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Practice Management

Surgical tray reduction for cost saving in pediatric surgical cases: A qualitative systematic review

Charlene Dekonenko, Tolulope A. Oyetunji, Rebecca M. Rentea *

Children's Mercy Hospital– Kansas City, Kansas City, MO 64108, USA

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ABSTRACT

Background: Standardization of surgical instrument trays and doctor preference cards (DPC) are known to reduce the cost of adult surgical cases. The practice in pediatric surgery may be more complex owing to a wide range of patient age, leading to difficulty with practice implementation and loss of potential financial savings, which underscore the importance of the review of this topic.
Methods: A systematic review of pediatric surgical tray standardization and cost-effectiveness was performed. Original and review articles from 2000 to 2018 were extracted from MEDLINE (via PubMed), Embase, Cinahl, Cochrane, and an electronic search through Scopus. After screening by inclusion and exclusion criteria, articles were selected and reviewed.
Results: Five articles were included. On average, discontinuation of disposable instruments and standardization of equipment resulted in a removal of 40%–70% of surgical instruments per set. This yielded a cost savings of 20% (an average US $200), with no intraoperative complications or perceived safety issues.
Conclusions: Standardization of operating room (OR) doctor preference cards (DPC) and surgical instrument trays in pediatric surgical cases result in lower operative supply costs without impacting OR time or safety.
Level of evidence: Level 3.

Contents

Concerns over rising healthcare costs in the setting of the introduction and application of new technologies have underscored the need to evaluate and streamline processes around resource utilization in operating rooms (ORs). Increased scrutiny of health care expenditures is evidenced by a growing body of literature assessing the efficiency of

* Corresponding Author at: Comprehensive Colorectal Center, Department of Pediatric Surgery, Children's Mercy- Kansas City, 2401 Gillham Road, Kansas City, MO, USA. Tel.: +1 816 234 3575.
E-mail address: rrentea@cmh.edu (R.M. Rentea).

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ORs and their impact on the delivery of patient care, physician satisfaction, and the hospital's bottom line [1]. Operating room costs comprise 33% of total hospital costs and $20–$62 dollars per minute operationally [2,3]. Therefore, small changes in efficiency of operating room processes or direct costs of equipment can quickly add up to meaningful differences in hospital operating costs and health care spending [4]. Measurable costs include materials and cost savings (theoretically operating room preparation time, tray weights, number of trays used, number of instruments utilized, total instrument reprocessing savings, turnover time, and theoretical hospital-wide savings) [4]. In addition, unmeasured hospital savings include decreased instrument wear, maintenance, replacement frequency, and decontamination costs [4]. Instruments used during a surgical procedure are one area under a surgeon's purview, where cost–benefit metrics can be easily assessed [1]. Multiple single-institution studies have shown that standardization and reduction of surgical instrument trays reduce the cost of surgical cases [4–10].

The instrument tray cycle is a long and complex process involving over 13 major separate steps [1]. A detailed breakdown of total processing cost per individual instrument has been previously outlined by Stockert et al. [1]. Excess instruments in trays drive direct costs. These involve labor, such as time to clean and pack instruments, at around a total processing cost of $0.10 as well as depreciation, which varies by instrument type, running between $0.02 and $0.18 of total processing cost. Indirect costs are driven by excess volume through central processing and include utilities (detergents, biologic checks, quality checks) at $0.09 total processing cost and repair (maintenance contracts for sterilization of equipment and additional repair of equipment needed for categorizing and packing) with a total processing cost of $0.14. Other recorded quantifiable variables include water, electricity, depreciation of durable equipment, floor space/storage, labor costs spent setting up trays/searching for instruments/counting, and replacement costs for instruments lost or damaged in heavy disorganized trays. Unquantifiable variables include the burden to employees lifting heavy trays, organizational coordination for a larger volume of instrument inventory, and disruption of operating room flow and surgeon and staff focus [1].

