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Quality Improvement in Rehabilitation: A Primer for Physical Medicine and Rehabilitation Specialists

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Abstract

Physiatrists in all practice settings can improve the care of rehabilitation patients through the rigorous application of quality improvement (QI) methodology. This primer provides a step-by-step guide to QI in rehabilitation settings for academic and community physiatrists, using the Model for Improvement. Key concepts discussed include Plan-Do-Study-Act cycles, setting optimal aim statements and measures, involving the rehabilitation team, diagnostic tools to understand root causes of quality problems, selection of change concepts and ideas, and utilizing run charts for data analysis. A QI project focused on the secondary prevention of vascular complications in amputees with diabetes admitted to inpatient rehabilitation is used as an illustrative example throughout the primer.

Introduction

This article provides a step-by-step guide for physiatrists to actively engage in quality improvement (QI) projects in their practice using widely accepted methodology, by exemplifying fundamental QI tools and illustrating their application with a real world example project. The approach to QI we present is the Model for Improvement, which is based around completing Plan-Do-Study-Act (PDSA) cycles to accelerate improvement by appropriately selecting, testing, and implementing changes.[1] By using these principles, physiatrists can lead effective changes in their practices and achieve both better patient outcomes and provider satisfaction.

A recent scoping review of QI publications in rehabilitation medicine identified a relatively small but growing body of work.[2] Although reassuring that there exists a nascent field of QI in rehabilitation, the review highlighted that many projects did not fully utilize well-accepted QI methodology such as authentic execution of PDSA cycles. In our opinion, there is a pressing need for the field of physical medicine and rehabilitation (PM&R) to embrace QI in a more systematic and widespread manner. The Institute of Medicine (IOM) quality dimensions are safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity.[3] Using the domain of safety as an example, a recent retrospective chart review of a sample of American Medicare beneficiaries in free-standing rehabilitation facilities estimated that 29% of patients experienced adverse events, of which nearly half were preventable.[4] Although the review encompassed only a single rehabilitation setting, it demonstrates that rehabilitation patient populations are susceptible to iatrogenic harm. Engaging in QI can reduce preventable harms such as falls[5] and improve care. Beyond improving rehabilitation care, QI can also meet other goals such as satisfying hospital or payer demands, meeting accreditation requirements, or maintaining certification. While there is growing interest in teaching core QI skills during residency, there are still significant gaps in knowledge among both trainees and practicing physiatrists.[6]

Some specialties including cardiology[7] and rheumatology[8] have published discipline-specific QI primers to support members engaging in QI, but no such resource is presently available to PM&R specialists. QI is highly context specific, and there are defining features of PM&R as a specialty that favor the successful integration of QI in our practice settings. For example, PM&R practice is intrinsically multidisciplinary and interprofessional, and

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the close collaboration of physiatrists with other health care providers should be a facilitator to the execution of QI projects, which invariably require broad-based engagement of health care teams to maximize success. Physiatrists also typically follow patients longitudinally, which may facilitate data collection, testing of iterative change ideas, and engaging patients as active participants in QI initiatives. Finally, whereas other specialties based in acute care may focus improvement efforts on preventing patient harm and other safety issues, physiatrists optimize patients' quality of life and function; therefore measures of quality in rehabilitation may diverge from other specialties and reflect more broadly on all six of the IOM quality domains. Because formal training in QI may not be universally accessible to physiatrists seeking to increase their familiarity and facility with QI, this primer provides a pragmatic foundation of QI theory and methods to enable any academic or community physiatrist to embark on QI work in his/her own practice. Although advanced training is required for more complex projects, we review some core skills below that should allow anyone to improve their practice.

