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Surgical Safety Checklists in Operative Medicine in Switzerland

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Abstract

Objective: Despite the known positive impact of surgical checklists on morbidity and mortality rates, data on the implementation of checklists in Swiss operating rooms as well as the resulting experiences are missing. The present study evaluated the general use and design of checklists in operative medicine in Switzerland, the difficulties in introduction and the subjective impact on adverse events.

Methods: An anonymous national survey of directors of adult departments in operative medicine in Switzerland was conducted during spring 2011. They were identified from the database of the Swiss college of surgeons (fmCh). The survey included questions about the use, type and content of the used checklists, the prevention of mixing up patients and the awareness of wrong site surgery.

Results: Overall, 237/799 (29.7%) surveys were returned. At the time of the survey, 172/233 (73.8%) departments used surgical checklists (4 missing values). The median time needed for collecting data per patient was 60 (range 10-600) seconds. In all, 46/161 (28.6%) participants reported a subjective decrease of adverse events after the introduction of a surgical checklist (11 missing values). Out of 217 respondents, 62 (28.6%) knew of one event and 87 (40.1%) of more than one event of wrong site surgery (20 missing values).

Conclusions: There is still room for improvement in the use of surgical checklists, which impresses, in regard to the time needed for data collection per patient, and which is not excessively time-consuming. However, acceptance problems of the majority of respondents during the introduction phase of surgical checklists vanished over time.

Key words: *Checklist, patient safety, surgery, Switzerland*

Introduction

It is estimated that 234 million surgeries are performed annually across the world and approximately one procedure annually for every 25 human beings, respectively [1]. The figures exceed, by nearly double, the yearly volume of childbirth [1]. A systematic review has shown that almost two thirds of in-hospital adverse events are associated with surgical care and that one in every 150 patients admitted to a hospital dies as a consequence of an adverse event [2]. In 2-8% of all hospitalizations, preventable adverse events occur with transient impairment (30-50%), permanent impairment (9%) or even death (3%) [3].

Strategies to reduce such events have included training initiatives, guidelines, clinical pathways and other quality and safety programs [4,5]. One of the most promising approaches to reducing adverse events has been the implementation of safety checklists. Checklists are well established in complex technical industries, like aviation or aeronautic. They decrease the risk of human error by increasing the standardization of work processes, avoiding reliance on memory and reducing communication failures [6,7].

In 2008, the World Health Organization (WHO) published guidelines to reduce the number of surgical deaths across the world [8]. The initiative "Safe surgery saves lives" aimed to identify minimum standards of surgical care that could be universally applied across countries and settings [9]. One component was the introduction of a perioperative checklist, which had been translated into eight languages until now.

In a pilot study, the WHO checklist was prospectively tested in eight hospitals in eight countries representing a variety of economic circumstances and diverse populations of patients [10]. The introduction of the WHO surgical safety checklist into operating rooms was associated with a statistically significant decrease of the death rate from 1.5% to 0.8% ($p<0.003$) and the inpatient complication rate from 11% to 7% ($p<0.001$) [10].

The international reactions to the publication of the WHO checklist and the results of the pilot study were different: Whereas the reactions in Germany were relatively restrained [11], the National Patient Safety Agency in the UK has made it mandatory for all hospitals of the National Health Service (NHS) to implement the checklist or an adapted form by February 2010 [12]. Consequently, two studies showed a significant reduction of surgical morbidity and mortality by the use of checklists [13, 14].

The evidence of improvement in surgical outcomes is substantial, but the underlying mechanism is less clear and most likely multifactorial. The use of checklists comprises changes in systems and behavior of individual operating personnel [15].

In Germany, the German Coalition for Patient Safety and the German Society of Surgery recommend the use of checklists, for instance, in the operating room [11]. Representative data about the quantity of German hospitals using checklists is lacking.

In Switzerland, patient safety is a key issue [16]. Since 2003, the Patient Safety Foundation has been active on patient safety aspects and quality management in medicine in Switzerland [16]. Despite the above-mentioned positive impact of surgical checklists on morbidity and mortality rates, data on the implementation of checklists in Swiss operating rooms and the resulting experiences is missing. The present study evaluated the general use and design of checklists in operative medicine in Switzerland, the difficulties in introduction and the subjective impact on adverse events.

