

Surgical Technologies Whitepaper



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The Complex OR Environment

Utilizing technology and 'system thinking' to manage the many challenges of the OR workflow to improve efficiency and performance.

Background:

The KARL STORZ CollaboratOR is a hub for surgical information in the perioperative environment. With the CollaboratOR, care teams can view a wide range of content in many different formats, e.g. PDFs, images, and videos as well as utilize common communication tools like Microsoft Teams, Zoom and Webex. To evaluate the utilization of the CollaboratOR and its potential impact on workflow efficiency and communications, KARL STORZ Medical & Scientific Affairs conducted a U.S. customer survey in late 2023-early 2024 through a third-party company. A formal, clinical study was not conducted, but this whitepaper shares the aggregated results of the online survey and describes other use cases of the KARL STORZ CollaboratOR observed in the field. There are three (3) formfactors of the CollaboratOR: Lite, GO and Pro.

Key results:

- The CollaboratOR can reduce set-up times by **up to 23-minutes for robotic cases and up to 15-minutes for laparoscopic cases**, potentially improving room turnover and on-time starts.
- Respondents reported a **238% improvement in accessing and viewing patient procedure information** during cases with a CollaboratOR, compared to before use with a CollaboratOR.
- **23% of respondents noted a slight decrease in procedure time by an estimated 5-10 minutes, enhancing efficiency.**
- **59% of respondents indicated that the CollaboratOR “significantly increases” or “increases” the ability to gather information about the patient, procedure, or surgeon’s preferences,** potentially reducing risks and errors.
- **91% of respondents** who use the CollaboratOR for teaching during a case or live didactic lecture found it useful for that application.
- **The number of respondents who were “extremely satisfied” tripled** after using a CollaboratOR compared to before using a CollaboratOR.

The whitepaper also includes observations on utilization of the CollaboratOR at different customer sites, such as during live case lectures, simulation labs, communicating with internal and external care partners, procedural checklists, computer downtime situations and the ability to operationalize an independent patient management system in the operating room. **The CollaboratOR centralizes information, providing clinicians with high visibility of essential patient, procedure, and policy information.** By interacting with the CollaboratOR both physically and cognitively, there is **potential to improve workflow efficiency and communication** in the operating room, **thereby positively impacting clinical outcomes.**

Introduction:

The complex and fluid environment of the operating room (OR) has often been described as organized chaos, meant to be a choreographed sequence of procedures where teamwork, communication, workflow, and equipment design can all impact clinical outcomes and patient safety.¹ This high-risk sociotechnical environment with various professionals working in close proximity requires effective



team communication and is the foundation of optimal patient outcomes.² Furthermore, complex work processes, including multitasking and interruptions, are other challenges with potential effect on patient safety.³ In attempts to understand and influence how complex systems, such as OR workflows, traditional ways of thinking in terms of linear causality models are insufficient. A 'system thinking' approach that considers the flow of interactive activities (e.g. between people, equipment, procedures) and the continuous adjustments needed to cope with system variability can help to improve safety and performance in the daily practice in an OR.⁴

With all the tasks and responsibilities, one may ask how does technology play a role in the OR environment? While the OR environment is a highly technical space, some technologies work synergistically with other technologies, and some do not. Can technology be harnessed to positively impact operating room metrics? Even with technology, without a team that communicates effectively, there can be negative impacts to patient safety and outcomes.⁵ Teamwork in the operating room refers to the coordinated and collaborative efforts of multidisciplinary healthcare professionals working together seamlessly to achieve the optimal patient outcomes.⁶ With the turnover in the surgical area exceeding national average⁷, having a stable team can be challenging. Additionally, when the labor market tightens, hospitals often bridge the gap by employing travel staff.⁷ **During these staffing challenges, the CollaboratOR can help by displaying processes and pictures to visualize information, potentially establishing consistent awareness among all involved, regardless of staff longevity.**