Plan

Selecting a Target for Your QI Project

Selecting an appropriate quality problem to target is the first step of any QI project. There may be multiple quality gaps in your practice, but not all merit application of formal QI methodology. For example, some QI problems may have an easy fix that can be implemented immediately and without need for extensive study, whereas others may be system-wide issues necessitating an institution-wide or regional strategy. Other problems are not in our control at all. Consider the following factors when selecting an ideal QI project:

1. Frequency and severity: How common is the problem? How significant are the impacts on patients?
2. Locus of control: Is the problem under your direct control? If not, then effecting change may be difficult unless you have buy-in from the process owners.
3. Feasibility: Given available time and resources, how feasible is tackling this problem? How readily available are the data you will need? What are the anticipated costs (including opportunity costs)?
4. Unintended consequences: Fixing one problem may inadvertently cause new problems. For example, introducing a checklist may increase staff workload or distract from other important clinical activities. What do you anticipate may be the nature and severity of these potential consequences?
5. Synergy: Does your project idea align with your organization's strategic plan or an existing QI initiative? If so, you are more likely to gain support from senior leaders, and access to resources and funding.

Any QI project idea should be evaluated critically using these criteria to choose a project with the highest chance of success.

Case Example: This primer's example project aimed to optimize prescription of vascular protective medications for patients with diabetes on an inpatient amputee rehabilitation unit. As per the Canadian Diabetes Association (CDA) Guidelines, vascular protective medications could include a statin, angiotensin-converting enzyme inhibitor, and/or aspirin, depending on individual risk factors. Anecdotal evidence suggested that many diabetic inpatients were not on the appropriate medications at time of discharge from rehabilitation, hence this was a frequent problem and one with potentially severe morbidity, as they were at risk for future cardiovascular events including contralateral limb amputation or death from cardiac arrest/stroke. The physiatrist discussed the issue with the unit hospitalist and pharmacist, and they decided that this was a problem they could feasibly address through small changes to their prescribing practices and workflow. In terms of unintended consequences, prescription of new medications poses risks of adverse effects (eg, increased bleeding on aspirin); however, these risks did not outweigh the potential benefits. While there was no obvious synergy with other ongoing QI projects, the physiatrists embarked on this QI project because of its importance in terms of improving patients' quality of life and function, which is a critical aspect of PM&R practice.

Gap Analysis

The next step in the "Plan' stage is to perform a gap analysis and collect baseline data to confirm that the suspected quality problem is indeed real. Not infrequently, perceived problems may not be borne out by the data, hence it is important to confirm the existence and scope of the problem before expending much effort on a project. It is a common belief that large-scale chart audits are necessary in order to establish baseline performance rates; however, Etchells et al demonstrated statistically that a chart audit of only 15 to 20 random or consecutive patients is typically sufficient to confirm the presence of a quality gap.[9] At this stage, the objective is not to rigorously measure the baseline rate, but only to establish whether you are meeting the expected standard or not.

A chart audit of 22 consecutive diabetic inpatients admitted to the amputee unit showed that only 23% were on the correct vascular protective

medications, thus confirming there was a significant quality gap worth addressing.

Aim Statement

To focus the QI project, a clear aim statement is needed. A good aim statement should answer three key questions: (1) "What are we trying to accomplish?"; (2) "By how much?"; and (3) "By when?", meaning that the aim should be specific, with a quantitative target that you are seeking to attain, and a deadline by which that improvement should be achieved. This is analogous to goal setting with rehabilitation patients; QI aim statements should be "SMART"—that is, Specific, Measurable, Attainable, Relevant, and Time-framed. The scope of your project should be narrowed as much as possible to maximize feasibility of achieving the aim in a reasonable time period. The aim statement can also be adjusted over time as your understanding of the problem and interventions increases.

Our aim statement was "To ensure that over 90% of diabetic amputees are discharged from rehabilitation on appropriate vascular protective medications, as per the CDA guidelines, by May 1, 2015."

Once an aim statement is selected, rather than jumping directly to "Do" and implementing a solution based on what you think will solve the quality problem, it is crucial to finish the "Plan" stage—engage stakeholders and diagnose the problem—before leaping to implementing solutions.