Methods

Study design: This study is based on an anonymous national electronic survey of directors of adult departments in operative medicine in Switzerland (classified according to the Swiss Medical Association [FMH]) [17]. They were identified from the database of the Swiss college of surgeons (fmCh), the umbrella organization of all operative disciplines in medicine in Switzerland [18]. Data were collected during spring 2011. Response enhancement techniques included notification in advance and a mailed reminder. As the survey included healthy people on a voluntary basis, this study did not require further ethical considerations.

Survey instrument: The questionnaire included four parts: Part 1 addressed data on the type and size of participating department.

Part 2 of the survey consisted of 15 items regarding the use and content of the used checklist. Information on the time and way of documentation was obtained, as well as potential problems of acceptance and the subjective impact of the implementation of checklists on the occurrence of adverse events.

Part 3 was based on questions about the prevention of mixing up patients. The respondents were asked about verifying the identity of patients, whether a marking of the surgical site was implemented and who performed it. Furthermore, the presence and type of team time-out were evaluated. The relevance of the team time-out was rated on a five-point Likert scale, anchored by 1= "very relevant" to 5= "not relevant at all".

In part 4, the respondents were asked about the awareness of wrong site surgery.

Statistical analysis: All statistical computations were performed by an experienced statistician (NB).

Continuous data were expressed as median (range) or mean (standard deviation [SD]). Categorical or dichotomous data were expressed as frequencies and percentages.

Bivariate correlations were used for cross-table analysis. As a bivariate correlation is a correlation between two (ordinal) variables, Kendall's Tau-b and Phi Coefficient were calculated. Depending on the significance level (two-tailed at a level of 0.05), Tau-b and Phi Coefficient show the strength of the correlation between two variables. Positive values show positive correlations, whereas correlations up to ±0.2 are very weak, from ±0.2 to ±0.4 weak, from ±0.4 to ±0.6 average, from ±0.6 to ±0.8 strong, and from ±0.8 to ±1.0 very strong.

All statistical tests were two-sided with a significance level of 0.05. Collected data were analyzed with SPSS version 19.0 (SPSS; Chicago, Illinois, USA).

Results

Overall, 237/799 surveys were returned, for a response rate of 29.7%. The characteristics of the participating departments are shown in Table 1. The median number of surgeries performed per year was 2200 (range 100-25000).

Table 1. Characteristics of the participating departments (n=237).

Characteristic	No.of respondents	(%)
Hospital category, 4 missing values		
Type U	22	(9.4)
Type A	27	(11.6)
Type A1	13	(5.6)
Type A2	40	(17.2)
Type B3	27	(11.6)
Type B2	38	(16.3)
Type B1	28	(12.0)
Type C	20	(8.6)
Private practice	18	(7.7)
Specialty, 16 missing values		
General surgery	66	(29.9)
Anesthesia	59	(26.7)
Plastic and reconstruction surgery	24	(10.9)
Gynecology	22	(10.0)
Orthopedics	20	(9.0)
Otolaryngology	9	(4.1)
Hand surgery	6	(2.7)
Cardiac surgery	4	(1.8)
Neurosurgery	4	(1.8)
Ophthalmology	3	(1.4)
Pediatric surgery	3	(1.4)
Urology	1	(0.5)
Maxillofacial surgery	0	(0.0)