The Institute of Medicine (IOM) states that quality care should be efficient, equitable, safe, family-oriented, timely, and cost-effective. Reduction in variables related to operative setup and equipment not only reduces costs but also improves the quality of care by decreasing error [11,12]. Cost reduction can be achieved by standardizing the delivery of care and minimizing variability [11]. A large number of surgical instruments per tray, including infrequently used instruments, have been associated with adverse consequences. It has been shown that the majority of instruments (70%) in trays used in adult surgery meet the criteria for being superfluous [5], and their existence on the operative field has been associated with increased instrument count error rates [1]. Furthermore, the daily costs of rewashing, resterilizing, repacking, and then reopening surgical instruments can carry significant financial costs [5,9,13,14]. Surgical instrument tray reduction and standardization are often utilized to avoid these consequences and can be instituted by the creation of standardized doctor preference cards (DPCs). Standardized DPCs have been shown to result in improved operational efficiency and cost-saving in several single-institution adult studies [3,5,6,8–10,13,15,16].

In pediatric surgery, the implementation of operative efficiency by standardizing the surgical instrument process poses unique challenges compared with adult surgery. The same operations can be carried out on a broad range of ages and sizes for patients between birth and more than 18 years of age. In addition, while pediatric surgery departments are often small, with an average of 3 to 10 surgeons, multiple surgical specialists also practice in these hospitals, some of which rotate between different surgical settings within pediatric or adult hospitals. The pediatric surgical practice model also differs widely from that of academic practice, private practice, to a single surgeon performing locum tenens work. Furthermore, hospital structures of OR locations vary widely from stand-alone children's hospitals, dedicated pediatric floors, or operating suites within an adult hospital, to surgery centers dedicated to pediatric care or mixed with adult surgery.

In pediatric procedures, there is a wide variation in operative technique, equipment used, and approach (open vs. laparoscopic) for each surgical procedure. Each operation can utilize a variable amount of disposable single-use items ranging from a few simple sutures to multiple laparoscopic staplers, retrieval bags, trocars, and handheld hemostatic devices. There is also variability in the types of procedures that can be performed utilizing a single surgical tray, as the prevalence of performing certain rare operations can vary between surgeons, who may only perform a rare operation once a year if at all. While this variability, unique to the practice of pediatric surgery, results in complex processes for the delivery of care in the operating room, reducing surgical instrument trays is cost-effective compared to having multiple different surgical trays for individual surgeons. The cost savings and benefits of surgical tray reduction and DPC standardization have been seen in adult surgical cases, but while also described in the pediatric surgical literature, have not been widely instituted in the field. The practice in pediatric surgery may be more complex, leading to difficulty with practice implementation and loss of potential financial savings, which underscore the importance of the review of this topic. The aim of this systematic analysis was to summarize the methods used to reduce surgical instrument trays and evaluate the outcomes in the pediatric surgical population.

1. Methods and materials

1.1. Identification of studies

We conducted a comprehensive literature search of articles published between January 1, 1990 and February 14, 2019 in PubMed, Embase, Cinahl, Scopus and the Cochrane Library. In PubMed and the Cochrane Databases the following search query was used: "Operating Rooms OR Surgeons OR Surgical Procedures, Operative OR Surgery OR Surgical OR operating room OR operating rooms" AND "Instrumentation OR Surgical Equipment OR instrument tray OR instrument trays OR Surgical tray OR Surgical trays OR Surgical kit OR surgical kits OR surgical instrument OR surgical instruments'" AND "standards OR statistics and numerical data OR Reference standards OR preference card OR preference cards OR standard OR DPC"AND "Hospitals, Pediatric OR Pediatrics OR Pediatric Nursing OR Nurses, Pediatric OR Pediatric* AND English". The latest search was done on June 26, 2019.

Titles and abstracts were examined against the inclusion and exclusion criteria, and full texts of potentially eligible studies were obtained. Relevant articles were reviewed by title, keywords, and abstract by the authors (R.R. and C.D.), and a full-text assessment of selected articles was performed. Any discrepancies were reviewed and solved in agreement. To ensure literature saturation, we also screened references for relevant studies. This analysis was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines for study selection [17].