Engaging the Rehabilitation Team

A QI project team should be assembled by identifying the key stakeholders, including anyone who is affected by the problem and anyone who may be involved with or affected by the changes you implement. In a private practice setting, stakeholders may include the physiatrist, office administrative staff, patients, and referring physicians. In the hospital environment, physiatrists work with interprofessional teams to provide rehabilitation services, and members of these teams should naturally be invited to participate in any QI projects. Senior hospital leaders who can champion the project and representatives from other relevant departments are also important. Engaging stakeholders early and often will help you to fully understand the problem, inform your change ideas, build commitment for the change, and promote successful implementation. Methods of engaging with stakeholders include inviting them to join the project team, providing them with regular updates about project progress, and soliciting their opinions and suggestions at key junctures.

Our project team included the physiatrists on the amputee unit, PM&R residents, the unit hospitalist, and pharmacist.

Engaging Patients

Patients are often overlooked in QI initiatives, even though understanding the patient experience is critical to improving it. QI teams can utilize patient interviews, patient experience surveys, and patient co-design to engage patients. The patient perspective on a problem often leads to unexpected solutions that were in the "blindspots" of clinicians.[10,11] Inpatient and outpatient rehabilitation patients and their families constitute readily available cohorts of potential QI project collaborators.

We interviewed inpatients to help understand potential barriers to taking the required medications, and patient feedback was used when developing the intervention.

Taking a Systems Approach

When trying to understand the root causes of your quality problem, always take a systems approach. Quality problems rarely have only one root cause, but rather result from multiple smaller issues in a system. It is often helpful to be explicit about this when working with your team, to allay fears of individual blaming.

Poor communication and transfer of accountability (hand-offs) were identified system issues leading to underprescription of necessary vascular medications. Staff were hesitant to change medications at admission without enough medical information provided in the acute care records, and physicians were hesitant to start medications in rehab when it was unknown if they would have follow-up for potential side effects and response postdischarge.

Several tools can be used to identify the root causes of your quality problem. In this primer, we describe some invaluable and commonly used tools for root-cause analysis: the fishbone/Ishikawa diagram, Pareto chart, and process mapping.

Fishbone/Ishikawa Diagram

An Ishikawa or "fishbone" diagram is a diagnostic cause and effect analysis tool used to identify various system factors leading to a quality problem and is best generated by brainstorming with your rehab team in order to obtain everyone's unique perspectives on the problem. First, the clearly defined QI problem (the "effect") is written in a

