Journal of Visceral Surgery 159 (2022) 450—457

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ORIGINAL ARTICLE

# Why and how to implement an electronic resident's surgical logbook to improve operating-room training? First 5-year feedback from a French center

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Available online 4 October 2022

## HIGHLIGHTS

- The electronic logbook for general surgery residents is filled in only 55% of cases.
- Supervising general surgery residents in the operating room has no impact on postoperative major morbidity.
- Supervision of general surgery residents in the operating room is preferentially performed by a fellow or a practicing physician rather than an associate professor or a clinical professor.
- The filling of a surgical logbook should be extended for all residents in French centers.

**KEYWORDS**
Resident;
Surgery;
Training;
Logbook;
Operating room

**Summary**
*Introduction:* The evaluation of general surgery residents' operating room (OR)-training and technical skills progression may be difficult in the absence of a standardized evaluation tool. The aim of this study was to evaluate the impact of the implementation of an electronic ''surgical logbook'' for general surgery residents.
*Methods:* A prospective single center study was conducted between May 2015 and October 2020. An electronic logbook was filled by all residents immediately after each surgical procedure and data were prospectively collected and analyzed.
*Results:* Fifty-five students (34 men/21 women) reported their participation to 6917 surgical procedures, which corresponded to 55.5% of all procedures performed in our department. Residents performed the entire procedure as the operating surgeon in 28.5% of cases ($n = 1963$), parts of the procedure as operating surgeon in 32.5% of cases ($n = 2230$) and as operating-assistant in 38.5% ($n = 2672$). Residents were more likely an operating surgeon for the entire procedure

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https://doi.org/10.1016/j.jviscsurg.2022.07.005

when they were assisted by a fellow or a practicing physician than an associate professor or a clinical professor ($P < 0.001$). There was no significant difference in the major morbidity rate between different resident's contribution to the procedure ($P = 0.14$).
*Conclusion:* We present here a simple, useful and cost efficient tool which offers easy data collection and reporting that could help improve OR-training, OR-supervision and certification at a local or national level.


## Introduction

The operating room (OR) experience is one of the core aspects of training for general surgery residents. This axis of training is strongly recommended by the French Academy of surgery [1]. The safety of residents' participation in surgical procedures without any impact on postoperative mortality and morbidity has previously already been demonstrated [2].

In France, with delay compared to English speaking countries, a new ethical ''never the first time on a patient'' concept recently emerged and became daily practice. This concept was mainly developed by anesthesiologists [3] but may also be applicable in digestive surgery, particularly to prevent or decrease intraoperative and postoperative morbidity. For this matter, surgical simulation strongly evolved [4]. Residents are now asked to develop their skills on simulators in a dedicated unit before performing a certain procedure in the OR [5].

According to the post-graduate year (PGY), the resident may be able to perform operations of minor level of difficulty as the main operator either alone or under the supervision or act as an operating-assistant for medium to high level of difficulty procedures. In France, surgical residency is structured into several rotations by semesters (from May to October or from November to April of each year) which can be completed in different surgical departments within a university hospital or a non-university institution. Thus, the evaluation of the OR-training and the progression of operative skills of the residents may be difficult in the absence of a standardized evaluation tool. Furthermore, a recent survey answered by residents and fellows in general surgery in France suggested that most considered their OR-training to be unsatisfactory [6]. Measuring the quality of a residency training program is imperative to produce competent surgeons and to ensure patients' safety [7].

The lack of an evaluation tool for residents' OR-training may be a cause for this unsatisfaction. American, Spanish and Belgian teams reported their experience on the use of computerized logkooks [8—11] which could be helpful to evaluate operative performance across the successive training years of residency. Furthermore, such logbooks were developed into smartphone applications handily available for everyone. In France, since 2017, OR-training should be, by law, evaluated in each surgical department welcoming residents through a logbook completed by the resident and certified by the supervisor, containing the operative procedures in which the student participated or that he/she performed [12]. Our department of surgery has developed and implemented a simple and user-friendly ''surgical logbook'' to evaluate both quantitative and qualitative aspects of the OR experience for each resident. Although everyone agrees that the surgical logbook is a mandatory tool for surgical training, its impact on resident's everyday life has little been reported.