Situational awareness in the operating room is crucial for enhancing teamwork and communication among surgical teams. It involves the continuous perception and understanding of the surgical environment, patient status, and team dynamics, enabling timely and accurate decision-making. Studies have shown that high situational awareness correlates with improved technical performance and surgical outcomes.^{8,9} Mishra et al. demonstrated a strong link between surgeons' situational awareness and their technical outcomes in laparoscopic cholecystectomy procedures.¹⁰ The shared context with integration of information is one strategy that may improve the surgical team's situational awareness and reduce communication breakdowns. From a psychological perspective, functioning in complex situations is related to an individual's perception of key elements in that situation; failure of this situational awareness inevitably leads to inaccurate decisions.⁸ **Having the availability of a collaborative communication tool can allow for real-time adaptation to help the team maintain OR-related outcomes.**

One systematic review found that optimization of teamwork reduced operative time, while poor

teamwork increased morbidity and costs. Disturbances and communication failures in the operating room negatively affected operative time and surgical safety.⁶ **The KARL STORZ CollaboratOR has a multitude of capabilities, from pre-op to post-op, that may potentially change the dynamics inside and outside of the operating room and could positively impact operating room metrics, such as case set-up and turnover times, for example. Although not inclusive, Table 1 lists additional capabilities of the CollaboratOR.**

Table 1:

CollaboratOR Capabilities
Centralize count sheets, preference cards, room layouts, back table set-ups, time-out checklists, patient hand-off workflow, room turn over documentation*, training content and any other files.
Display PACS and other radiographic images*
Annotation on the screen
Telepresence of up to 8 simultaneous live video feeds to facilitate virtual consults, live educational courses, real-time proctoring with Zoom, TEAMS, WebEx, GoogleMeet, Multi-site.
Display live surgical feeds**
Live timers, alarms, and stopwatch for general purpose use
Tracking of room turnover times*
Connect and view live surgery displayed on another CollaboratOR for surgical consults and coordination of care – Multi-site feature*

*Must be integrated with other platforms to utilize

**Does not include use as a primary surgical monitor

Customer Survey Results about the CollaboratOR:

KARL STORZ United States conducted a third-party online survey to determine the utilization of one of their OR1 products, the CollaboratOR. There were 115 emails sent with a request to forward to end users and there was a return of 68 responses.

Results from the survey

There were 56 participants who answered the demographic questions of the survey. Of the 56 respondents, the clinicians had the following titles: Physician/Surgeon, OR Administrator/Leader, OR Clinical Lead (Coordinator, Educator), OR Nurse, Surgical Technician. There were also 10 people who identified as “Other”, which included Cath Lab RN, Sterile Processing Department (SPD) Staff, First Assistant, Certified Surgical First Assist, Surgical Assist, non-OR, education leadership, and Healthcare Simulation Educator. The survey was conducted across various facility types, including academic hospitals, large non-academic health system facilities, community hospitals, children’s hospitals, ambulatory surgical centers, and offices/clinics. The respondents have been in practice for varying numbers of years, as shown in Table 2. Table 3 displays the length of time the respondents had been in their current roles at the time of the survey. While

# of Years as a Medical Professional	Percentage	Count
Less than 1 year	0	0
1-2 years	7%	4
3-4 years	4%	2
5-9 years	14%	8
10-19 years	34%	19
20-30 years	30%	17
More than 30 years	11%	6

Table 2. The number of years respondents have been a medical professional, N=56.

most respondents (75%) had been in the medical profession for 10 years or more, many of the respondents (42%) had only been in their current role for 2 years or less. Respondents also had a variety of experience with the CollaboratOR, ranging from less than 30 days to greater than 4 years (Table 4).

The survey revealed that one of the top uses for the CollaboratOR is to keep a count sheet visible in the room, showing the items that have gone into the patient and those that are reconciled or removed. Another major use is viewing diagnostic images.