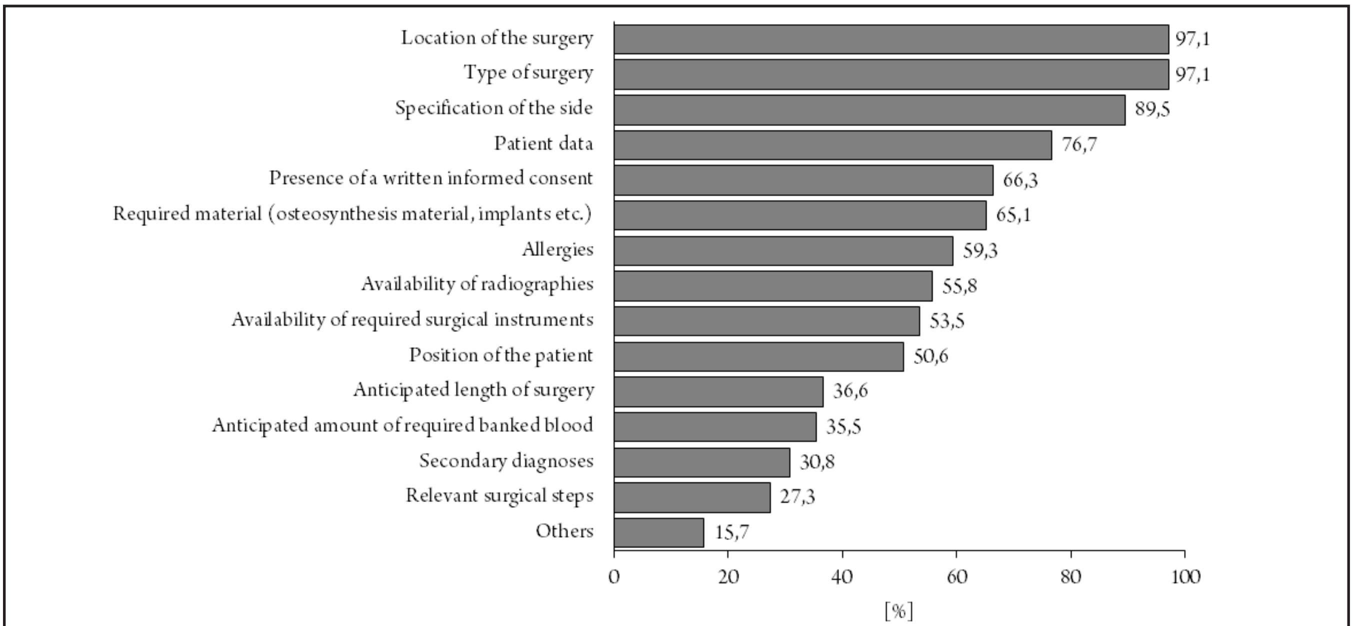

Figure 1. Detailed content of the surgical checklists used (n=172)

Others = patient identification, presence of patient file, presence of further examinations (ECG, ultrasound, etc.), carried out oral informed consent, removal of dentures and jewelry, marking of the surgical site, risk of difficult intubation, laboratory values, pressure sores risk, fasting patient, antibiotic prophylaxis, thrombosis prophylaxis, postoperative status, beds on intensive care unit.

Use of surgical checklists: At the time of the survey, 172/233 (73.8%) departments used surgical checklists, whereas 158/233 (67.8%) used them for all kind of surgeries, 12/233 (5.2%) for elective surgeries and 2/233 (0.8%) for part of the surgeries. Of the remaining departments, 31/233 (13.3%) were planning the implementation of surgical checklists and 30/233 (12.9%) did not use or plan to implement them (4 missing values). The median time, since the introduction, amounted to 24 (range 12-264) months. A correlation between hospital category or number of surgeries performed per year and the use of surgical checklists

Table 2. The use of surgical checklists depending on the hospital category or number of surgeries performed per year.

Characteristic	Use for all kinds of surgeries, N (%)	Use for elective or part of the surgeries, planned implementation or no use, N (%)	Tau-b	p
Hospital category, 4 missing values				
University hospitals (n=22)	17 (77.3)	5 (22.7)	0,056	0,35
Non-university hospitals (n=211; 2 missing values)	140 (67.0)	69 (33.0)		
Number of surgeries performed per year (median value 2200)				
< median value	68 (63.0)	40 (37.0)	-0,088	0,17
≥ median value	77 (72.0)	30 (28.0)		

Table 3. Comparison of different characteristics regarding the subjective decrease of adverse events after the introduction of a surgical checklist and methods to prevent the mistaking of procedures, respectively.