The aim of this study was to evaluate the impact of the implementation of an electronic surgical logbook for general surgery residents in a single institution.

## Material and methods

### Study design

This was a prospective single center study conducted between May 2015 and October 2020 in the department of general surgery of the university hospital of Strasbourg, Hautepierre Hospital, France.

### The surgical logbook

The surgical logbook was an anonymous Excel file available through the local web server of the hospital. The surgical logbook was available for all members of the surgical team, including residents and their supervisors. Each page was dedicated to a resident who was asked to fill several information after each surgical procedure. The page was divided according to the anatomical structures operated on (appendix, colon, stomach, hernia, small bowel, incisional hernia, obesity surgery, esophagus, rectum, gallbladder, proctology, abdominal traumatology, port-a-cath reservoir [PAC], diverse). One should note that, in our department, PAC reservoir implantation is performed through a surgical approach of the cephalic vein in the deltopectoral groove.

For each procedure, the resident was asked to fill the following items:

- date of the procedure;
- type of procedure;
- resident's contribution during the procedure: ''all'' if the resident performed the whole procedure and ''nothing'' if the resident did not perform any part of the surgical procedure. If ''partly'' was selected, the resident had to report which procedure he or she performed (for example: omentectomy, half of a manual bowel anastomosis, opening or closure of the abdominal cavity);
- if the skills for the performed procedure by the resident were acquired or more training was needed;
- if the procedure was supervised and by whom.

Completion of the operative logbook was done prospectively by all residents immediately after each surgical procedure, to reduce recall bias. All items (except the resident's contribution which is text free) were prefilled for an

efficient and uniform completion. Every 2 months during a semester, a collective step point and a recall evaluation was performed.

### The surgery residents' team

In France, residency begins after the completion of 6 years of medical studies and represents the 3rd cycle of medical training. Every semester (6 months), the residents change rotations, thus our department welcomes a new team of residents. Before 2017, the former 5-year residency was composed of 10 semesters which could be performed in different surgical departments within a university hospital or a non-university institution. Since the 2017's reform of residency training in France, residency is now structured into 3 blocs: a 1-year common core curriculum bloc, a 3-years advanced training bloc and a 2-year consolidation training where the resident is titled ''Junior doctor'' as opposed to ''Chief Resident'' previously.

Our university department of general surgery trains both national residents and international medical graduates (IMGs). French residents are often heading to become general surgeons but may also specialize into others surgical specialties such as gynecology, urology, vascular, thoracic or pediatric surgery. Thus, the number of residents may vary from one semester to another.

All rotating residents and international medical graduates at the time of the study were included regardless of their role or post-graduate year.

### The surgical team and surgical activity

Our surgical department is composed of 3 clinical professors, 1 associate professor, 3 practicing physicians and 4 fellows. Each medium to high-level difficulty procedures was performed under the supervision of at least one senior. Our department's surgical activity comprises colorectal, upper-gastrointestinal, esophageal, bariatric, abdominal wall, peritoneal metastasis, soft tissue sarcoma and trauma surgery. Furthermore, our department is part of the regional trauma center. Liver or pancreatic surgeries are not daily performed but may be undertaken occasionally in some cases.

### Data management

Data about residents and their respective operative logbooks were prospectively collected and analyzed. Since 2016, we implemented an Enhanced Recovery after Surgery program for colorectal and bariatric surgeries. Through the course of the 5-years study period, upperGI, small bowel, peritoneal metastases, incisional hernia and soft tissue sarcoma surgeries were progressively integrated into the department's Enhanced Recovery after Surgery program. Regarding postoperative morbidity/mortality, data was extracted from this database and reported according to the comprehensive complication index (CCI) that integrates all adverse events with their respective severity [13].

A CCI under 26.2 (equivalent to grade IIIa in Dindo—Clavien classification [14]) was considered as a minor complication whereas a CCI upper or equal 26.2 was considered as a major complication.

