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Mobilizing or standing still? A narrative review of Surgical Safety Checklist knowledge as developed in 25 highly cited papers from 2009-2016

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Abstract

The Surgical Safety Checklist (SSC) was implemented as part of the World Health Organization's Safer Surgery saves lives campaign. The SSC and its reported positive influence in the operating room was first published in 2008. Since then, this positive perception has changed. New research has identified mixed results showing limited or no change in outcomes following SSC implementation. Such research has prompted calls for the reconsideration of policies mandating the SSC as an organisational safety practice. In the context of this debate, the purpose of this narrative review was to evaluate how knowledge about SSC has been represented and reconstructed in high impact SSC papers. We used the h-index to identify highly impactful articles published between 2009 and 2016. We analysed these articles using three criteria that emerged as we reviewed them: 1) Whether the SSC was conceptualized as a 'thing' or a 'process', 2) Whether the SSC problem and solution were characterized as straightforward or complex issues and, 3) How the SSC knowledge was reconstructed from one paper to the next. We found that many papers in the sample exhibited a pattern of simplifying the story of SSC from earlier work, even when that work may itself have discussed a more nuanced characterization of SSC. This simplicity suggests that knowledge has not been mobilizing effectively across this body of work. We conclude that knowledge mobilization would be improved with a new generation of SSC research that particularly explores and enhances our understanding of the socio-cultural nuances of SSC practices.

Background

The World Health Organisation (WHO) Surgical Safety Checklist (SSC) was developed in 2008 as part of the Safe Surgery Saves Lives campaign [1]. Broadly mandated and put into practice in hospitals around the world, the SSC has been the focus of 8 years of extensive research. Initial studies reported positive outcomes on morbidity and mortality [2, 3]. Other studies have reported more limited impacts, e.g., [4], still others have reported no impact at all [5, 6] or questioned the SSC's effectiveness [7]. Such results have prompted calls for the reconsideration of policies mandating the SSC as an organisational safety practice [8].

Much is at stake here. The role of team communication in care quality is incontrovertible [9, 10]; therefore decisions to pursue or abandon the SSC are consequential and should be made by drawing from a robust knowledge base. With the significant difficulties associated with progressively improving patient safety, the decision to abandon established and promising initiatives should be

taken only after careful consideration of what has been achieved and a systematic assessment of what remains to be done [11]. A multitude of studies, commentaries and reviews have been published since the introduction of the SSC, making this a good moment to pause and ask: How has knowledge mobilized and accumulated across high impact papers in the SSC literature?

Methods

Literature search and selection

Studies where the SSC was the central concern, available in English and published between 2009 and 2016 were included in the review (Figure 1). Our search strategy focused on the term "surgical safety checklist" and used the h-index[1] both from Web of Science and Scopus to help us identify highly impactful articles between 2009 and 2016. The first Web of Science search took place on February 19th 2016, and the h-index value was 25, where 25 articles were cited 25 times or more. Of the 25 articles from the h-25, 1 was rejected as not directly relevant to the SSC. Further h-index searches were conducted in Web of Science and Scopus on June 22nd, June 27th and July 4th 2016 to consolidate the top 25 list after discarding duplicates.   The h-25 papers were then described and analysed (Table 1).

FIGURE 1 ABOUT HERE

Analytical stages

The data analysis process was iterative and the categories described below emerged from a process of reading the papers and discussing patterns among the research team in a series of meetings. Once we had identified and defined the main thematic categories, one researcher (BM) categorized all 25 papers according to these definitions. These categorizations were reviewed by at least one other researcher (BN, SC or LL), and difficult or discrepant examples were discussed in group meetings until consensus was achieved and the three categories were sufficiently refined to account for all papers.

The first analytical categorization asked the question: how does the literature conceptualise the SSC? We analysed the 25 papers for whether they conceptualised the checklist as a *thing*, as a *process*, or as both. Specific verbal and visual markers supported the categorization: SSC as a *thing* was signalled by images of the checklist, references to checklist items, and use of terms such as "tool" or "instrument". SSC as a *process* was signalled by verbs emphasising what the checklist does, e.g., coordinate perspectives and references to SSC as part of a broader set of practices such as team communication.

