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EDITORIAL

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From weaning theory to practice: implementation of a quality improvement program in ICU

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In their recent article in *Intensive Care Medicine*, Bo et al. [1] report the effect on clinical outcomes of implementing a comprehensive quality improvement (QI) program aiming to improve the compliance with protocol-directed weaning. The authors performed a before–after cluster randomized trial in 14 China intensive care units (ICUs), enrolling 884 patients. In the non-QI group, 444 patients (193 for the baseline, 251 for the QI phase) and in the QI group 440 patients (199 for the baseline, 241 for the QI phase) were included. The protocol-directed weaning in the QI group was associated with significant decreases of median duration of mechanical ventilation [from 7 days in the non-QI group to 3 days in the QI group ($p = 0.003$)] and median lengths of ICU stay [from 10 to 6 days ($p = 0.004$)] and hospital stay [from 23 to 19 days ($p < 0.001$)] in mechanically ventilated patients. The authors concluded that the QI program involving protocol-directed weaning was associated with beneficial clinical outcomes in mechanically ventilated patients.

Albert Einstein said: "In theory, theory and practice are the same. In practice, they are not". Healthcare quality has received sustained attention during recent years [2]. The importance of sharing its accomplishments through the published literature increases [3], particularly in the ICU setting. Quality improvement programs have been used for implementation of protocols of intubation [4, 5], sedation analgesia [6], support for families [7, 8], prevention of nosocomial infections [9, 10], or nutrition [11]. Interestingly, the study by Bo et al. [1] is the first Chinese study to present and assess a QI program in the setting of weaning of mechanical ventilation with a randomized controlled clustered design. The level of proof is high and further strengthens the results of the study.

Quality improvement programs seek to apply proven treatments and recommended strategies to "real-world" patients. Changing practices is challenging in an ICU setting, with necessary education of a large team [12] and real-time safety audits [13]. Moving from theory to practice is harder than it looks. The Hawthorne effect was first seen in the 1920s at the Western Electric Company's Hawthorne Works, from which the term derives. The Hawthorne studies were designed to find ways to increase worker productivity. The Hawthorne effect is a psychological phenomenon that produces an improvement in human behavior or performance as a result of increased attention from superiors or colleagues. In a collaborative effort, the effect can enhance results by creating a sense of teamwork and common purpose. As suggested by Bo et al. [1] in their discussion, the Hawthorne effect was sought in the QI group, on the basis of the assessment of staff compliance with the weaning protocol by a site inspection and progress noted during the QI phase in the QI group. Power of observation is a major factor in implementing protocols and improving patient management, as formalized through the "Deming wheel", made popular by statistician William Edwards Deming in the 1950s, in the Plan Do Check Act (PDCA) method [6]