The PACS viewer is often located on a computer in the corner of the room, behind surgical equipment, making it difficult for the surgeon to see. By routing the image to the CollaboratOR, it can be easily viewed from the surgical field. **Other uses include storing preference cards and back table photos for accurate room setup, videoconferencing for consults or teaching, providing resource information and how-to videos for staff orientation or annual training, displaying device settings, and showing procedure checklists.**

The respondents were asked to estimate the average time to set up a case. Tables 5, 6 and 7 show the answers for typical set up times of laparoscopic, robotic, and non-laparoscopic, non-robotic cases, respectively. All respondents were asked to estimate the times both before and after having the CollaboratOR. Participants were asked to enter a zero if he or she did not perform this task at the facility, which are reflected as an “N/A” in the tables. **A 15-minute difference was noted between the highest values for setting up laparoscopic cases before and after having a CollaboratOR. A difference of 23-minutes was noted between the highest values for setting up robotic cases.** Lastly, there was a 5-minute difference noted between the highest values for setting up non-laparoscopic, non-robotic cases. During utilization observations, set-up was completed by using

# of Years in current role	Percentage	Count
Less than 1 year	9%	5
1-2 years	33%	18
3-4 years	29%	16
5-9 years	15%	8
10-19 years	9%	5
20-30 years	4%	2
More than 30 years	2%	1

Table 3. The number of years in current role at time of survey, N=55.

Length of time using the CollaboratOR	Percentage	Count
Less than 30 days	2%	1
1-2 months	5%	3
3-5 months	20%	11
6-11 months	9%	5
1-2 years	36%	20
3-4 years	15%	8
More than 4 years	13%	7

Table 4. Length of time using the CollaboratOR, N=55.

Before CollaboratOR (laparoscopic cases) N=20			After CollaboratOR (laparoscopic cases) N=19		
# of minutes	Percentage of Respondents	Count of Respondents	# of minutes	Percentage of Respondents	Count of Respondents
N/A	20%	4	N/A	11%	2
1	10%	2	1	11%	2
5	5%	1	2	5%	1
15	10%	2	3	5%	1
25	10%	2	10	5%	1
30	15%	3	15	5%	1
35	5%	1	17	5%	1
40	5%	1	25	11%	2
45	10%	2	30	26%	5
60	10%	2	40	5%	1
			42	5%	1
			45	5%	1

Table 5. Estimated time to set-up a laparoscopic case before and after having a CollaboratOR.

Before CollaboratOR (robotic cases) N=13

After CollaboratOR (robotic cases) N=19

# of minutes	Percentage of Respondents	Count of Respondents	# of minutes	Percentage of Respondents	Count of Respondents
N/A	46%	6	N/A	25%	3
1	15%	2	1	17%	2
30	15%	2	2	8%	1
35	8%	1	3	8%	1
40	8%	1	30	25%	3
65	8%	1	35	8%	1
			42	8%	1

Table 6. Estimated time to set up a robotic case before and after having a CollaboratOR.

Before CollaboratOR (non-laparoscopic, non-robotic cases) N=23

After CollaboratOR (non-laparoscopic, non-robotic cases) N=21

# of minutes	Percentage of Respondents	Count of Respondents	# of minutes	Percentage of Respondents	Count of Respondents
N/A	9%	2			
1	9%	2	1	14%	3
2	4%	1	2	5%	1
5	9%	2	5	10%	2
10	9%	2	15	14%	3
15	17%	4	17	5%	1
20	4%	1	20	5%	1
30	22%	5	30	33%	7
35	9%	2	40	5%	1
40	4%	1	45	5%	1
45	4%	1	50	5%	1