The second analytical categorization asked the question: how are the surgical safety 'problem' and the SSC 'solution' characterized within individual papers? This analysis focused on each paper's introduction and discussion sections. We categorised the 'problem/SSC solution' characterization in one of two ways. Straightforward categorization emphasizing the obviousness of the problem and simplicity of solution, or nuanced characterization emphasizing the complexity of the problem and multifactorial or ambiguous nature of solution.

The third analytical categorization asked the question: how is SSC knowledge taken up from one paper to another as studies accumulate over this body of work? This analysis involved an intertextual analysis of the introduction and discussion sections of the papers. Specifically, we

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[1] The h-index was developed by J.E. Hirsch and published in Proceedings of the National Academy of Sciences of the United States of America 102 (46): 16569-16572 November 15, 2005

tracked both intertextual references (citations of earlier work) and recontextualisations (representations of earlier work) to identify how existing knowledge is characterised and how new knowledge is placed in relation to it.

Results

The articles analysed (n=25) comprised empirical studies (15 quantitative and 2 qualitative), commentaries (2), systematic reviews (5) and an editorial (1). The articles reported studies from 14 countries.

Conceptualisation of the SSC

Most articles used both conceptualisations -- checklist as *thing* and checklist as *process* -- but emphasized one: 12 papers predominantly conceptualised the checklist as a *thing* and 8 as a *process*. In 5 papers, it was not possible to discern greater emphasis on one conceptualisation or the other.

Papers that conceptualised the checklist as a *thing* commonly referred to it as a "tool", [1, 12] and many included a visual representation of the checklist, [2, 13, 14, 15]. When the checklist was conceptualised as a *process*, the emphasis was on practice rather than tool; for example, Carney et al described "checklist driven briefings and debriefings" [16:727].

Articles conceptualising the SSC as both *thing* and *process* followed two patterns. In one, the checklist as *thing* orientation was presented for the purpose of arguing against it. For example, Weiser et al [17] problematized the "apparent simplicity" of the checklist as "a formal list used to identify, schedule, compare or verify a group of elements" (quoting Federal Aviation Administration, no year) and then described that their "goal was to create a tool that supported clinical practice without attempting to substitute a rigid algorithm for professional judgement" [17:365]. In the other combined pattern, articles began with a *thing* orientation which evolved into a *process* orientation as the paper unfolded.   Illustrating this pattern, Borchard et al presented checklists as "effective and economic tools" in their introduction [18:925] but their discussion problematized this conceptualisation, acknowledging the need to integrate the checklist into the existing hospital system.

Characterisation of the problem and SSC solution within papers

Our analysis of how individual papers characterised the surgical safety 'problem' and the SSC 'solution' revealed three different patterns: 3 employed straightforward characterization in both introduction and discussion; 9 used straightforward characterization in the introduction with a more nuanced characterization in the discussion; and 13 used nuanced characterization in both introduction and discussion. Kwok et al [19] provide an illustrative example of the first pattern. Their introductory hypothesis that "implementation of a hospital-wide checklist program will significantly reduce postoperative hazards and complications…" [19:633] takes a straightforward stance on the SSC's likelihood of success, with no foreshadowing of lurking complications. Their discussion maintains this stance, with assertions such as "It is unlikely that a case's observed status motivated providers to change their behaviour" [19:637] which simplify the potentially complex issue of observer effect.

For the pattern of straightforward and nuanced characterisation of problem/solution, there were some examples where straightforward introductory characterisation was 'unpacked' in the discussion. In Haynes et al the problem of surgical safety was introduced straightforwardly in a

number of claims including this one: "at least half of all surgical complications are avoidable" [2:492]. The discussion of this paper, however, considered a number of nuances not signalled in the introduction, such as "the exact mechanism of improvement is less clear and most likely multifactorial" [2:497]. Similarly illustrating the straightforward intro/nuanced discussion pattern of characterization, Bliss et al introduced the SSC as "an inexpensive tool" [20:766], but discussed a number of nuances, including "the need for focus on deficiencies in communication...as well as disruptive behaviour" [20:722].

