance and support from QI expert.	Administrators /chairs, managers, or supervisors	QI project champions or process owners	1	Participation on a QI team	None	Multiple choice questions. Open book/notes	Green-belt
Gold	Apply, facilitate, coach and teach process improvement using QI frameworks including DMAIC/Lean/6 sigma/applying structure process improvement/new process design methodology. Incorporating change management best practices, guiding and encouraging individuals	QA faculty members, analysts, QI advisors	QI practitioner/resource	2	Leading QI teams, mentoring at least 1 individual through Silver level	Oral presentation and/or publication of at least one related subject at large venue	Multiple choice questions. Open book/notes	Black-belt

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and teams through process improvement initiatives, and spreading successful innovation								
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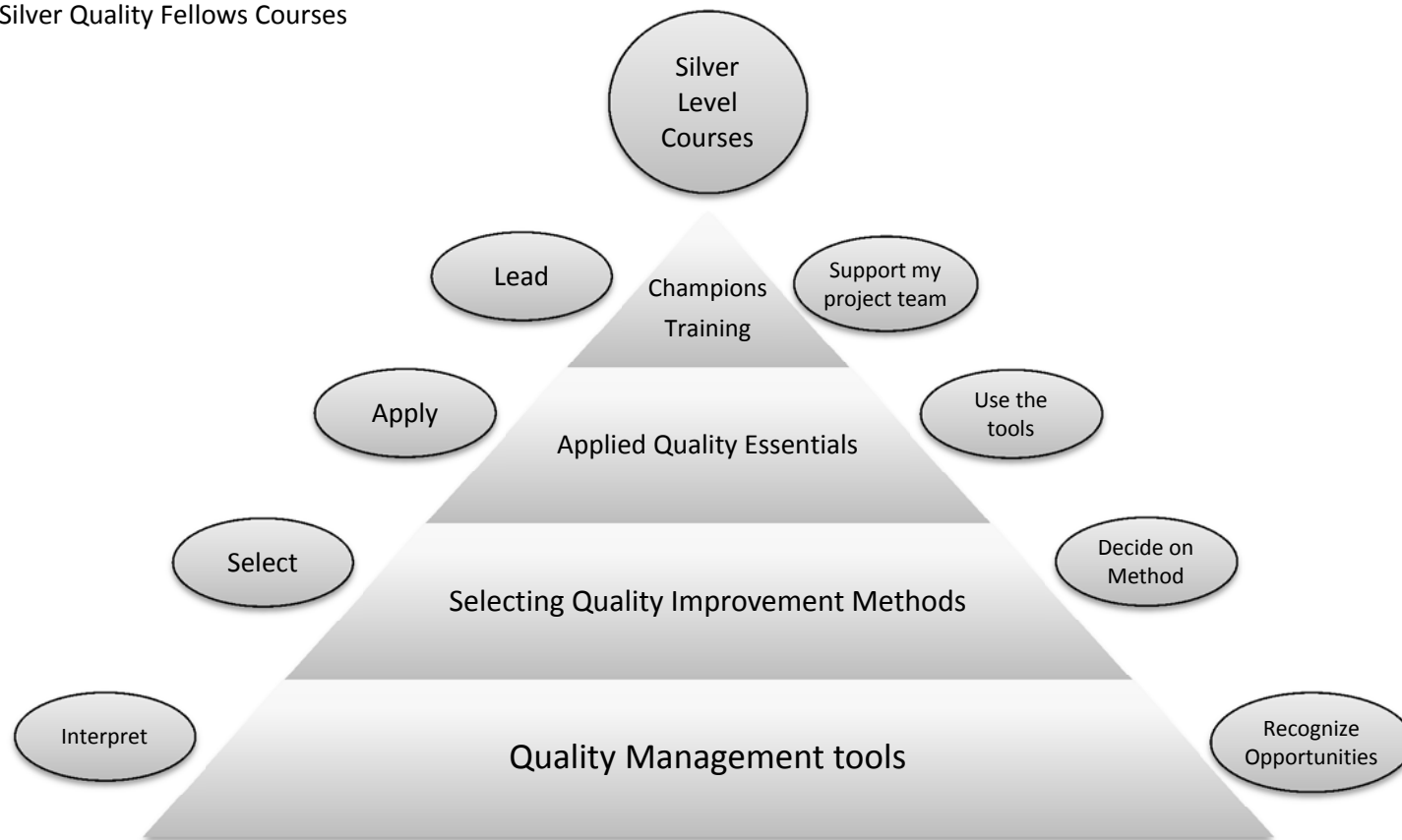
Table B: Objectives of the individual Silver Quality Fellows Courses