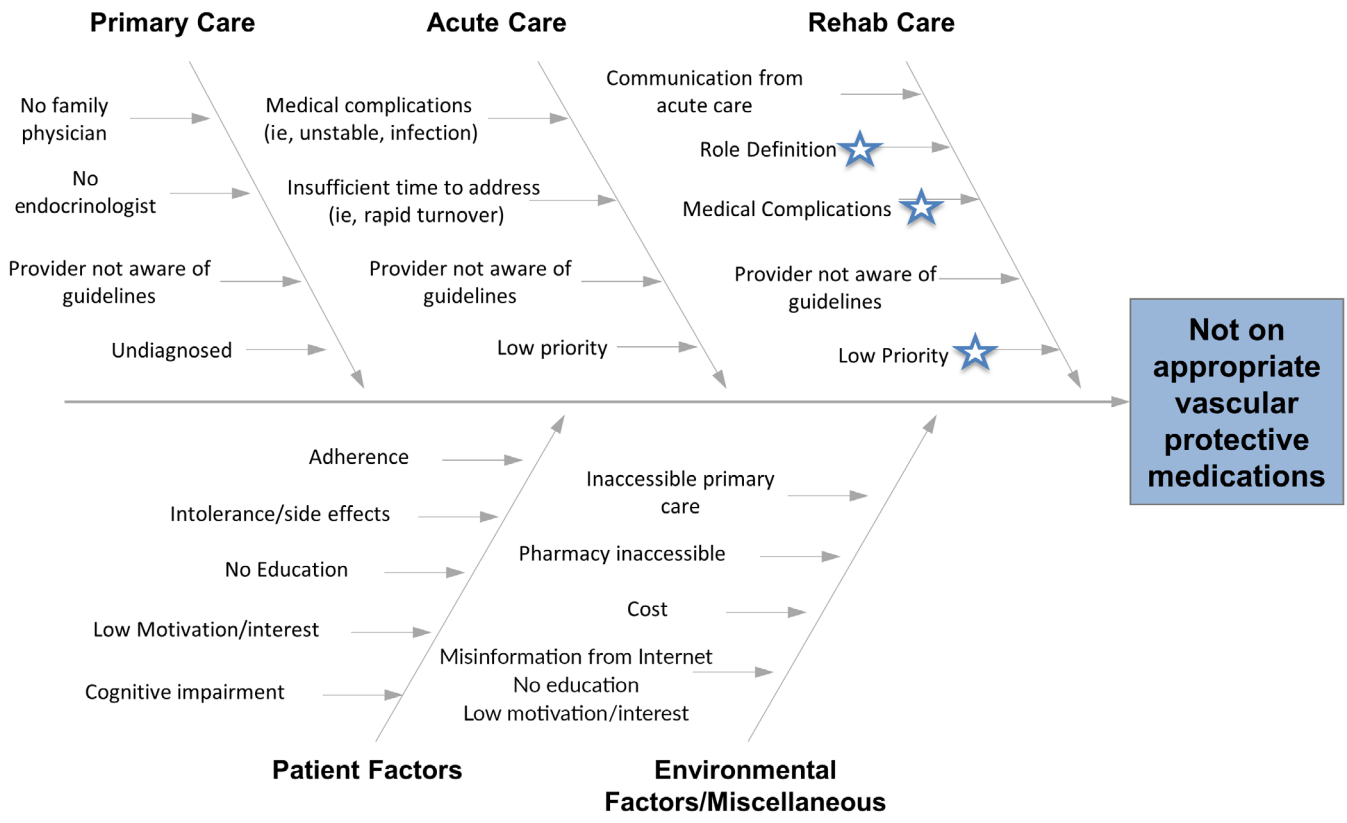

Figure 1. An example fishbone cause-effect diagram. The top three causes identified by the rehab team are starred.

box on the right side as the "fish head."[12] Broad categories of root causes such as provider, policy, environment, patient, and equipment-related factors are represented as bones that connect to the fish head. However, rehabilitation patients are often followed by PM&R specialists longitudinally, with rehabilitation as one step in our patients' complex journeys. So, it may be appropriate to add "bones" like "acute care" and "primary care" to more clearly see our locus of control and the impact of transitions. Then, your team identifies specific root causes in each category through brainstorming and data collection and draws these as smaller bones under each heading.

Figure 1 illustrates the Fishbone diagram which was created after consultations with the physiatrist, hospitalist, residents, pharmacist, and patients on the amputee rehab unit.

Pareto Chart

Pareto charts use bar graphs to categorize data and illustrate the frequency of different causes for a QI problem. The Pareto principle states that 80% of problems are due to 20% of the causes. The most frequent (top 20%) causes will typically be the highest-yield targets for your QI interventions. The Pareto chart is constructed after an audit that tracks the number of problems and their causes, or after multivoting by rehab team members on causes from the fishbone diagram in situations where data is unavailable.

The identified causes are arranged in descending order of frequency on the x-axis. For each cause, the frequency percentage is listed on the y-axis. A line graph is superimposed on the bar graph to illustrate the cumulative percentage of instances of problems. The causes leading to 80% of the problems are likely suitable targets for improvement.[13]

Multivoting by the rehab team revealed that lack of a clear process owner, concerns about possible medication side effects, and perceived low priority of prescribing these medications during the rehab admission were identified as the top three reasons that patients were not discharged on the optimal medications.

