■ EDITORIAL

Returning to operating following COVID-19 shutdown: what can human factors tell us?

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COVID-19 has enormous implications for orthopaedic surgery worldwide. In many countries, elective operations such as arthroplasties were suspended for months while hospitals cleared space to care for infected patients. The resumption of elective arthroplasty faces many challenges, from managing hospital capacity alongside COVID-19 patient care to ensuring sufficient personal protective equipment. Orthopaedic surgeons also face the prospect of starting to operate again after a long break, which poses the potential problems of reduced technical proficiency. Human factors from knowledge developed in other industries and professions may help to identify the challenges and possible strategies to mitigate deleterious effects on outcomes. The concepts of the "learning curve" and "re-learning curve" which reflect [1]quantitatively the increased time taken to complete a task following a period of inactivity, are relevant to the current COVID-19 experience. These concepts suggest that the operating time per case should increase, even if there is no increased time associated with cleaning the operating theatre between cases or completing infection prevention protocols.

However, experience in most places has shown that during the pandemic every operation already takes considerably more time due to the infection prevention protocols. Combining the additional COVID-19 protocols and the re-learning curve effect will increase the total time it takes to complete operations. The precise number of operations required to regain the learning effect depends on where the surgeon is on the learning curve, so the effect will be surgeon-specific. Unfortunately, the specific number of operations required to return to the pre-shutdown operating time cannot be specified for everyone.

Surgeons and hospitals are under pressure to take care of patients who have been waiting for their previously-scheduled surgery and to restore financial stability. Thus, surgeons may feel pressure to complete operations quickly even though they are experiencing anxiety and stress resulting from changes in practices to reduce the generation of aerosols, such as reducing the use of pulsed-lavage. Given that it is expected to take longer, even completing an operation in the usual pre-COVID-19 time would make it rushed. It is important for surgeons to recognize this and to make sure that they complete the operation with the same level of attention to detail they would have before COVID-19, in order to ensure optimal infection prevention, prosthetic component positioning, soft-tissue balancing and the "hundred-and-one" other things that are so critical to a good outcome. Surgical teams may also have lost proficiency and need time for re-learning before returning to their previous levels of efficiency. In addition to increased time required to perform tasks, the literature dealing with human factors shows a reduction in skills with disuse. Many quantitative studies involving medical trainees have shown a decreased retention of surgical skills after a period of time when they have not been used.[2,3] While much less is known about the retention of skills in experienced surgeons who encounter a disruption in practice, studies of military deployment indicate that physicians and surgeons deployed to military theatres report perceptions of a decline in skills on returning to civilian practice.[4,5] It has been shown that competence and skills decrease if they are not used in general,[6] and also in other highly skilled professions.[7] Virtual reality (VR) training has been shown to improve trainee performance in total hip arthroplasty (THA),[8] but it is not known whether the same would apply if it were used as a re-training tool after a long lay-off from such work, or in more experienced surgeons.

It has been known for a long time in the aviation industry that disuse affects flying skills, and countermeasures have been developed.[9] While the use of simulators is the most common strategy to maintain skills in the absence of high-volume flying, there is also evidence that experienced commercial pilots can improve their performance after a break using cognitive simulation, in which they mentally rehearse flying tasks before performing them in the cockpit.[10] While VR and physical simulators are not widely available in arthroplasty surgery, all surgeons can use a mental rehearsal procedure before resuming arthroplasty surgery.[11]

The duration of surgery has been shown to affect the complication rate after THA.[12] Thus, even if there were no additional effects on the loss of technical proficiency, we might anticipate a deterioration in outcomes after the slow-down in practice caused by the pandemic. Arthroplasty registries will play a critical role in providing longer-term surveillance of these effects on outcomes. The Michigan Arthroplasty Registry Collaborative Quality Initiative is designing the analytics necessary to conduct these analyses as arthroplasties start to be undertaken again in Michigan. The National Joint Registry in the UK is also planning a modified approach to data reports due to the expected changes in throughput and practice.

In the UK and other countries with a centralized health service, the pressures on waiting lists are

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political as well as clinical, with huge amounts of comparative data published upon which hinge thousands of managerial and administrative jobs as well as the morale and aspirations of both patients and doctors. Therefore, it is imperative that these additional potential barriers to the rapid recovery of these systems are properly considered at all levels of health care delivery. Preventing undue pressure being applied to operating teams must be our goal, and by doing so we should minimize the anticipated serious effects on their health and levels of stress as well as the potential adverse effect on outcomes. It has been reported[13] that half of early revision THAs are deemed to be avoidable, which is to say that they relate to some technical inadequacy. If this proportion increases during any re-learning curve the implications would be very serious.

Some surgeons use patient-specific instrumentation, computer-assisted navigation, and/or robotic assistance for their arthroplasties,[14] and may be tempted to feel they would be protected from any re-learning curve by the specific instrumentation or robot which might be considered to be immune to such problems. This might be a dangerous assumption because in the case of patient-specific instrumentation, the engineers and others involved in the production of the instruments may also experience loss of skills, or personnel may have changed due to the economic consequences of the pandemic. A learning curve for the use of robots in such surgery has been identified,[15] but since most robotic operations are robot-assisted the relative contribution of the robot and the surgeon to that learning curve may be difficult to establish, and might vary from one system to another. A meta-analysis reported by Arthur et al[6] showed that a decrease in the performance of cognitive tasks is greater than that of physical tasks following periods of disuse, suggesting that the ability of surgeons to perform a sequence of tasks to operate the robot may be impaired more than the manual aspects of surgery. Moreover, surgeons should beware of "risk homeostasis,"[16] whereby their misperceptions of the benefits of patient-specific instrumentation and robots may drive them to make mistakes.

In the immediate future, as we return to more normal arthroplasty work, there are many aspects of the process and the routine monitoring which will be important to mitigate these potential risks. The surgical teams will need to pay particular attention to the safety checks and checklists. Multidisciplinary team meetings will take on an even more important role in the early detection of complications. Units may have to consider how best to monitor the technical competence of each operation by such measures as the group review of postoperative radiographs. New procedures such as those described by other industries could well be a useful adjunct to heightened levels of awareness of our usual practices. The early detection of such problems will need to reflect increased local governance and scrutiny. Registry-based quality, complication, and surgeon reports will be important for hospitals and surgeons to monitor their performance during this period , but will need to be interpreted with even greater care than usual in view of the many competing influences. It seems likely that we will escape a noticeable deterioration in patient outcomes only if everyone concerned pays an unusual amount of attention to all these issues.

Take home message

- The absence of elective surgery due to COVID-19 makes surgeons and their operating theatre teams susceptible to the re-learning phenomenon.
- It is known that skills can decrease in highly-skilled professions during a period of disuse.
- Cognitive simulation before resuming surgery may mitigate the harmful effect of the shutdown on surgical skills.
- Use of robots in surgery may not mitigate, and may even exacerbate, these effects because there is a learning curve to using robots.
- Registries will monitor the effects of COVID-19 and the associated shutdown of elective surgery on patient outcomes.

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