An example of the third pattern of problem/solution characterisation can be found in Urbach et al [5]. Its introduction characterized both problem and solution in a nuanced manner with statements such as "the effect of the mandatory checklist implementation is unclear" and "implementation of the surgical safety checklists is not uniform" [5:1030]. The discussion continued this nuanced characterization; in fact, the authors argued that the existence of straightforward, simple characterizations of the SSC may derive from the fact that "studies showing improvements in outcomes after checklist implementation are more likely to be published than are negative studies (publication bias)" [5:1037]. Similarly, Fourcade et al's paper offered a nuanced/nuanced characterization: their introduction suggested that "...questions have arisen about their [checklists'] ease of introduction into workflow patterns and their true impact on safety" [14:1] and their discussion acknowledged that: "A checklist is often put across as a tool to enhance communication and as a reminder in stressful circumstances but, like other operational tools, it impacts on the organisation of work" [14:6].

Knowledge mobilization across the papers

Intertextual references to previous large SSC trials were common in the 25 analyzed papers. However, the pattern of recontextualisation of knowledge from previous work was recurrently one of simplification, particularly in introduction sections. Haynes et al [2] is a case in point. Haynes et al [2] was by far the most cited article in our sample, with citations numbering 1545 in Web of Science, 1979 in Scopus and ranking number 1 in Web of Science and Scopus. All empirical papers in our h-25 list referenced Haynes et al [2], most in the first few sentences of their introduction. In almost all cases, these introductory references recontextualised Hayne's et al 's [2] insights into a straightforward knowledge claim such as "Mortality significantly declined from 1.5% before the SSC to 0.8% afterwards and inpatient complications fell from 11% to 7%" [15] or "Large benefits have been reported following implementation of the checklist, including reductions in adverse events" [21:1664]. We characterized such recontextualisations as simplifications because they do not represent Haynes et al's [2] extended discussion of the complex, multifactorial nature of SSC in their interpretation of results.

Another pattern of recontextualisation was visible in discussion sections. All of the nuanced discussions acknowledged the complexities associated with interpreting SSC implementation and its impact. For instance, papers discussed that "the exact mechanism of improvement is unclear" [2] or "organisational changes are needed while implementing a surgical checklist" [14]. However, in half of cases, these discussions contained no intertextual references to previous work. For example "Improved outcomes after implementation may be explained by a number of mechanisms" [22:1933] and "Checklist adoption in isolation fails to maximise the potential impact" [20:722] are both concepts that were raised in earlier papers such as Haynes et al [2] but neither is accompanied by a reference to earlier, similar insights.

For those papers that did reference previous insights regarding the complexities of SSC intervention, most did so perfunctorily. That is, a citation was provided, but the paper neglected to engage with or

advance those insights. For instance, papers acknowledged what others have indicated previously that "simply enforcing the use of checklists will likely not suffice when substantial improvements in safety culture are desired" [4]. However, the discussion did not elaborate beyond the need for future research.

Discussion

Our results suggest that knowledge is not effectively mobilizing across papers in the SSC literature. Given that later papers have cited earlier ones in the sample, this knowledge stasis is not due to lack of awareness of others' work. Nor do we believe that the SSC literature suffers from biased study reporting. The problem is more subtle than that. The problem is one of inappropriate simplification. Many papers in the sample exhibit a pattern of simplifying the story of SSC in their introductions by recontextualising the findings from earlier work, even when that work may itself have discussed a more nuanced characterization of SSC. In a significant subset of papers, this simplification persists into the discussion section such that insights about the social complexity of SSC are presented either as new or as repetition without development or elaboration. This produces the sense across this body of high impact literature that knowledge is stuttering, or even standing still, as studies repeatedly discover the social complexity of SSC.

We offer two possible explanations for this pattern of recontextualisation. The first relates to the genre of scientific publications in clinical journals. Medicine tends to publish short, multiauthored research papers (in average 9 pages) vs. other disciplines that favour long, single-authored articles (e.g., computer science with 27 pages or law with 43 pages) [23]. Thus, the common generic structure of empirical papers in medical journals is for introductions to be short and to the point, and for discussions to draw out nuance and complexity, which may explain why existing knowledge of SSC complexity gets simplified in paper introductions. Genre does not, however, explain the pattern of discussion sections drawing out nuanced insights but either not noting that those insights resonated with previous work, or merely noting the resonance without further discussion.