### Statistical analysis

Quantitative data were expressed as means ± standard deviation. Nominal data were represented as numbers and percentages. When appropriate, data were compared with the chi-2 or Fischer exact or Kruskal-Wallis tests. A *P*-value < 0.05 were considered as statistically significant.

## Results

### Residents' team characteristics

Between May 2015 and October 2020 (representing a total of 11 semesters), 55 rotating residents and IMGs were included (34 men/21 women), having spent at least one semester in our department. Thirteen (24%) completed 2 semesters, 10 (19%) completed 3 semesters, and 1 (2%) completed 4 semesters. During the study period, the team consisted of a mean of 8 training residents (from 6 to 9). The detailed resident's PGY for each semester are summarized in the Table 1.

Only seven residents (12%) were subject to 2017's reform of residency training in France.

Thirty-seven residents (67%) were general surgery trainees in categorical programs, 11 (20%) were ob-gyn categorical residents, 4 (7%) were urology categorical residents and 3 (5%) were vascular surgery, pediatric or thoracic surgery trainees, respectively.

Forty (73%) were National Graduates and 15 (27%) were IMGs.

After completion of their residency, 13 of them (24%) were enrolled as fellows in our department.

### Details of the surgical logbooks

During the study period, the residents reported their participation to 6917 surgical procedures. The percentage of procedures reported in the logbook (thus, the filling compliance rate) was 55.5% of all procedures performed in our department during the same period. The detailed compliance filling rate according to each semester is shown in the Table 2.

During the semester from May to October 2017, 5 of 9 residents (56%) didn't fill the logbook at all, and the remaining four did it very partially.

The residents reported a mean of 76 procedures per semester.

The average participation in a procedure according to the residents' respective PGY can be seen in Fig. 1. There was a trend towards an increased mean number of procedures in parallel to the residents' PGY level ($P = 0.07$).

The resident's contribution was unspecified for only 52 procedures (0.5%).

The residents performed the entire procedure as main surgeon in 28.5% of cases ($n = 1963$), a part of the procedure in 32.5% of cases ($n = 2230$) and were operating-assistants in 38.5% of cases ($n = 2672$). As shown in Fig. 2, the mean number of procedures entirely performed as a first surgeon significantly increased according to the PGY level ($P = 0.0002$).

Most of the procedures performed by the residents as a first surgeon were PAC reservoir implantation or removal (41%), hernia repair (9%), proctology (8.5%), cholecystectomy (9.5%) and diverse procedures (14%) (Table 3).

**Table 1** Detailed resident's postgraduate years (PGY) for each semester.

| Residents postgraduate (PGY) years | | | | | | |
|---|---|---|---|---|---|---|
| Semester period | PGY-1 *n* | PGY-2 *n* | PGY-3 *n* | PGY-4 *n* | PGY-5 *n* | Total *n* |
| May 2015 | 0 | 2 | 1 | 1 | 4 | 8 |
| November 2015 | 1 | 1 | 4 | 2 | 1 | 9 |
| May 2016 | 5 | 0 | 1 | 1 | 2 | 9 |
| November 2016 | 1 | 0 | 3 | 0 | 4 | 8 |
| May 2017 | 1 | 0 | 2 | 3 | 3 | 9 |
| November 2017 | 0 | 2 | 2 | 1 | 2 | 7 |
| May 2018 | 0 | 4 | 3 | 1 | 0 | 8 |
| November 2018 | 0 | 2 | 1 | 1 | 2 | 6 |
| May 2019 | 0 | 1 | 1 | 4 | 2 | 8 |
| November 2019 | 1 | 2 | 2 | 3 | 1 | 9 |
| May 2020 | 2 | 1 | 0 | 4 | 2 | 9 |
| Mean | 1.00 | 1.36 | 1.82 | 1.91 | 2.09 | 8.18 |