Characteristic	Subjective decrease of adverse events, N (%)	Absence of a subjective decrease of adverse events, N (%)	Tau-b	p
Hospital category (1 missing value)				
University hospitals (n=18)	5 (27.8)	13 (72.2)	-0,009	0,91
Non-university hospitals (n=153; 12 missing values)	41 (29.1)	100 (70.9)		
Number of surgeries performed per year (median value 2200)				
< median value	17 (25.8)	49 (74.2)	-0,091	0,26
≥ median value	28 (34.1)	54 (65.9)		
Acceptance problems during the introduction of surgical checklists (4 missing values)				
No/few (n=125; 8 missing values)	35 (29.9)	82 (70.1)	0,059	0,44
Moderate – very serious (n=43; 5 missing values)	9 (23.7)	29 (76.3)		
Acceptance problems at the time of the survey (7 missing values)				
No/few (n=153; 11 missing values)	43 (30.3)	99 (69.7)	0,130	0,04
Moderate – very serious (n=12)	1 (8.3)	11 (91.7)		
Technical patient identification system (9 missing values)				
Yes (n=72; 19 missing values)	17 (32.1)	36 (67.9)	0,062	0,45
No/being planned (n=156; 53 missing values)	27 (26.2)	76 (73.8)		
Marking of the surgical site (6 missing values)				
Yes (n=204; 56 missing values)	43 (29.1)	105 (70.9)	0,049	0,50
No (n=27; 17 missing values)	2 (20.0)	8 (80.0)		
Involvement of the patient when marking the surgical site (40 missing values)				
Yes (n=178; 50 missing values)	40 (31.3)	88 (68.8)	0,086	0,25
No (n=19; 3 missing values)	3 (18.8)	13 (81.3)		
Team time-out (9 missing values)				
Yes (n=210; 59 missing values)	41 (27.2)	110 (72.8)	-0,168	0,11
No (n=18; 12 missing values)	4 (66.7)	2 (33.3)		

could not be found (Table 2).

The surgical checklists included sign in (e.g. identification of the patient, location of the surgery) in 163/172 (94.8%), sign out (e.g. completeness of the material, problems with the equipment) in 122/172 (70.9%), team time-out in 155/172 (90.1%) and all three steps in 116/172 (67.4%) of the participating departments. Figure 1 depicts in detail the content of the used surgical checklists. The median time needed for collecting data per patient was 60 (range 10-600) seconds and was documented in 137/169 (81.1%) of the cases (3 missing values). The documentation of a successful checklist check was usually performed by the anesthetist (38/151, 25.2%) alone and the anesthetist and surgeon in combination (42/151, 27.8%), respectively (21 missing values).

Acceptance problems during the introduction of surgical checklists were reported by 99/168 (58.9%; 4 missing values), acceptance problems at the time of the survey by 53/165 (32.1%) respondents, originating from surgeons, in-patient physicians, elder physicians and nursing staff (7 missing values). There was a weak positive correlation between the number of surgeries performed per year and acceptance problems during the introduction of surgical checklists (Tau-b 0.202; $p < 0.01$). No correlation could be found in terms of hospital category and acceptance problems during the introduction of surgical checklists (Phi Coefficient -0.015; $p = 0.85$).

In all, 46/161 (28.6%) participants reported a subjective decrease of adverse events after the introduction of a surgical checklist in their department (11 missing values). A comparison of different characteristics regarding the subjective decrease of adverse events after the introduction of surgical checklists showed a significant, weak correlation between a subjective decrease of adverse events and no/few acceptance problems at the time of the survey (Tau-b 0.130; $p = 0.04$) (Table 3). A subjective decrease of adverse events thus lead to a decrease of current acceptance problems in a weak correlation.

Prevention of mistaking procedures: The different methods to prevent the mistaking of procedures are shown in Table 4.

In most of the cases, the verification of the patient's identity and surgery to be performed was conducted by the anesthetist and surgeon together (133/229, 58.1%) and the verification of the patient's allocation to the right operating room by the anesthetist or the anesthesia nursing staff (126/214, 58.9%).