A further explanation may lie in the how these high impact papers approach the SSC phenomenon. Most assume that the SSC is an object that can be inserted, controlled and measured; that the SSC is independent of its uptake by people in contexts; and that SSC-based discussions can be explained in terms of universal laws, including cause and effect [24]. Reflecting such positivist assumptions, most of the highly cited SSC papers are deductive, concerned with the control and prediction, grounded in hypothesis testing and experimental design, with a goal of producing generalizable knowledge[24]. Controlled experiments of SSC outcomes approach the SSC as an objectively real and stable entity andare therefore not only not designed to *explore* the social complexities, ambiguities, and inconsistencies associated with SSC implementation, they are not oriented to even *consider* these possibilities. This problem is not unique to SSC research; there is a growing recognition of the limits of positivist research for evaluating and understanding complex health services interventions [25,26].

We would contend that this positivist orientation largely explains the failure, across this body of high impact SSC research, to accumulate increasingly refined insight into the finding that SSC implementation is complex, inconsistent and troublesome. When investigators are oriented towards the SSC as a stable object, they design studies reflective of that orientation, and therefore they have no basis for making sense of findings that suggest otherwise. Thus, the pattern of recontextulisation in which introductions assert that the SSC is a *clear solution to a well-defined problem*, and discussions acknowledge that *it's more complicated than we thought, but we can't say much more because our study was designed to measure the impact of a clear solution on a defined*

problem. While a small body of social science research explores the complexities and inconsistencies associated with altering the communication routines of surgical teams, much of this work is very recent [27, 28, 29] and earlier publications [30, 31] do not appear to have influenced the highly cited SSC publications we reviewed. Nonetheless, research using a social science lens offers valuable lessons. For example, Vats et al identified detrimental effects on workplace culture when SSC implementation strategies are not carefully thought out [32]. Therefore using checklists requires a scientifically-grounded understanding of how organizations and people work [33, 34], including whether there is explicit awareness of the multifactorial underlying mechanisms of safety, mainly around the ways in which organizational values drive communication and teamwork practices [28, 35]. And given that organizational values are made explicit via stories, Hilligoss & Moffatt-Bruce remind us of the affordances of narrative methods to explore the complexities of checklist-driven practices [27]. One such complexity pertains to the relationship between team mobilization practices and participation in safety checks. Using an innovative approach from sociolinguistics, conversation analysis and social semiotics [36], Korkiakangas recently found that mobilisation practices were most affected by the timing of the checklist (e.g., after the patient was positioned or during anaesthetist activities); the presence and distribution of staff (e.g., getting staff in the same place), and the kinds of instigation practices (e.g., loud and clear 'Inclusive calls' that address everyone in the room vs. 'exclusive calls' vs. 'no calls') [37]. These findings continue to challenge the assumption that improvements in team interactions should automatically follow the introduction of a checklist within an organization. Expanding the view to the global context has also revealed the complex interrelation between checklist procedures, context, culture and behavioural changes. An ethnographic study by Aveling et al in hospitals in low-income and high-income countries showed that local policies, institutional support and cultural views around transparency and accountability that are encoded within checklist practices require careful scrutiny [38]. Until the influence of cultural and economic contexts is better understood, it will remain a challenge to straightforwardly measure the potential of the checklist for patient safety. While we are not advocating against controlled experiments of SSC, we do call for better uptake of existing social science approaches and knowledge to grapple with the complex sociological dimensions of SSC implementation and impact [39].

Limitations

The majority of literature included in this review was taken from a period of 8 years immediately following the publication of the first WHO SSC study. While this was regarded as sufficient to plot patterns of knowledge mobilization concerning the SSC, it did not take into account some seminal articles from the exploratory research leading up to the WHO study.

We analysed only the top 25 cited papers, of a body of literature in the 1000s of publications. This sample is appropriate to understand major advances in knowledge which would be expected to be found in the highest impact papers. However, the h-25 index excludes many recent papers and those published in less prominent journals, therefore we cannot know whether the recontextualisation pattern we describe holds across the entire body of SSC knowledge. We suspect that the pattern may not be stable; e.g., Urbach [5], one of the most recent papers in our sample, does not exhibit the pattern of imprecise recontextualisation we observed in other papers. Future research should explore whether SSC knowledge is mobilizing more effectively outside the h-25, and the influence of epistemology, article genre and journal impact factor on such mobilization.