1.2. Inclusion and exclusion criteria

Articles written in the English language, which contained relevant information, including cohort and pediatric surgery, and provided outcomes of surgical tray reduction were included. All data were extracted into an electronic data sheet in a standardized manner. For currency, the US dollar was utilized. Commentaries, news reports, reviews, or systematic reviews were excluded. Reference lists of relevant articles were manually searched for additional articles. Duplicates were deleted. Animal studies and studies discussing extracorporeal membrane oxygenation or central venous catheters were excluded.

2. Results

The initial search generated 1722 results. Of these, 15 remained after initial screening, and 5 articles and their references were screened individually for relevance. Of these, 5 studies were identified by all authors as meeting inclusion criteria (Fig. 1). The PRISMA flowchart and the stratification for focus on pediatric surgical instrument trays are summarized in Fig. 1. The following topics were excluded: superiority of a specific surgical approach to champion cost savings [18,19] or feasibility of laparoscopic equipment use and cost-effectiveness of surgical approaches [20,21]. Given the heterogeneity and limited objective data, a narrative review was undertaken. Grade quality and risk of bias were determined for individual studies owing to the breadth of the review and qualitative synthesis of results.

2.1. Scope of instrument tray reduction

Methods for standardization and reduction of pediatric surgical instrument trays were explored in each of the single-institution studies (Table 1). Pediatric surgeons were convened as a department, which usually consisted of 5 to15 surgeons. Standardization took place for single common surgeries, such as appendectomy and inguinal hernia repair in four of the studies [11,14,22,23], and was applied to multiple pediatric surgical specialties in only one study [24].

2.2. Methods of instrument tray reduction

Each study employed a different technique of instrument tray reduction within the surgical setting. In one of the earliest of these studies, surgeons convened as a group to perform instrument tray reduction through the development of standardized DPCs [11]. Surgeons were individually responsible for instrument utilization reduction [11,23], developed a standardized approach to equipment via tray and DPC development prior to implementation [14,22], or had a stakeholder meeting with unanimous decision making for all surgical trays [24]. In order to develop the DPC, each surgeon was given a copy of their cost data in comparison to those of their surgical partners, and education regarding cost data for disposable and nondisposable instrumentation was provided to the surgeon group. Following the provision of personal utilization information, a representative preference card was created and refined [11]. Another group who also utilized individual feedback to minimize instrument utilization, provided real-time feedback of OR supply cost data to individual surgeons via automated dashboards and monthly reports. Each surgeon's baseline operating room supply use was examined to find opportunities for cost improvement before intervention [23]. A consensus opinion among 6 surgeons was utilized to create a uniform DPC utilizing previously identified effective and inexpensive devices available in the healthcare system and tracked through a hospital cost-accounting program [14]. A standardized lowest cost DPC was then instituted for utilization and application [14].

2.3. Stakeholder engagement in tray reduction efforts

Stakeholder engagement discussions were utilized by both Koyle and Farrelly et al. to create instrument reduction and standardization in surgical trays [22,24]. Lean principles and a formal presentation were shared with all major stakeholders, surgeons, and OR nurses in order to develop a standardized pediatric inguinal hernia instrument tray for both pediatric general and urologic surgery groups [22]. Four independent observers evaluated instrument use in the operating room