Table 4. Methods to prevent the mistaking of procedures.

Characteristic	No. of respondents (%)
Technical patient identification system (radio wristband, barcode scanning, etc.), 9 missing values	
Yes	72 (31.6)
No	143 (62.7)
Being planned	13 (5.7)
Verification of the patient's identity and surgery to be performed, 8 missing values	
Yes	229 (100)
No	0 (0)
Verification of the patient's allocation to the right operating room, 9 missing values	
Yes	214 (93.9)
No	14 (6.1)
Marking of the surgical site, 6 missing values	
Yes, always	168 (72.7)
Yes, for elective surgeries	36 (15.6)
No	27 (11.7)
Team time-out, 9 missing values	
Yes	210 (92.1)
No	18 (7.9)

The marking of the surgical site was performed by the surgeon (114/198, 57.6%), the ward physician (51/198, 25.8%) or another person (33/198, 16.7%) with an active involvement of the patient in the marking procedure in 178/197 (90.4%) of the participating departments (6 and 7 missing values, respectively). The marking consisted of a sign (161/198, 80.9%), letter (5/198, 2.5%), word (7/198, 3.5%) or another marking (e.g. drawing, marking of the incision, initials, arrow, cross, shave on the ward, wristband) (25/198, 12.6%) (6 missing values).

Independent of surgical checklists, 210/228 (92.1%) of the participating departments used a team time-out (9 missing values). The respondents indicated that 139/158 (88.0%) of the team time-outs were performed immediately before the skin incision, 9/158 (5.7%) during the induction of the anesthesia, 2/158

(1.3%) during the preoperative preparation, 2/158 (1.3%) in the evening before surgery and 6/158 (3.8%) at another time (52 missing values). It was initiated by the surgeon (89/152, 58.6%), anesthetist (31/152, 20.4%), operating-room nurse (20/152, 13.2%), anesthesia nursing staff (6/152, 3.9%) and other persons (6/152, 3.9%) (58 missing values). The respondents with a running team time-out rated it on a five-point Likert scale as very relevant (1.5±0.7); participants without a running team time-out rated it as neutral (3.0±1.3).

Wrong site surgery: Out of 217 respondents, 62 (28.6%) knew of one event and 87 (40.1%) of more than one event of wrong site surgery; 68 (31.3%) were not aware of any adverse event (20 missing values). On the question, "what do you think in how many cases relevant adverse events occur," respondents estimated it in 5% (range 0-40%) of the hospitalizations, whereas 2% (range 0-100%) were valued to have direct consequences for the patient.

Discussion

The results of this first report in Switzerland show that almost three quarters of the participating departments use surgical checklists with more than a quarter of the participants reporting a subjective decrease of adverse events after the introduction. More than half of the respondents knew of events of wrong site surgery. Before starting the intervention, among other means of prevention of mistaking procedures, all of the departments made a verification of the patient's identity and surgery to be performed.

Patient safety in Switzerland is known to be of good quality, also in comparison with other European countries [19,20]. Accordingly, we found with three quarters a high rate of departments using surgical checklists.

The WHO checklist suggests three phases: Sign in, time-out and sign out. During the introduction of the WHO checklist in a UK hospital, Vats et al. found that the sign in and time-out sections were completed more consistently than the sign out section, largely because it was unclear when to perform this section and because nobody assumed responsibility for the sign out checks in the busy period toward the end of an operation [21]. We found that in over 90%, the surgical checklists of the participating departments contained sign in and team time-out, but less than three quarters of them comprised sign out.

Completion time is an important factor for the acceptance of checklists [22]. The introduction of the WHO checklist was found to take no longer than two to three minutes [12]. With a median time of 60 seconds needed for data collection per patient, we found an even lower expenditure of time due to the use of a checklist.

In contrast to a pilot study at a UK hospital, which proposed giving the lead of the checklist process to nurses to flatten the hierarchy and support shared teamwork, we found that the documentation of a successful checklist check at the participating departments was usually performed by the anesthetist alone and the anesthetist and surgeon in combination [21].