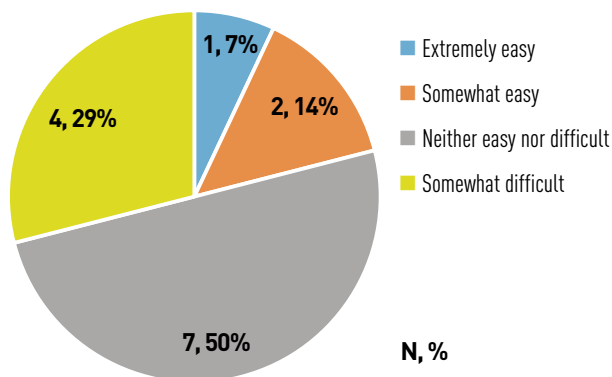
Table 7. Estimated time to set up a non-laparoscopic, non-robotic case before and after having the CollaboratOR.

pictures and/or notes for a particular procedure. Pictures of the correct setup for a specific procedure can be stored on the CollaboratOR. These pictures assist the end user to match the table to the picture, allowing setup to be completed with minimal direction. **This process is particularly helpful when travelers or new orientees are part of the staffing mix and there are limited resources for a personal preceptor for every task.** Not only does this assist with accuracy, but the pictures may also save time, according to survey results.

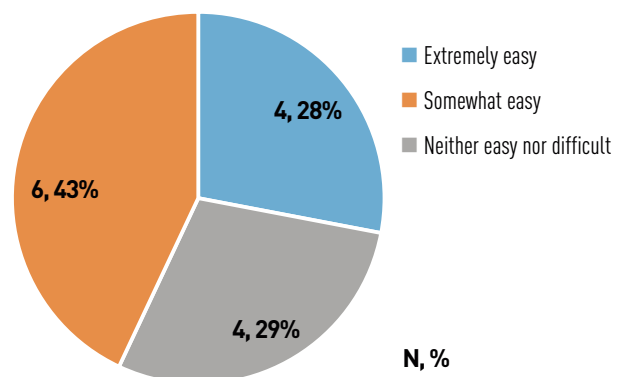
Respondents were also asked to rate the process for viewing patient and procedure information during a case both before and after having the CollaboratOR. The results showed that it is easier to access and view patient and procedure information during a case using the CollaboratOR. (See Figure 1 BEFORE and Figure 2 AFTER). Before respondents had the CollaboratOR, the process for accessing and viewing patient and procedure information during a case was rated as “somewhat difficult” by 29% (n=4) clinicians. However, after the CollaboratOR was placed in the operating room, there was improvement as no one selected “somewhat difficult” and the neutral group shifted their response to either, “extremely easy” or “somewhat easy”. Only 21% of respondents answered as either “extremely easy” or “somewhat easy” to accessing and viewing patient and procedure information during a case before the CollaboratOR in the operating room. **However, after having the CollaboratOR in the OR, 71% respondents answered either “extremely easy” or “somewhat easy” to access and view patient and procedure information during a case.** It is possible that if information can be accessed easier, then the workflow would also be positively impacted. When information is perceived as easier to access, it may also be more likely for the clinician to seek additional or clarifying information.

There was a survey question related to procedure time. Out of the 22 participants that answered the question, most respondents (68%) answered there was no impact on procedure time. There were two outlier

Rate the process for accessing and viewing patient and procedure information (diagnostic information) during a case before having a CollaboratOR.



Rate the process for accessing and viewing patient and procedure information (i.e., diagnostic information etc.) during a case AFTER having a CollaboratOR.



responses, one respondent answered that the CollaboratOR “significantly increases procedure time (estimated > 10 minutes more)”, and conversely one person answered that the CollaboratOR “significantly decreases procedure time (estimated > 10 minutes less)”. The most notable results were the 23% respondents (5 persons) who answered the CollaboratOR “slightly decreases procedure time (estimated 5-10 minutes)”. **When the clinicians were asked if the CollaboratOR improves operating/procedure room efficiencies (i.e. workflow, etc.), 47% of respondents either agreed or strongly agreed with this statement (33% or 14 respondents “agree” and 14% or 6 respondents “strongly agree”).** If this number were to hold true in a larger response group and a more formalized study, then the impact of saving 10 minutes per procedure could be quite powerful financially considering the mean cost of OR time across California hospitals is \$36-\$37 per minute.¹¹ In other research, the cost of each wasted minute in ORs in the United States can range from \$60-\$100.¹² Whether or not workflow efficiency is actually improved with a CollaboratOR needs to be further studied.