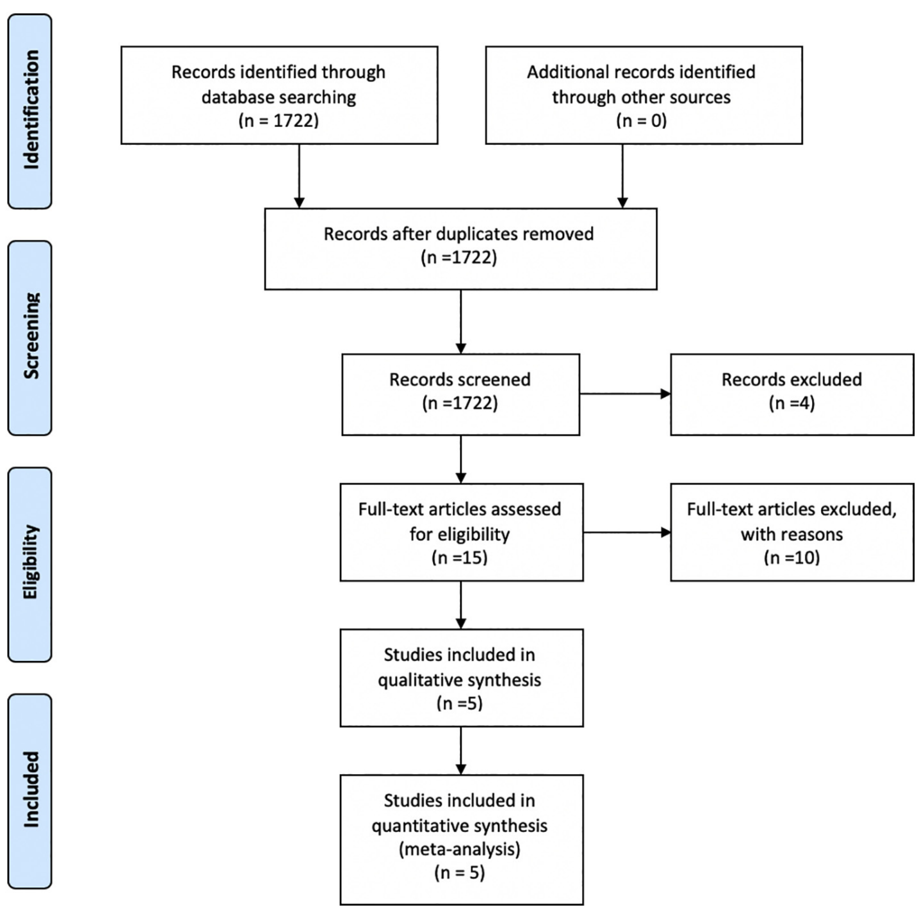

Fig. 1. PRISMA flow diagram describing the study selection process.

Table 1
Articles selected for systematic review.

Author, year	Method	Specialty	Operation	Surgeons (n)	Economic outcome	Study design	Strategy/approach	Outcome
Avansino [11] 2012	Tool reduction	Pediatric surgery	Appendectomy	10	20% average reduction in cost per case. Annual cost savings $41,000	Single center prospective observational study	Consensus opinion to develop standardized preference card following individual reports. Pre- and postimplementation surveys.	No change in operative time, OR total time, length of stay or intraoperative complications.
Skarda [14] 2015	Tool reduction Disposables reduction	Pediatric surgery	Appendectomy	6	Cost per appendectomy decreased from $844.11 to $305.32	Single center prospective observational study	Consensus opinion to develop standardized preference card with most economic equipment.	Operative times and outcomes unchanged.
Farrelly [24] 2017	Tool reduction	Pediatric surgery, thoracic, urology, orthopedic, neurosurgery	All	5	Annual instrument cost avoidance of $53,193 to $531,929 using an average instrument life span of 1 to 10 years.	Single center prospective observational study	Multidisciplinary stakeholder meeting. Each tray addressed individually. Study of multiple surgical specialty tray reduction with feedback questionnaires.	Decreased labor cost, instrument reduction, avoidance of costs, central processing nonlabor cost saving, decreased tray weights.
Koyle [22] 2017	Lean 5S Tool reduction	Pediatric surgery, pediatric urology	Inguinal hernia	14	Central supply processing time reduced from 11 to 5 min. Decreased instrument tray weight 13.5 to 11.2 lb.	Single center prospective observational study	Standardization of preference card following period of observation with pre and post surveys.	Decreased processing time from 11 to 5 min, and instrument tray weight. Surveys demonstrated increased agreement that standardization increases efficiency, cost and safety.
Robinson [23] 2018	Supply cost	Pediatric surgery	Appendectomy	8	Median supply cost decrease from $884 (IQR $705–1025) to $388 (IQR $182–776)	Single center prospective observational study	Real-time feedback of OR supply cost to individual surgeons. Compare supply cost and patient outcomes including OR duration and adverse events.	Supply cost comparisons decreased with feedback to individual surgeons. No changes in outcomes.

and then designed a new tray, with the old tray available as backup for a period of time [22]. Finally, all surgical services were able to make sweeping changes to all surgical trays by holding a multidisciplinary stakeholder meeting attended by operating room nurses, scrub technicians, individuals from central sterile processing, individuals from material management, and all 5 pediatric surgeons. Surgical trays for all operations and DPCs were addressed in this study. A list of procedures associated with each individual tray was provided to the surgeon at the time of review. Instruments were eliminated only if there was a unanimous agreement among all surgeons in the group [24].