**Table 2** Detailed compliance filling rate according to each semester.

| | May 2015 | November 2015 | May 2016 | November 2016 | May 2017 | November 2017 | May 2018 | November 2018 | May 2019 | November 2019 | May 2020 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Performed (*n*) | 1161 | 1283 | 1197 | 1329 | 1207 | 1154 | 1205 | 1086 | 1129 | 872 | 843 | 12466 |
| Declared (*n*) | 903 | 1000 | 707 | 839 | 141 | 758 | 776 | 286 | 437 | 450 | 620 | 6917 |
| Declaration (%) | 77.78 | 77.94 | 59.06 | 63.13 | 11.68 | 65.68 | 64.40 | 26.34 | 38.71 | 51.61 | 73.55 | 55.49 |

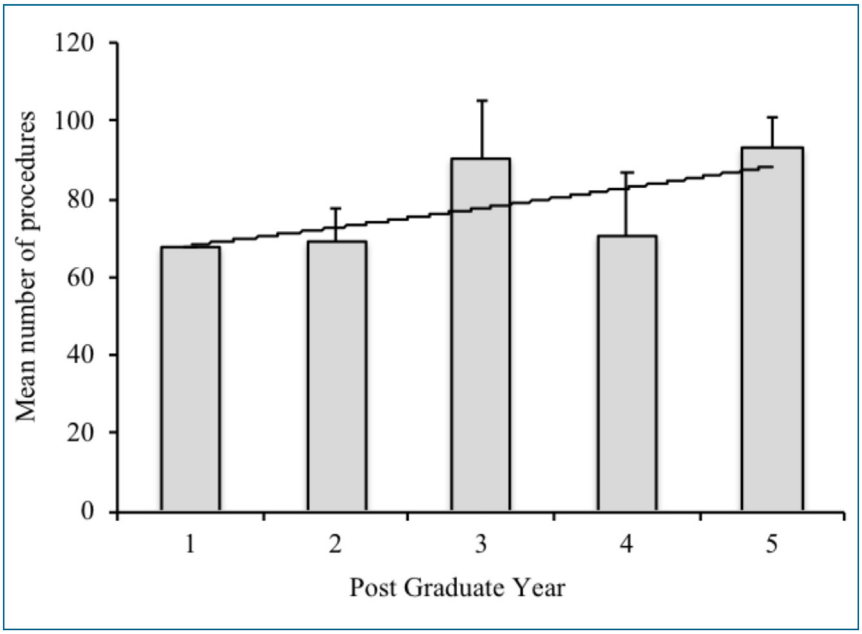


**Figure 1.** Mean number of procedures according to the post graduate year of the residents.

Among the 2230 procedures for which the residents' participation was noted as ''partly'', several steps could be performed. One step was performed in 43% of cases (*n*= 964) and several steps were performed in 37% of cases (*n* = 828). The detailed participation of the ''partly'' performed procedures was unspecified for 440 procedures (20%). Wound opening was performed in 29.5% of cases (*n* = 659), dissection/exposition or resection was performed in 37% of cases (*n* = 830), wound closure was performed in 46% of cases (*n* = 1033), half of a bowel anastomosis was performed in 8.5% of cases (*n* = 189), a complete bowel anastomosis was performed in 5.5% of cases (*n* = 119) and other steps were performed in 10% of cases (*n* = 227).