Not only is there a potential to positively impact workflow efficiency, but the CollaboratOR may also potentially have an impact on patient safety. One survey question asked the clinician to rate the impact the CollaboratOR has on the ability to gather information about the patient, procedure, or surgeon’s preferences to reduce the potential for risk and errors. **Out of 22 responses, 13 respondents (59%) selected the CollaboratOR “significantly increases” or “increases” the ability to gather information about the patient, procedure, or surgeon’s preferences to reduce the potential for risks and errors.** Of the other 9 responses, 8 chose there was “no impact” and 1 respondent chose it “decreases” the ability to gather information about the patient, procedure, or surgeon’s ability to reduce the potential for risks and errors.

In another related question, participants were asked to what extent do they agree or disagree with the statement “Overall, using the CollaboratOR assists in keeping my patient safe.” Out of the 42 responses, over half either agreed (19 responses) or strongly agreed (4 responses) with this statement. Thirty-six percent of the respondents were neutral as they neither agreed nor disagreed with the statement and 10% (4 responses) strongly disagreed. In the fast-paced perioperative environment, surgical teams need expert clinical knowledge, technical skill, and the ability to share real-time information to ensure accurate understanding of patient and environmental factors throughout the procedure.⁹ It is likely that having the visual cues of patient information, procedure information, count sheets, diagnostic images, and other relevant information in front of everyone in the operating room provides situational awareness to the surgical team. Further studies would be necessary to substantiate this statement.

The clinicians were also asked to rate how useful the CollaboratOR is for teaching during a case or a live case didactic lecture. There were 41 respondents and while 44% answered “not applicable” as they did not have experience with this utilization of the CollaboratOR, 52% found it to be useful in varying degrees from

slightly to extremely useful. Only 5% did not find the CollaboratOR useful during teaching. **If the “not applicable” answers are removed, then 91% of respondents rated the CollaboratOR as “useful” for teaching during a case or a live didactic lecture and 30% of those found it “extremely useful”.** This question revealed an opportunity for those that answered “not applicable” as perhaps better training is warranted around this application. **KARL STORZ United States has since implemented personnel to assist in the deployment of the CollaboratORs at large accounts. This assistance will allow for improved and sustainable education for clinicians about this feature and other best practices.**

Lastly, the clinicians were asked to rate how the CollaboratOR impacted staff satisfaction with OR efficiencies, communications, and set-up at the facility, both before and after having a CollaboratOR. **The biggest change from before and after having a CollaboratOR was to the area of “extremely satisfied” which tripled from 3 to 9 respondents (7% to 20%) after using a CollaboratOR. (Table 8).**

Rate how the CollaboratOR impacted staff satisfaction with OR efficiencies, communications, and set-up at the facility.

	Extremely dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Extremely satisfied
Before having CollaboratOR	0	1 (2%)	22 (48%)	20 (43%)	3 (7%)
After having CollaboratOR	0	2 (4%)	16 (35%)	19 (41%)	9 (20%)

Table 8. The CollaboratOR’s impact on staff satisfaction with OR efficiencies, communications, and set-up at the facility.

Observed Use Cases

During the visitation of multiple institutions to conduct the survey, several CollaboratOR utilizations were observed. The CollaboratOR was observed to be used as a **teaching tool** during live case and didactic lectures and can also be used in simulation labs. **Interdepartmental communication** was conducted regardless of the persons or departments being internal or external to the facility location.

The CollaboratOR also assisted with **procedural checklists** and **computer downtime situations**. These use cases demonstrated expanded capabilities and flexibilities that can be defined by the clinicians using the CollaboratOR as an operating room assistance tool.