2.4. Metrics to measure cost-savings

A large amount of variety exists in the metrics utilized to measure the success of cost-saving and implementation in pediatric surgical hospitals following operating room tray reduction initiatives. The utilization of a standardized DPC reduced the cost of performing a laparoscopic appendectomy to $688 from $781 ($p < 0.007$) with a reduction in supply cost of $167 per case (21%) [11]. In another study, a uniform DPC decreased the device cost per appendectomy from $830 to $280 for patients with nonruptured appendicitis, and from $874 to $361 for patients with ruptured appendicitis. The cost savings directly attributable to the implementation of the uniform DPC during the one-year time period of this study were $195,042 [14]. In a prospective observational study for appendectomy, the institution utilized reports of average operating room supply costs that were generated monthly to provide real-time feedback to surgeons. Laminated pocket cards listing commonly used supplies with costs were also distributed to surgeons and operating room personnel. Cost was reduced from $884 (IQR $705–$1025) preintervention to $388 (IQR $182–$776) postintervention $p < 0.001$), representing a 56% reduction. Coincidently, costs of operating room services, anesthesia, and the postanesthetic care unit stay also decreased following the intervention. The reduction in supply costs was the greatest magnitude. Overall, hospital cost after intervention decreased from $4225 (IQR $3864–$4989) to $3949 (IQR $3462–$5996). There was no change in fixed costs, while operating room supply costs decreased by 75% [23].

2.5. The cost of instrument processing

Cost savings were not uniformly categorized across all studies. Koyle et al. monitored cycle time in the central supply area to rinse, sterilize, and repack each tray using a calibrated stopwatch on 10 pre- and poststandardized sets. In addition, the weights of each of the three trays were measured. They found that 68% of instruments in the old trays were never utilized. Processing of a tray by cycle time was reduced from 11 to 5 min, and tray weight was reduced from 13.5 to 11.2 lb [22]. In another study, bar code scanning provided a granular level of detail in surgical tray preparation time [24]. Factors evaluated that were able to be given monetary and time metrics included surgical tray build time data, labor costs savings, calculation of instrument cost avoidance, nonlabor processing cost savings, and tray weights. In order to calculate a cost per second of personnel who were performing central processing, the pay per second of central processing personnel was $0.0047, which was approximately $17 per hour, and per instrument labor cost was $0.15. Following intervention, processing time was reduced by an average of 28.7% (range 2.6%–56.3%), and 45,856 fewer instruments were processed per year. A $97,628 instrument cost reduction was achieved between thoracic and general pediatric surgery. However, the larger cost savings of $176,705 and $229,237 for urology and spine services, respectively, were because of the elimination of more difficult to process instruments such as endoscopes and expensive spine surgery instruments. A total of 2668 instruments were eliminated from regular central sterile processing, resulting in an annual instrument cost savings of $531,929 (using an average instrument life span of 1 year). For instruments with 5- and 10-year life spans, an annual instrument cost avoidance decreased to $106,386 and $53,193, respectively. A nonlabor cost estimate of $0.41 per instrument and a reduction of 84,617 instruments processed per year, resulted in a total operational cost savings (including depreciation, materials, utilities, repair and maintenance costs) of approximately $43,693 per year. Tray weights were reduced an average of 3.2 kg (range 1.8–5.4 kg, 20.3%–41.4%) [24].

In a model-based article, potential savings via an economic evaluation comparing the cost of surgical trays containing redundant instruments to surgical trays with reduced instruments ((reduced 'trays') were calculated. Input parameter variables per instrument included: decontamination time 4 s, packing time 17.5 s, per second cost of personnel time $0.006, per instrument cost of depreciation $0.06, and per instrument indirect cost $0.23 [25]. Redundant trays resulted in a cost of $21,806 which decreased to $8803 in reduced trays, for a 1-year cost savings of $13,003 based on the surgical volume at the institution [25]. When indirect costs were added to the model, the decrease went from $48,781 to $19,692 for $29,088 per year estimated cost savings [25].