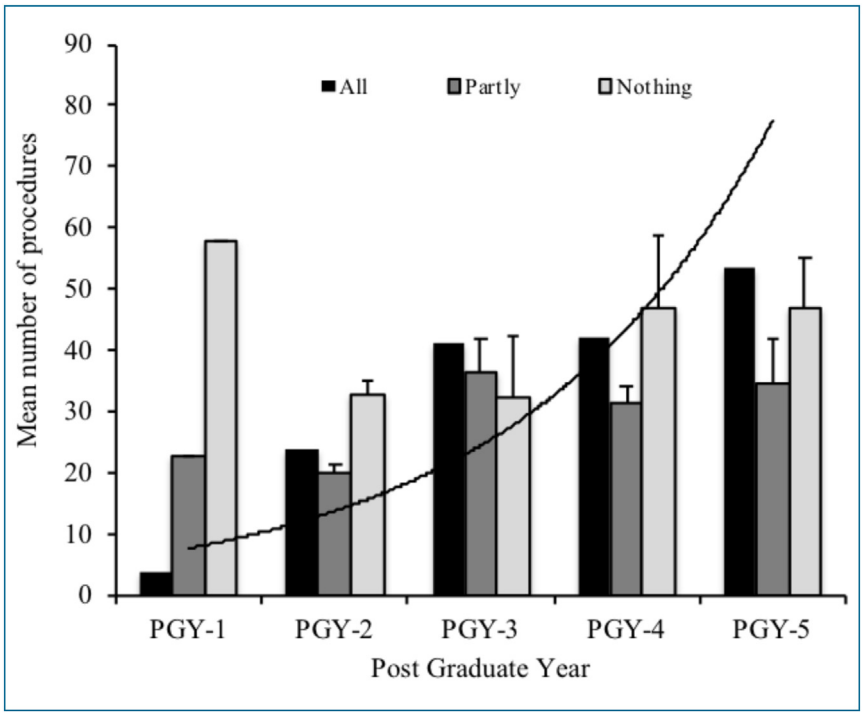


**Figure 2.** Mean number of procedures according to the post graduate year of the residents and their respective contribution to the surgical procedures. The black courb represents the exponantial courb for the entire procedure as first surgeon.

**Table 3** Resident's contribution according to the type of surgical procedures.

| Resident's contribution | | | | | |
|---|---|---|---|---|---|
| | All *n* (%) | Partly *n* (%) | Nothing *n* (%) | Unspecified *n* (%) | Total *n* |
| PAC | 800 (84) | 111 (11.5) | 42 (4.5) | 0 | 953 |
| Proctology | 166 (26.5) | 100 (16) | 357 (57) | 5 (0.5) | 628 |
| Gallbladder | 188 (34.5) | 179 (33) | 175 (32) | 2 (0.5) | 544 |
| Hernia | 171 (25) | 251 (37) | 258 (38) | 2 | 682 |
| Appendix | 155 (62) | 59 (23.5) | 32 (13) | 4 (1.5) | 250 |
| Insisional hernia | 46 (13) | 170 (48.5) | 134 (38) | 2 (0.5) | 352 |
| Colon | 59 (7) | 427 (52) | 337 (41) | 1 | 824 |
| Small bowel | 48 (16) | 153 (51) | 97 (32) | 3 (1) | 301 |
| Stomach | 18 (7) | 80 (31) | 148 (57) | 13 (5) | 259 |
| Trauma/Emergencies | 27 (20) | 65 (48) | 44 (32) | 0 | 136 |
| Bariatric | 14 (3.5) | 89 (34) | 271 (72.5) | 0 | 374 |
| Rectum | 2 (1) | 84 (32.5) | 170 (65) | 4 (1.5) | 260 |
| Oesophagus | 0 | 70 (45) | 85 (55) | 0 | 155 |
| Adrenal gland | 0 | 0 | 2 (100) | 0 | 2 |
| Pancreas | 0 | 1 (100) | 0 | 0 | 1 |
| Liver | 0 | 0 | 2 (100) | 0 | 2 |
| Diverse | 269 (22.5) | 391 (33) | 518 (43) | 16 (1.5) | 1194 |
| Total | 1963 (28.5) | 2230 (32.5) | 2672 (38.5) | 52 (0.5) | 6917 |

PAC: port-a-cath reservoir; *n*: number.

## Resident's contribution according to the surgical supervisor

Details on the resident's contribution according to the surgical supervisor are shown in Table 4.

Interestingly, residents performed significantly the entire procedure more frequently when they were supervised by a fellow or a practicing physician compared to an associate professor or a clinical professor ($P < 0.001$). Similarly, they performed more frequently a part of the procedure when the supervisor was a practicing physician, $P < 0.001$.

## Impact of residents' training on postoperative complications

Detailed data on the postoperative morbidity/mortality were available for 727 patients.