Process Mapping

Process mapping is a diagnostic tool that documents process activities in a detailed graphic form to improve understanding of the process under study. Every system achieves the results that it was designed to, or in other

words, quality gaps occur due to flawed system designs and poor system usability.[12] Therefore, understanding a health care process in detail is fundamental to making it function better. Process mapping can identify inconsistencies, gaps, wait times, and overlaps in care; these deviations from an ideal system represent potential targets for QI interventions.[14]

Process mapping is ideally performed by directly observing processes and shadowing patients or clinicians. An effective process map must capture what happens in the health care system, not what is supposed to or assumed to happen. The purposes of the process map include[15]:

1. Identifying the flow or sequence of steps in the health care process
2. Understanding the relationships and interactions between personnel and processes
3. Identifying deviations between how a process works and how it is supposed to work

Once the initial process map is drawn, it should be validated with the rehab team members involved in each step. By involving the team, process mapping can be used as a stakeholder engagement tool as it pushes them to think about the system rather than individuals. The process map can be used to break down system complexity and communicate to the team the reality of the system.

PM&R residents shadowed the rehab unit staff and reviewed rehab admission and discharge documentation. Interviews with physiatrists, hospitalists, patients, nurses, pharmacists, and administrative staff were completed to finalize the process map and identify key points in the admission process at which to intervene to improve prescribing practices (Appendix S1).

Do

After identifying the root causes of the quality problem, the next step, "Do," involves implementing solutions to address them and selecting measures to track the success of your interventions. You should be able to clearly articulate a theory that links the quality problem to your intervention through a "change concept," which is a general approach to change used to develop specific "change ideas."[16] In health care improvement, commonly used change concepts have been codified into a Hierarchy of Intervention Effectiveness[17] by the Institute for Safe Medication Practices. The Hierarchy illustrates that change concepts that rely on individual provider behaviors are less effective than system-level changes, because of human factors that introduce variation and lack of reliability in task completion. Interventions that we commonly jump to such as an education session for the rehab team or a new policy in fact have the lowest effectiveness in changing provider behaviors. Reminders, checklists, standardization, or simplification are more effective because they are more embedded in the workflow, whereas automation and forcing functions (in which system design limits the ability of users to make certain errors) are the top tier on the hierarchy because they "hardwire" change at the system level.

Once you have selected an effective change concept to address your quality problem, the change idea that you implement should be a specific intervention tailored to your context. For example, the change concept of "reminders" can take various forms, such as an electronic medical record reminder or a bedside sign on gait aid use. Each of these approaches represents a different change idea, and the selection of which method to implement should be customized to what makes the most sense in your local setting.

Based on our root cause analysis, we theorized that optimizing medication prescription was not part of the regular workflow for the amputee rehab team. Adopting the change concept of reminders/checklists, the pharmacist, hospitalist, physiatrists, and residents worked collaboratively to develop their specific change idea, which was a vascular protection checklist based on the CDA guidelines, and which was then utilized for every new admission to the rehab ward.

PDSA methodology emphasizes small-scale, rapid cycle change. Unlike research, where outcomes are measured before and after implementation of interventions and in which biases are controlled or minimized, QI takes place in the complex and real world of rehabilitation care as it happens. Therefore, the goal is not to implement the perfect solution for a quality problem at the outset, but rather to make incremental changes that bring you closer and closer to your goal, while collecting data along the way to track your progress. The concept of PDSA seems deceptively simple but can be challenging to implement rigorously. Taylor et al found in a study of 73 published QI projects that only 15% collected data frequently enough (defined as at least monthly) to fine-tune interventions through small-scale changes.[18] Strategies to facilitate frequent data collection include using automatically collected hospital or systems level metrics whenever possible, harnessing the resources of the interprofessional team, and enlisting the help of learners.

Every QI project should track a "family of measures," consisting of outcome, process, and balancing measures,[19] to comprehensively capture the impact of the intervention. The primary outcome measure should map directly to the aim statement and is the clinically relevant outcome you are trying to improve.