2.6. Measures of safety and impact on clinical outcome

Variability of safety and outcomes was also demonstrated in all studies of the measurement of safety following implementation. Measures utilized often involved basic patient demographics, operative times, total OR time, and length of stay [11,14,23]. Following the implementation of a standardized DPC, there was no change in mean operative time (65 vs. 69 min; $p = 0.14$), total operating room time (116 vs. 114 min; $p = 0.15$) or length of stay (2.5 vs. 2.3 days; $p = 0.60$), as well as no intraoperative complications in either group [11]. Robinson et al. demonstrated no change in median operative procedure, but the length of stay after instrument reduction and standardized DPC decreased [23]. In a separate study, use of a standardized DPC consisting of more cost-effective instruments did not lead to worse postappendectomy outcomes including readmission, postdischarge emergency department reevaluation, abdominal abscess development, reoperation, postoperative interventional radiology drainage requirement, subcutaneous abscess development, and the use of CT imaging postoperatively [14].

2.7. Satisfaction surveys

Pre- and postsurgical tray reduction and DPC standardization surveys were often utilized to demonstrate stakeholder satisfaction with implementation. Survey respondents, including nurses, surgeons, and surgical OR circulators, all took pre- and postsatisfaction surveys and agreed that standardization improved cost and safety [11]. Respondents to the questionnaire were asked if the implementations were considered cost-effective, efficient, and should be expanded, and positive responses increased from 58% to 91% preimplementation to postimplementation [22]. Feedback via questionnaires was also obtained to monitor satisfaction with surgical tray presentation/instrument availability over a 6-week period following surgical tray optimization [23]. Requests to add instruments back to the tray took place in only 3 of 27 cases, and all three were part of the same tray. Five questionnaires (18.5%) contained comments about instruments that were supposed to be in the new trays but were not present at those operations [24].

3. Discussion

In this systematic qualitative review, standardization of surgical trays and DPC resulted in lower operative supply costs without impacting operative room time or safety in high-volume common pediatric surgical procedures such as appendectomy and inguinal hernia repair [11]. The catalyst for instrument tray reduction and development of uniform DPCs most often took place via individual surgeon buy-in or through performance improvement initiatives. Surgeons more frequently were responsible for significant cost savings per case following the implementation of standardized DPCs by agreeing on less costly disposables and removal of redundant instruments or through performance improvement engagement of committee/stakeholder and employment of improvement processes.

The pediatric surgical literature championed cost-effectiveness in the operating room through the retrospective evaluation of instruments utilized for a specific surgical approach. The instrumentation required to perform the surgical technique was then calculated and assigned a value, but there was no mention of the standardization of a DPC or tray creation [18]. For example, when performing an appendectomy, laparoscopic equipment can be utilized to perform the entire operation through a single incision [18,19] vs. three separate laparoscopic incisions. While one incision may seem superior to three separate incisions, patient disease, surgical anatomy, and body habitus may make the surgical approach with three incisions necessary. Many examples exist comparing surgical approaches and then ascribing a dollar amount. However, one must be careful to note that retrospectively ascribing costs to operative approaches is not synonymous with instrument tray reduction or development of DPC initiatives.

Multiple methods for decreasing instrument tray utilization have been explored in adult procedures. One method of reducing utilization is the 'Lean' method, which is defined as a process of value stream mapping or evaluating objects/steps (instruments in this study) and labeling them as necessary (value-added) or not necessary (no value-added). The no value-added steps are progressively eliminated, making it leaner [26]. However, while processes such as Lean are becoming popular to initiate institutional efficiency, there was a uniform demonstration on the importance of first developing a DPC before the implementation of surgical tray reduction when surgeons initiated any changes for pediatric surgical operations [11]. Among the studies examined in this review, surgical instrument tray reduction was often initiated at an individual surgeon level with cost and supply comparisons. Compared with peers, when reductions of operative costs were averaged to 17% per case, there was no difference in outcomes [8]. Comparison with peer surgeons also served to engage the competitive nature of individual surgeons to drive change [11,23].