It was not the intention of this paper to judge the methodological rigor or quality of the research presented in the analysed papers, nor to answer the debate about the extent of SSC impact on surgical safety.

Conclusion

This analysis of the top 25 cited SCC papers as a body of knowledge reveals at the least a stuttering effect and at worst a standstill, where studies repeatedly (re)discover the complexity of the SSC phenomenon but are not designed to advance insights about that complexity. We conclude that knowledge mobilization would be improved with a new emphasis on SSC research that explicitly aims to address the lack of sophisticated understanding of the socio-cultural nuances of SSC practices. Recently emerging, such research would be commensurate with a shift underway in safety science that seeks to move beyond standardising and measuring organizational routines, to understanding the role of adaptive human and social practices in safety efforts [40, 41]. For SSC knowledge to build effectively, it will need to directly engage with complexity and variability, not as a surprise or a citation in the interpretation of results, but as a central feature of studying local, emergent, adaptive team behaviour.

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Table 1: h-25 SSC articles

Article	Country	Year	Journal	Type	Description
1. Haynes et al,[2]	Jordan, India, US, Tanzania, Philippines, Canada, England and New Zealand.	2009	New England Journal of Medicine	Quantitative prospective observational study (prepost)	8 hospitals were studied in 1 year: 3733 patients pre-intervention, 3955 post. Concluded that implementation of the checklist *was associated* with reduction in rates of death and complications.
2. De Vries et al,[3]	Netherlands	2010	New England Journal of Medicine	Quantitative prospective observational study (prepost)	6 hospitals in the Netherlands. 18 month study. 3760 patients pre-intervention, 3820 post. Concluded that use of SURPASS is associated with reduced complications and mortality in hospitals with a high baseline standard of care.
3. Weiser et al,[17]	N/A	2010a	International Journal for Quality in Health Care	Commentary	Guidance drawing from the aviation industry to facilitate developing a checklist.
4. Weiser et al,[42]	Jordan, India, US, Tanzania, Philippines, Canada, England and New Zealand.	2010b	Annals of surgery	Quantitative prospective observational study (prepost)	Using data from the Haynes et al (2009) [2]. 842 patients pre-intervention, 908 post. Concluded that the checklist was associated with a one-third reduction in complications for adults undergoing urgent non-cardiac operations.
5. Semel et al,[1]	Jordan, India, US, Tanzania, Philippines, Canada, England and New Zealand.	2010	Health Affairs	Financial analysis	Using data from the Haynes et al (2009) study to assess financial implications of the checklist. Concludes that the checklist is both

Article	Country	Year	Journal	Type	Description
					effective and creates cost savings.
6. Carney et al,[16]	US	2010	AORN journal	Quantitative prospective survey	2, 024 surveys from 34 hospitals in the US were analysed for differences in nurse and surgeon perceptions of teamwork. Concluded that there are differences in perception of the checklist between different professions.
7. Sewell,[13]	UK	2011	International orthopaedics	Quantitative prospective audit (prepost)	480 pre and 485 post over 8 months from 1 hospital. Concluded that the use and staff perceptions of the checklist can be improved with education and infrastructure changes, but that this was not linked with a decrease in mortality.
8. Haynes et al,[43]	Jordan, India, US, Tanzania, Philippines, Canada, England and New Zealand.	2011	BMJ quality & safety	Quantitative prospective survey (prepost)	281 pre and 257 post surveys from the 8 hospitals from the Haynes et al (2009) pilot. Concluded that improvements in safety attitude and teamwork partly contributed to improved post-operative outcomes.
9. Conley et al,[44]	US	2011	Journal of the American College of Surgeons	Qualitative semi-structured interviews	5 hospitals in Washington, US, 90 telephone interviews over 3 months. They conclude that checklist implementation requires consideration of socio-cultural factors.
10. Takala et al,[12]	Finland	2011	Acta anaesthesiol	Quantitative prospective	4 teaching hospitals in Finland, 901 pre-intervention and 847