Course Title	Course Objectives
Quality Management Tools	<p>Understand drivers & core measures.</p> <p>Communicate your data.</p> <p>Interpret and react to quality opportunities.</p>
Selecting Quality Improvement Methods	<p>Explain the meaning of quality and process improvement.</p> <p>Identify common elements of the following projects: "just do it", problem solving, Lean, Six Sigma, and Design for Six Sigma.</p> <p>Compare and contrast methods to be used for quality improvement projects.</p>
Applied Quality Essentials	<p>Recognize, explain, and provide examples of current gaps and measurements in the quality of healthcare.</p> <p>Describe how to actively participate in quality improvement projects and advance the Mayo Clinic Mission.</p> <p>Recognize and apply the essential quality improvement strategies and tools of Lean and Six Sigma in the DMAIC (Define, Measure, Analyze, Improve, and Control) method.</p>
Champions Training	<p>Fulfill the role and responsibilities of a champion in selecting, commissioning, and guiding improvement project teams.</p> <p>Understand and apply how to sponsor projects through appropriate selection and prioritization methods.</p>

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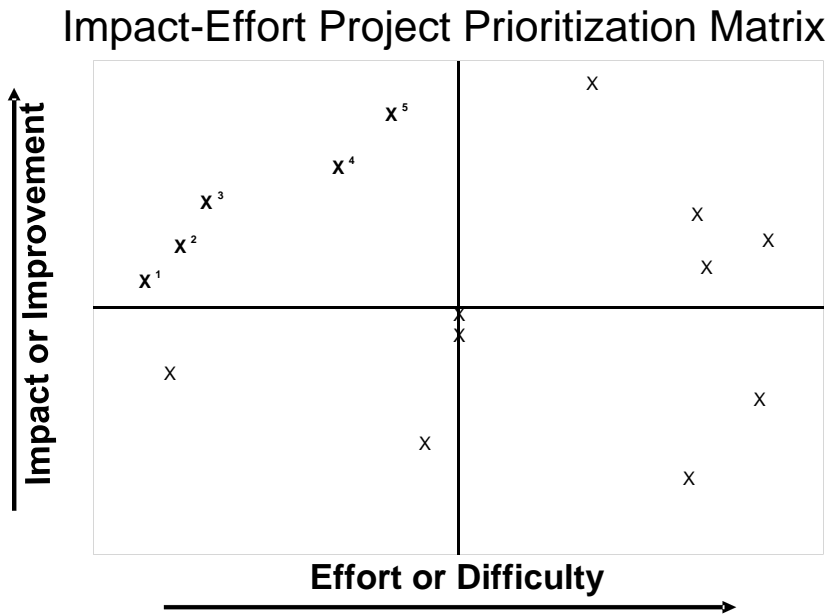
	Identify how to support and guide improvement teams Review and approve team deliverables through all phases of improvement projects
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Figure A. Silver Quality Fellows Courses



Supplemental Digital Figure 1

Impact-Effort Project Prioritization Matrix. The five chosen projects were located in the left upper quadrant with perceived highest impact and lowest effort. X¹: Increasing adherence to airway checklist; X²: Improving compliance with strict isolation; X³: Increasing use of appropriate sleep enhancement; X⁴: Improving compliance with sedation holidays; X⁵: Decreasing unnecessary urinary catheter days.



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Supplemental Digital Table 1

Student Survey of Training after First 30 Days of 2010-2011 Pilot (n=13)

	1	2	3	4	5	Mean
Pace (1 = very slow; 5 = very fast)	1	1	10	1	0	2.8
Content (1 = very easy; 5 = very difficult)	0	0	11	2	0	3.2
Instructor (1 = very ineffective; 5 = very effective)	0	0	2	3	8	4.5
Meeting your needs (1 = very ineffective; 5 = very effective)	0	0	3	4	6	4.2

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Supplemental Digital Table 2

Student Follow Up Survey of QI Training Program for Academic Year 2010-2011 after 10 Months Following Graduation (n = 15)

	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly agree	Mean
The Quality Improvement training increased my ability and confidence to undertake quality projects in healthcare	0	0	0	2	13	4.9
The inclusion of Quality Improvement in my fellowship training has been helpful in achieving my desired employment, positions, advancement, or responsibilities.	0	0	2	5	8	4.4
I have initiated or am currently participating in quality improvements in healthcare.	1	0	2	4	8	4.2
The Quality Improvement curriculum was at the appropriate content level and pace.	0	0	0	7	8	4.5
The Quality Improvement training sessions displaced other important clinical topics from the fellowship core curriculum.	1	8	3	2	1	2.6
The opportunity to apply the training to a healthcare project was a valuable part of the Quality Improvement curriculum.	0	0	0	4	11	4.7
I would recommend the Quality Improvement training be available to future critical care fellows.	0	0	0	5	10	4.7