At our institution, instrument tray reduction and standardization are seen in two contexts. In the first, the pediatric general surgery group members have participated in several randomized operative trials, which have led to subsequent standardization in many common operations such as appendicitis. In the second, efforts began within a single subspecialty, pediatric orthopedics. Following a period of observation from a single surgeon under and low utilized instruments were removed. The reduced tray with available peel pack instruments was then trialed by all members of the specialty to collect feedback on feasibility and ease of use, prior to standardization. Study of reduction and standardization of spinal instrument trays revealed a decreased surgical prep time by 66%, reduced ergonomic strain and infection risk, enhanced staff satisfaction, and a total annual savings of ~$388,000. The process was then repeated within each of the surgical departments within our institution. Currently, the Sterile Processing Division now leads the efforts in instrument tray reduction and standardization with daily tracking of instrument use within trays. Trends in unused instruments are presented to the surgical division OR team leader, and a collaborative decision is made to either keep or remove the instrument.

One barrier to implementation is that physicians may not understand their role in controlling costs. In a survey, only 36% of 2556 physicians believed that it was the individual practicing physicians' responsibility to reduce the cost of health care [27]. To reduce cost on instruments, the information provided to each surgeon included the following: average disposable equipment cost across a department, per case, the most expensive disposable items used, a list of commonly used expensive devices with alternative cost-effective options, and strategies to reduce one's individual cost by exchanging certain costly items for less expensive ones [16]. The lack of awareness of actual costs may explain the same physician's viewpoint that they do not bear significant responsibility for cost containment [16].

However, surgeon buy-in was frequently highlighted as key to achieve cost savings. Many papers commented on the difficulty of utilizing 'cost savings' alone as motivation, as it is difficult to measure who directly benefits [28]. There is also the perception that techniques, equipment restriction, and equipment substitution influence safety. Poorly functioning equipment potentially impacts patient safety and is not worth the trade in cost savings [29]. There is also difficulty adhering to published evidence as implementation often lags several years behind the publication. There is also the pervasive thought that the use of disposable instruments saves operative time, despite the lack of evidence to support this [30,31]. Overall, surgeons had the highest degree of agreement toward individual adherence with the lowest perception of team adherence, which highlights discrepancies in perceived adherence to standard work [11]. Perhaps with more evidence showing the benefits and safety of standardization of surgical instrument trays, surgeon buy-in will be easier to attain.

Initiating the surgical instrument reduction and DPC standardization process requires information and motivation. Demonstration of results, such as individual surgeon reports with deidentified information [11] or through individual reporting [23], creates a sense of ownership and competitiveness. Group buy-in through the workflow process is also of importance when efficiency initiatives are rolled out. Routine presentation of data and involvement of all participants help to create lasting processes. Reasons for noncompliance are as important to track as reasons for compliance. Any variations should be studied to unveil potential opportunities for improvement. Small iterative steps over time, as opposed to major practice shifts, ultimately help change practice. Group training sessions demonstrating the use of instruments, surgical techniques, equipment, and surgical flow lead by more experienced personnel help with adaption. Cost reductions that benefit the hospital should be linked with standardization practices to create incentives that are important to individuals, such as academic productivity, which may further increase adherence and therefore cost reduction [11].

Existing pediatric surgical instrument tray reduction studies consist of single-institution studies with limitations. The studies examined result in the potential influence of the Hawthorne effect — making it difficult to see if the changes are lasting and if reeducation has established new practice patterns [8]. A low heterogeneous group of surgeons participated in each study without longevity following implementation. Many institutions lack systems to track supply costs and instruments for individual cases. While overall standardization and reduction of supplies and durable instruments have benefits both inside and outside the OR [32], these elements were not tracked consistently. Many studies alluded to instruments or old trays being 'available' if needed, which in itself contributes to labor costs associated with pulling and reshelving. Finally, variability in measures of success was noted, including methods for cost-saving. Often measures of operative safety were an afterthought in the studies and not clearly defined but instead were categorized as operative complications, length of stay, and operating time.