**Table 4** Resident's contribution according to the surgical supervisor.

| Resident's contribution | | | | | |
|---|---|---|---|---|---|
| Supervisor | All *n* (%) | Partly *n* (%) | Nothing *n* (%) | uk | Total |
| None/other resident | 368 (19) | 105 (5) | 90 (3) | 7 | 570 |
| Fellow | 452 (23) | 602 (27) | 613 (24) | 4 | 1671 |
| Practising physician | 454 (23) | 844 (38) | 940 (35) | 12 | 2250 |
| Clinical/associate professor | 256 (13) | 646 (29) | 975 (36) | 10 | 1887 |
| Unspecified | 433 (22) | 33 (1) | 54 (2) | 19 | 539 |
| Total | 1963 | 2230 | 2672 | 52 | 6917 |

uk: unknown.

**Table 5** Postoperative morbidity according to resident's contribution.

| Resident's contribution | | | | |
|---|---|---|---|---|
| Postoperative morbidity | All/Partly *n* (%) | Nothing *n* (%) | Total | *P* |
| Major | 100 (26.5) | 79 (22.5) | 179 | 0.14 |
| No/minor | 277 (73.5) | 271 (77.5) | 548 | |

*P*: p-value.

As shown in Table 5, there was no significant difference in the major morbidity or mortality rate according to the resident's contribution to the procedure ($P = 0.14$).

## Discussion

This study is, to our knowledge, the first French report of the implementation of a daily logbook for residents in a digestive surgery department over a 5-years period. Nevertheless, several studies have already been published for urology, gynecology [15] or plastic surgery residents [16—21].

What is reassuring is that, in more than 60% of cases, the residents performed at least one step according to the respective skills. Wound opening and closure, dissection/exposition or resection were the most commonly performed. Bowel anastomosis was also frequently performed.

Despite the residents performing poteltial life-threatening steps such as bowel anastomosis, potentially life-threatening for patients, the major morbidity rate was not different according to the resident's contribution. Unfortunately, we were not able to collect the operative time for each procedure. But, one may hypothesize that when a resident operates whether partially or in full, the operative time may be longer. Nevertheless, it did not show an impact on postoperative major morbidity rate.

Curiously, residents performed more frequently the entire procedure when the supervisor was a fellow or a practicing physician compared to an associate professor or a clinical professor, both of which have teaching obligation tasks.

One may argue that most of the procedures in our department (32.5%) are performed by practicing physicians. Furthermore, in our department, associate and clinical professors have developed advanced technical skills such as for operating on complex abdominal wall reconstruction, peritoneal metastasis or sarcoma surgeries for which residents' skills may be insufficient for performing the entire procedure. For those highly technical demanding procedures, associate and clinical professors are more able to delegate gestures to fellows who are more technically skilled than residents. In this way, such a logbook may also be applicable to fellows to evaluate the evolution of their performance and their technical skills. We are now thus requiring all fellows in our department to fill out the same logbook.

Then, why and how to implement an electronic resident's surgical logbook to improve OR-training?

First, the resident's surgical electronic logbook seems to be a very useful tool that simplifies the recording and the analysis of residents' surgical activities, providing reliable, detailed and relevant data on OR-training [9]. This simplified record may act for residents as time saving and may allow their supervisors to perform a comprehensive evaluation.

Second, this simplified tool may be useful for the final certification of residency completion. In France, since November 2017, residents are required to fulfill the ''Residents' Handbook for Practical Teaching in Visceral and Digestive Surgery'' developed by the French College of Visceral and Digestive Surgery [5]. This 272 pages document details the objectives, the means of learning for each skill and the evaluation and assessment methods. This document does not define the number of procedures required, the mandatory procedures or the yearly goals per resident as compared to training in Great Britain or in Germany [22]. Our tool might be easier to use for both residents and evaluators. Despite the required submission of a logbook for residency training completion, the compliance for the logbook filling rate is relatively low, not exceeding 60%. When considering the time-consuming 5-year logbook shaping at the end of residency, one may consider it's a waste of time not to benefit from a daily prospective filling of the logbook. This study did not evaluate the impact of the logbook on the residents' working time, for which a diminution is required by our government. From a subjective point of view, the implementation of the logbook did not tend to reduce the residents' working time.