Article	Country	Year	Journal	Type	Description
			ogica Scandinavica	survey (prepost)	post over 3 months. They concluded that the checklist was suitable for OR and did not hinder activities, but that the culture of OR staff might need to undergo changes in order for it to become accepted.
11. De Vries et al,[22]	Netherlands	2011	Annals of surgery	Quantitative retrospective claims record review	294 malpractice claims were reviewed from the Netherlands over 2 years. Concluded that a third of malpractice claims may have been prevented by a SURPASS checklist.
12. Fourcade,[14]	France	2011	BMJ quality & safety	Checklist audit, interviews, group interviews and observations	1299 checklists audited, 1 group interview and 8 individual interviews in 18 Cancer Centres in France. Recommended tailoring the checklist and considering barriers to effective use.
13. Mahajan,[15]	UK	2011	Best Practice & Research Clinical Anaesthesiology	Commentary	Discussed the role of the WHO checklist and the barriers for implementation, including training and governance.
14. Borchard et al,[18]	US, Netherlands, Canada, Sweden, UK	2012	Annals of surgery	Systematic Literature Review	From 4997 citations, 22 were analysed for effective checklist implementation and compliance. Concluded that the checklist is economic and effective in reducing morbidity and mortality.
15. Van Klei et al,[4]	Netherlands	2012	Annals of surgery	Quantitative retrospective cohort study	25513 patient records in a university hospital

Article	Country	Year	Journal	Type	Description
					were analysed using hospital records over 3.5 years. Concluded that there was a decrease in postoperative mortality after checklist implementation, and that mortality was strongly associated with checklist compliance.
16. Levy et al,[45]	US	2012	Surgery	Quantitative prospective observational study	142 cases observed over 7 weeks in 2 hospitals in the US. Concluded that, although 100% compliance was recorded, checklists were not completed to the correct standard.
17. Walker et al,[46]	UK	2012	British journal of anaesthesia	Literature review	Summary of existing checklists and what the literature reports. Concluded that clinician culture needs to be addressed in order to perform checks in the correct way.
18. Bliss et al,[20]	US	2012	Journal of the American college of surgeons	Quantitative prospective observational study	Observation of procedures and data collection from a surgical database. Concluded that the checklist is an inexpensive intervention that can contribute to cost savings.
19. Fudickar et al,[47]	Jordan, India, Tanzania, Philippines, Canada, England and New Zealand; Netherlands; UK; Sweden;	2012	Deutsches Ärzteblatt International	Review	20 studies were analysed. Results showed a reduction in morbidity and mortality across the studies. Concluded that the SSC should be used in all

Article	Country	Year	Journal	Type	Description
	Finland; US; France				operative procedures as a tool for communication and teamwork.
20. Kwok et al,[19]	Moldova	2013	Annals of surgery	Quantitative prospective observational study (prepost)	2145 pre and 2212 post cases from 22 stations in a hospital in Moldova were analysed by supplying data-recording oximeters. Concluded that the SSC could improve patient outcomes in resource-poor regions.
21. Pickering et al,[21]	UK	2013	British Journal of surgery	Quantitative prospective observational study	294 operations were observed in 5 hospitals in the UK testing compliance with the checklist. Concluded that the checklist isn't being completed properly, particularly during 'sign out'.
22. Russ et al,[10]	UK	2015	Annals of Surgery	Multicentre Prospective study	Checklist Usability Tool was used for observations on time out (565) and sign out (309) procedures. Results showed a variation in checklist use.
23. Bergs et al,[38]	Jordan, India, US, Tanzania, Philippines, Canada, England and New Zealand; UK; Iran; Netherlands; Moldova	2014	British Journal of Surgery	Systematic Review and Meta-analysis	7 of 723 studies were included. Concluded that there was a reduction in morbidity and mortality after checklist implementation.
24. Leape,[8]	N/A	2014	New England Journal of Medicine	Editorial	Suggested that the failures of the SSC in Ontario and in the UK were caused by its improper use.

Article	Country	Year	Journal	Type	Description
25. Urbach et al,[5]	Canada	2014	New England Journal of Medicine	Quantitative prospective observational study	All acute care hospitals in Ontario were surveyed with 101 submitting SSCs for analysis before and after SSC implementation. Concluded that the implementation of surgical safety checklists in Ontario, Canada was not associated with significant reductions in operative mortality or complications.