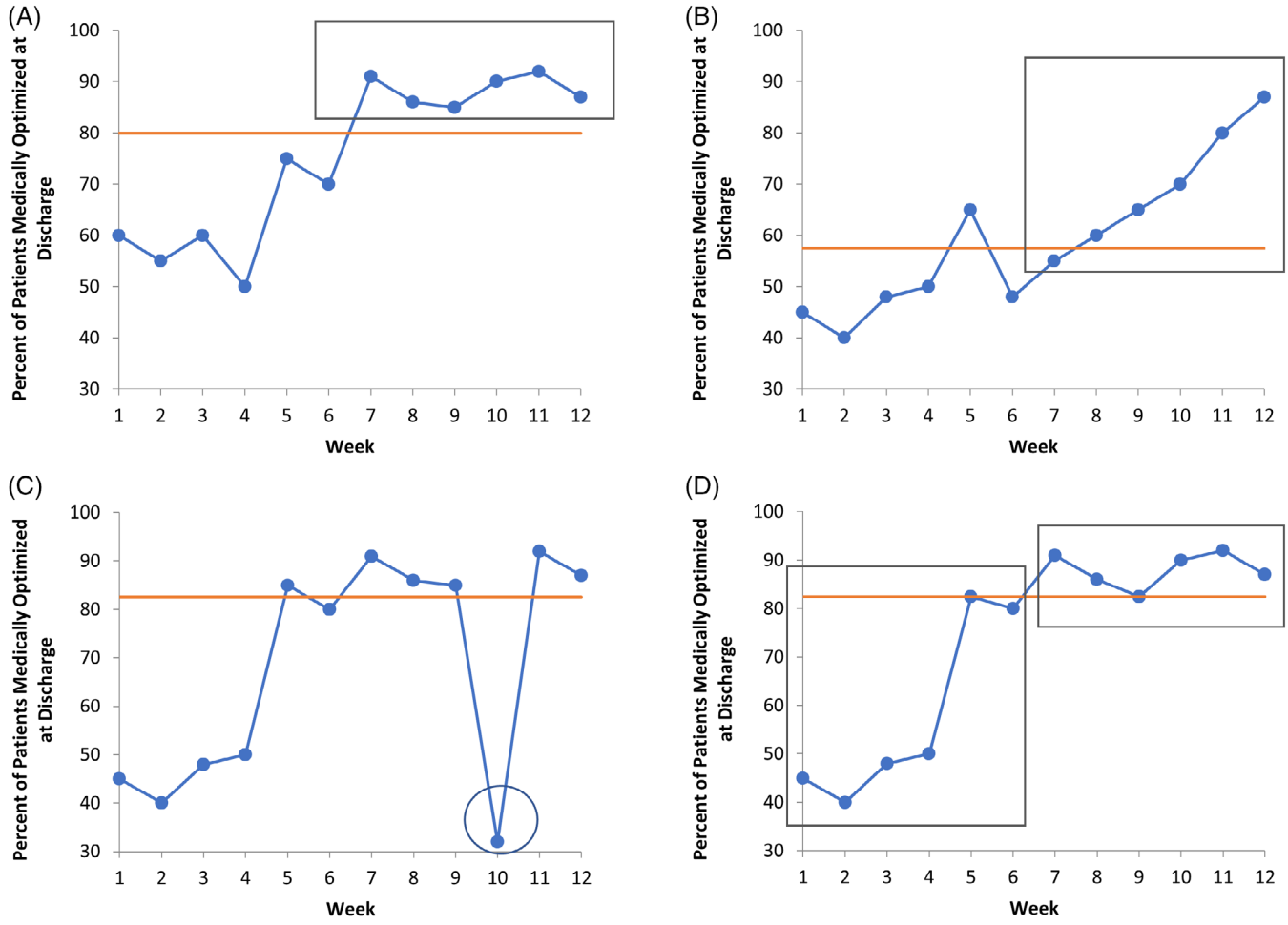

Figure 2. Sample run charts showing the four run chart "rules": shift, trend, astronomical point, and runs. The orange line represents the median.

The primary outcome measure was the percentage of diabetic patients who were discharged from amputee rehabilitation with optimized vascular protective medications.

To ensure that your intervention is being utilized as planned, process measures need to be collected to assess the uptake of your intervention by the rehab team.

The process measure was the percentage of patients with checklists completed.

Finally, balancing measures look for the unintended consequences of the intervention, as sometimes improving care in one area can result in problems in others.

The balancing measure was the percentage of patients with adverse drug reactions due to vascular protective medications.