Third, our logbook can stimulate mentorship. In our department, in order to motivate teaching, the prize of ''best mentor'' is awarded twice a semester, where a collective step point is performed based on the residents' logbook declarations. All residents' logbooks completed data are summarized and basic statistics are performed. The mentor who performed the most supervisions is declared ''best mentor'' and is rewarded with a bottle of local wine by the Head of Department. Thus, by creating a competition between senior surgeons based on the residents' logbook declarations, we may stimulate their teaching abilities.

During this step point, each resident can also compare his progression and participation with colleagues. It may allow identification of a marginal training with diminutive operative exposure relative to peers [23]. An Irish team applied a weighted-scoring algorithm to residents' operative volumes, based on surgical logbooks declarations, which increased the functionality of electronic logbooks throughout training institutions. This open-benchmarking of surgical-volumes stimulated residents to actively pursue operative-opportunities and record those experiences [23].

Furthermore, logbooks may lay the foundation for a structured and competency-based training which includes a defined curriculum [24]. This tool emphasizes on formative assessment rather than pure basic knowledges [24,25].

Finally, surgical logbook may create a bridge to encourage formative debriefing. Despite all the above-mentioned positive aspects, this declarative surgical logbook suffers from the absence of personal feedback from the seniors to the residents. One way to solve this issue would be to ask the supervisor to evaluate their resident's skills at the end of the procedure and to determine if the gestures were acquired or not [25]. Busemann et al. evaluated how valuable a logbook was for residents' surgical education. Less than half of them had the impression that the use of this specific logbook improved their education. The residents asked for a more intense interaction with the mentor and requested discussions about their personal strengths and weaknesses. They concluded that the logbook was a powerful and effective educational tool but that there was a need to adapt to each student's and institution's requirements. Otherwise it will only be seen as a purely labor intensive obligation [26].

However, we acknowledge some limitations.

As only 12% of residents were part of the 2017's reform of residency training in France, the impact of this reform on the surgical logbook could not be evaluated. In our department, surgical simulation has been implemented only in November 2021. Thus, its impact on the surgical logbook could also not be evaluated.

Furthermore, since the monocentric nature of this study, the results may be representative neither for the residents of the 3 departments of digestive surgery in our university hospital nor for the residents in our region. Thus, an evaluation at a regional and national level seems highly recommended. Another limitation of the study is that the presented logbook mainly reported quantitative data, based on the resident declaration. One step forward would be to include in the logbook other items which may evaluate qualitative parameters of the OR-training. Our new logbook generation, actually under implementation in our department, will be able to evaluate these aspects by adding items evaluating the atmosphere surrounding the procedure (''was the procedure performed in a hurry? yes or no?'') and asking for a subjective evaluation of the supervisor's training with a score between 1 to 10 when the residents performed the procedure whether partially or in full. We also added an item to evaluate if the resident prepared or revised the intervention before entering the OR.

One should note that the logbook's items should be easy to fill out and the content strictly minimized in order to achieve a high filling rate. Another improvement for this logbook in our department was the implementation of all items in an online platform which may render the filling easier.

Several teams already proposed and evaluated the feasibility of a smartphone iOS app in this matter [27]. They reported free, rapid and customizable tools. Those ''smart logbooks'' may become a common practice for the modern-day surgeon [28].

## Conclusion

The electronic surgical logbook in general surgery offers easy data collection and reporting. This could help to improve training and mentoring in the OR, as well as certification at a local or national level. This tool may need some improvement in the future and an evaluation at a regional and a national level is highly encouraged.

## Source of funding

None.

## Informed consent and patient details

The authors declare that the work described does not involve patients or volunteers.

## Acknowledgement

The authors thank Samer Diab and Sara Benammi for critical reading of the manuscript.

## Disclosure of interest

The authors declare that they have no competing interest.

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