The CollaboratOR used as a teaching tool involved learning during live cases and didactic lectures, viewed by a large audience residing in a different area of the hospital. The audience included surgeons, residents, and other clinicians who watched a pediatric case with an expert pediatric surgeon explaining each step of the procedure. This setup allowed the large audience to be involved in the procedure without compromising sterility or subjecting the patient to unnecessary infection risks.

With the US population expected to grow by an average of 1.8 million people per year¹³ and the surgeon shortage expected to reach between 15,800 and 30,200, depending on specialty by 2034,¹⁴ it is important to use innovative solutions for teaching new residents and collaborating with peers. If one expert could share his or her expertise to multiple surgeons at the same time without compromising patient safety, then it could be time saving and rewarding to both the novice and expert.

Another teaching use case for the CollaboratOR is utilization within simulation labs. The CollaboratOR serves as a white board with internet as it has video calling capabilities. It can assist with teaching and

working across the healthcare network to problem-solve about a patient and reach a collective, collaborative decision about the patient's health. Studies show that simulation-based training should be incorporated into surgical curricula specifically targeting novice learners.¹⁵ The addition of the CollaboratOR enhances the simulation experience by bringing multiple team members and technology into one learning environment.

Another CollaboratOR use case is for communicating with external care partners located within the hospital, but outside of the operating room, i.e. sterile processing department (SPD). Using the multi-site feature, the operating room can communicate directly with SPD to retrieve an item needed in the OR. Both departments can see the communication in real-time and are able to quickly respond or provide the other department with an answer, as necessary. Communication with the Pathology department is another example for utilizing the CollaboratOR for interdepartmental communication. Once the specimen is sent to Pathology for evaluation, the surgeon and pathologist can communicate with each other in real-time without leaving the patient's bedside or lab via Microsoft TEAMS, Zoom, or another meeting platform using the CollaboratOR.

Storing procedure checklists was a top utilization per the online survey and this use case was confirmed with observation. One example of a procedural checklist is the time-out checklist. Before any surgical procedure, a time-out is mandated by CMS and therefore accreditation agencies, such as The Joint Commission (TJC), Det Norske Veritas (DNV). Despite its effectiveness in increasing patient safety, compliance issues with the time-out remain a major problem in its implementation leading to gaps in its daily use.¹⁶ The time-out checklist could be stored on the CollaboratOR and completed in real-time in the operating room, as mandated by regulatory agencies. Using the CollaboratOR in this way can also serve as a showcase or storyboard item to share with regulatory surveyors and others. It highlights best practices and demonstrates how the operating room meets the National Patient Safety Goal (NPSG) requirement to "prevent mistakes in surgery". The universal protocol includes the timeout and pausing before each procedure to ensure a mistake is not being made. The CollaboratOR would assist everyone to visually confirm and all participants to audibly agree that the patient identifiers, procedure, and applicable anatomic laterality are correct.

Downtime Uses

During electronic medical record (EMR) downtime, the functionality of the CollaboratOR remains intact. As the CollaboratOR is not internet dependent, the OR team is able to maintain access to stored resources, like the count sheet, time-out record, preference cards, and other essential information. Accessibility to information is helpful to avoid delays during downtime. If the information is stored on the CollaboratOR before an unplanned downtime, it can serve as an invaluable tool to assist the OR team.



Conclusion

The CollaboratOR has the potential to boost workflow efficiency and communication in the operating room by centralizing information and improving clinicians' situational awareness. Evidence indicates that improved situational awareness leads to better surgical outcomes⁸. Although formal clinical studies have yet to confirm that the CollaboratOR directly enhances situational awareness and improves surgical outcomes, there is a possible correlation. Further research is needed to fully understand its impact on operating room metrics and patient safety. Recently, KARL STORZ has implemented a Customer Service Utilization Manager (CSUM), to assist with education, technical support, and customer satisfaction for the CollaboratOR and other KARL STORZ OR1 products.

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