The "Do" step is not only about implementing an intervention, but also simultaneously collecting data on outcome, process, and balance measures to ensure the success of the interventions.

Study

After implementing an intervention, it is time to study your outcome, process, and balancing measures. The primary methods of data analysis in QI are interpretation of run charts and statistical process control (SPC) charts, which display data graphically over time and help to reveal whether observed changes in your measures are due to the interventions or random chance. In any data series, there is expected, random variation that is nonsignificant, and these charts help to identify whether your intervention is resulting in positive improvements or not. By collecting data at regular intervals and analyzing the data in real time, interventions can be adapted rapidly to enhance success, which aligns with the PDSA principle of making small-scale, rapid cycle changes. Because most beginners use run charts, their use and interpretation will be explained here. Those interested in SPC charts are directed to "The Healthcare Data Guide."[20]

Run charts can be easily plotted without any specialized software. Time is on the x-axis and the outcome or

process measure of interest is on the y-axis. The median is calculated and plotted as the center line to guide chart interpretation (Figure 2); a minimum of 10 data points is recommended to interpret a run chart. Interpretation uses four rules: shift, trend, astronomical point, and runs. The presence of any of these four indicates a significant, nonrandom signal in the data.

A "shift" is when six or more consecutive points appear below or above the median line (Figure 2A), while a "trend" is five or more points increasing or decreasing consecutively (Figure 2B). The presence of either a shift or a trend indicates a nonrandom signal, which could be due to your intervention changing the measure. An astronomical point is a point that is subjectively but clearly different from the rest of the points on visual inspection of the run chart (Figure 2C). Its presence suggests that you should examine the data carefully and look for its cause. For example, an astronomically low point could occur because the usual team members are away and those providing coverage are not oriented to the intervention. The "runs" rule refers to too few or too many series of consecutive points that stay on one side of the median, which is termed a "run" (Figure 2D). Natural variation in data should cause random crossings of the median line. When too few or too many runs are seen, it suggests that something non-random, such as your intervention, is influencing the data. The number of runs expected for the total number of data points in the series can be found in the reference paper of Perla et al.[21] These rules may seem arbitrary, but they are based on mathematical probabilities.[21] Take for example the trend rule: the chance of five consecutive points increasing or decreasing purely by chance is 1 in 2^5 or 3.1%, which is less than the traditional 5% *P*-value threshold for statistical significance.

A run chart from the example project is shown in Appendix S2.

Act

In the "Act" stage of the PDSA cycle, decisions are made about next steps based on your results from run or SPC chart analysis. If the implemented intervention does not appear to be having the desired effect, then perform further diagnostics such as those described above in the "Plan" stage to understand "why" before embarking on another PDSA cycle. If the outcome and process measures are moving in the desired direction, then the intervention can be refined through another PDSA cycle with feedback from patients and rehab team members, particularly those you had not originally engaged, and a careful look at the fidelity of implementation. If the intervention is clearly not working, then you may decide to abandon this change idea, return to your root cause analysis, and test a new change idea in the next cycle. Continue to consult your rehabilitation team throughout this process to modify or select new change ideas based on their feedback. Once your intervention demonstrates sustained success, then you are ready to formally adopt the change idea as the new standard practice, and consider how to sustain the improvements over time, or spread them to other practice settings and/or institutions.

The checklist design was refined through several PDSA cycles of usability and pilot testing, and the checklists were centralized in one binder to facilitate review. After multiple PDSA cycles and ongoing data analysis, rates of patients being discharged on appropriate medications increased from 23% to 50%, and the checklist was formally adopted as a standard process on the unit.

Conclusion

QI methodology can help physiatrists work with their teams to take control of their practices and ultimately improve the quality of rehabilitation care. Physiatrists, whether in academic or community-based practice, inpatient or outpatient settings, should consider using QI approaches to improve care for their patients. For clinicians inexperienced in QI, the approach laid out in this primer, following the Model for Improvement and Plan-Do-Study-Act cycles, provides the simplest framework to embark on a journey to improve quality and patient safety.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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Disclosure

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