More than half of the participants reported acceptance problems during the introduction of surgical checklists, but less than one third at the time of the survey. The reason behind these acceptance problems might be that surgeons, nurses and anesthetists are accustomed to professional independence and that they are overwhelmed by time pressure [23]. Besides surgeons, in-patient physicians and nursing staff, the participants of our study also named acceptance problems of elder physicians. According to Amalberti et al., historical and cultural precedents and beliefs that are linked to performance and autonomy pose the greatest threat to improved safety [24]. Our finding of a subjective decrease of acceptance problems after the introduction of a surgical checklist is in accordance with the results of other studies [21,25].

One quarter of the respondents reported a subjective decrease of adverse events after the introduction of a surgical checklist, which is in accordance with the measured significant drop of the complication and in-hospital death rate in different studies [10,26]. Improvements in team interactions and communication have been shown to improve outcomes and such interactions were likely enhanced with use of the checklist [7,27]. Data suggest that at least half of all surgical complications are avoidable [28]. We further found that a subjective decrease of adverse events leads to a reduction of current acceptance problems in a weak correlation.

In cooperation with the German Coalition for Patient Safety, the German Society for Surgeons (DGCH) and the Swiss college of surgeons (fmCh), the Swiss Patient Safety Foundation has developed recommendations to prevent mistaking of procedures, including verification of the patient's identity, marking of the surgical site, verification of the patient's allocation to the right operating room and team time-out before the cut [29]. We found an implementation rate of over 90% regarding the verification of the patient's identity, verification of the patient's allocation to the right operating room and team time-out. Almost three quarters performed a marking of the surgical site. Similarly to the findings of Abbara-Czardybon et al., respondents with a running team time-out rated it as more relevant than participants without [30].

More than one third of the respondents knew of at least one event of wrong site surgery. In 2004, the Joint Commission on Accreditation of Healthcare Organizations mandated the Universal Protocol for the prevention of wrong site, wrong procedure, and wrong person surgery [31]. In a critical report conducted before its mandating, wrong site surgery was found in 1/112,994 operations, whereas the Universal Protocol with a preoperative verification process, marking of the operative site and a time-out procedure could have prevented two-thirds of the cases [32]. In a survey among hand surgeons, Meinberg et al. found a rate of 21% of respondents with at least one case of wrong site surgery in their careers [33].

Adverse events were estimated by respondents to occur in 5% of the hospitalizations. In the literature, the annual incidence of adverse events among hospitalized patients ranges from 2 to 8% and in surgical patients ranges from 0.6 to 21.9% [28,34]. The consequences of adverse events for the patient were underestimated by far by the respondents and in general [35].

A limitation of this study is the methodological setting as a survey based on subjective information. Even though the response rate was 29.7%, comparable with that of other surveys among surgeons, there might be a selection bias in the subjects [36,37]. Departments not using surgical checklists might have been reluctant to complete the survey. Due to the methodological setting of the study, the decrease of adverse events and the occurrence of wrong site surgery were evaluated on a subjective basis. Whereas checklists may have significant positive effects on adverse events, particularly in urgent cases, they have been used for elective surgeries only by 5.2% of the participating departments in our study [26]. The subjective decrease of adverse events might be higher if checklists would have been used for all kinds of surgeries. The main strength of this study is that it was conducted in all language regions of Switzerland, covering all hospital categories and specialisms of the Swiss college of surgeons (fmCh).

In conclusion, patient safety in Switzerland is a key issue and is known for its good quality in comparison with other European countries. Still, one quarter of the participating departments do not use surgical checklists, despite the significant drop of the complication and mortality rate shown in different studies and our finding of a subjective decrease of adverse events after the introduction by more than a quarter of the respondents. Thus, there is still room for improvement in the use of surgical checklists, which impresses, in regard to 60 seconds needed for data collection per patient, and which is not excessively time-consuming. However, acceptance problems of the majority of respondents during the introduction phase of surgical checklists vanished over time. Further research in terms of a prospective register is needed to evaluate the subjective decrease of adverse events after the introduction of surgical checklists and the occurrence of wrong site surgery in Switzerland.

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