4. Conclusion

Implementation of reduced surgical trays could substantially contribute to reducing nationwide and pediatric surgical hospital costs. The process which can be easily implemented involves surgeon buy-in, engaging stakeholders outside of the department, refining case cards and instrument trays, auditing, measuring results, and reinforcing the behavior (Fig. 2). Standardization of surgical trays and DPCs results in lower operative supply costs without impacting operative room time or safety, as demonstrated by implementation in high volume common surgical procedures [11]. Physicians, operating room staff, and hospital administrators alike should focus on surgical tray reduction at their institutions for an easy and effective way to reduce costs.

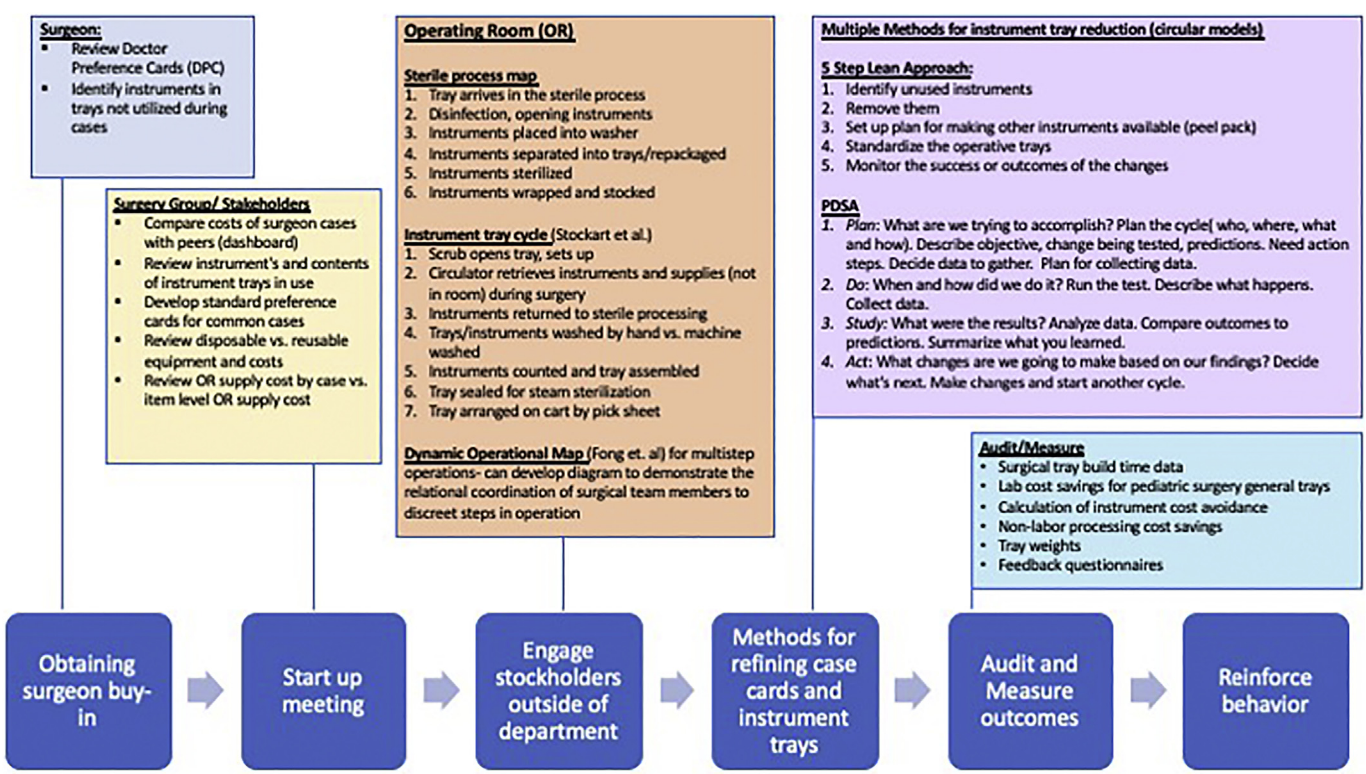

Fig. 2. Instrument tray reduction flowchart.

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