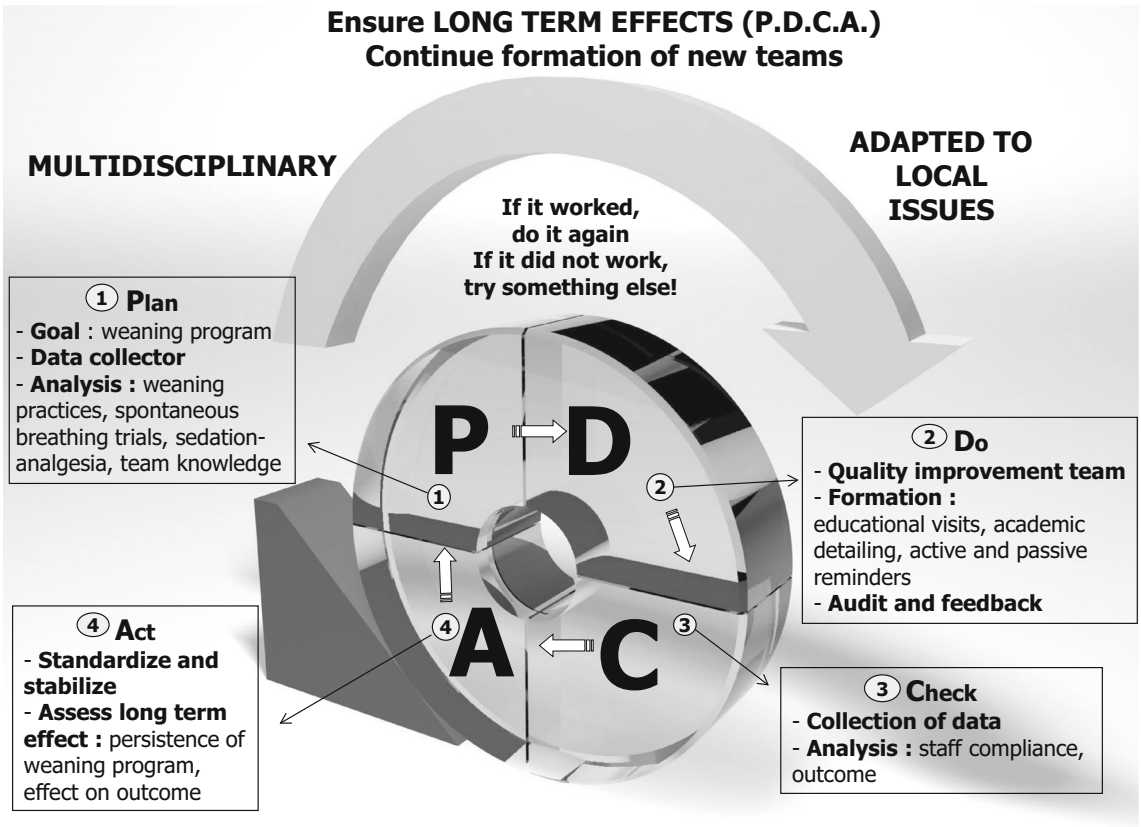

Fig. 1 Schematic of a weaning quality improvement program according to the Plan Do Check Act (PDCA) cycle. This infinite process follows the P-D-C-A steps performed in the ICU regarding the management of weaning of mechanical ventilation. Consecutive improvement steps are followed according to the PDCA method for quality improvement: *P* Plan the goal is clearly established (weaning program), then a data collector is selected, who collects data permitting the analysis of weaning practices, spontaneous breathing trials, sedation–analgesia, or team knowledge about weaning of mechanical ventilation. *D* Do a multidisciplinary quality improvement team is created, which provides training (educational visits, academic detailing, active and passive reminders), followed by audit and feedback, all adapted to local issues. *C* Check data are again collected, allowing one to analyze the staff compliance to the weaning program and the effect of the weaning program on outcome. If the "Check" step reveals that the "Do" step did not work, the process can go back to the "Plan" step. *A* Act what finally worked to improve weaning and outcome is standardized and stabilized. In view of this, the process continues, assessing long-term effect, i.e., persistence of weaning program and effect on long-term outcome. The "Plan" step should be done again regularly, followed by the other steps, to ensure the formation of "new" teams, and to remind the weaning program to "old" teams

(Fig. 1). The PDCA cycle is an iterative four-step management method used in business for the control and continuous improvement of processes and products. It consists in iterative cycles of outcome measurement, identification of problems, and implementation of potential solutions and repeated measurement. The "Plan" part identifies and analyzes the problem, the "Do" part develops and tests a potential solution, the "Check" part measures how effective the test solution was and analyzes whether it could be improved in any way. Then, the "Act" part implements the improved solution fully. Finally, looping back to the plan phase allows one to seek out further areas for improvement, or maintain the positive effect over time. Figure 1 presents a schematic of the PDCA cycle applied to weaning QI. In the study by Bo et al. [1], the PDCA cycle was not formally applied, and the study stopped at the "Check" part.

Conversely, in the study by Bo et al. [1], despite being significantly associated with a decreased duration of mechanical ventilation and length of stay in ICU, inclusion in the QI group was not associated with a diminution of reintubation rate, ICU mortality, hospital mortality, or 60-day mortality. The QI intervention was only delivered during a period of 6 months, which might not be sufficient to achieve a reduction in mortality, and the "Act" part of the PDCA model following the "Check" part was not performed. We wonder what could happen 1 year or even 10 years later, with new teams of nurses and physicians.

However, it is worth noting that in the setting of weaning QI programs, PDCA should be adapted to the

local problems specific to each country, state, and/or ICU, as specified in the SQUIRE (Standards for QUality Improvement Reporting Excellence) statement [14]. The SQUIRE statement provides a checklist of 19 items that authors should consider when reporting QI studies. Most of the items are common to all scientific reporting, but many items have been modified specifically for QI programs. In the study by Bo et al. [1], the local problem of low rate of spontaneous breathing trials is therefore described, and the implementation of a "local leader" was appropriately chosen to deal with the specificities of each ICU.

Further, a multidisciplinary approach is essential in QI programs, placing responsibility with the team rather than with individuals, and is often more successful than a monodisciplinary approach in improving quality of care [15]. An important limitation of the study by Bo et al. [1] is the absence of implication of the nursing team in the QI protocol implemented. Involving the entire team in the QI program could be a simple way to further improve the strength of such programs. Another limitation, also related to the default of involvement of the nursing team in the ICU, is the absence of an algorithm to manage sedation–analgesia. However, sedation and analgesia protocols are strongly related to the weaning of mechanical ventilation. In the clinical realm, mechanical ventilation and sedation/analgesia are often intricately intertwined, particularly when controlled modes are used.

To conclude, the study by Bo et al. [1] shows with a strong methodology that implementation of a QI protocol of weaning management helps reduce the length of mechanical ventilation in critically ill patients. This is just the beginning; to improve the quality of care in ICUs further we need more, and more detailed, studies, with long-term actions and monitoring, to successfully move from weaning theory to weaning practice through local and multidisciplinary implementation of optimal weaning protocols.

Conflicts of interest Dr. Jaber reports receiving consulting fees from Dräger, Hamilton, Maquet, and Fisher & Paykel. No potential conflict of interest relevant to this article was reported for Dr. De Jong.

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