# Use of equipment whiteboard checklists in improving communication while reducing case cost during ureteroscopy

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## ABSTRACT

**Introduction:** Effective communication is essential in operating room (OR) settings to reduce interruptions, ensure patient safety, and reduce equipment-related waste. In the setting of percutaneous nephrolithotomy equipment, whiteboards improved OR staff perceptions of communication and decreased procedural costs. Given that ureteroscopy has varying equipment needs from case to case, we sought to evaluate the effectiveness of equipment whiteboard implementation in ureteroscopy.

**Methods:** Thirty-three urology OR staff were recruited to complete questionnaires assessing confidence in equipment accuracy and efficacy of communication both with and without the equipment whiteboard. Furthermore, 50 cases were randomly allocated 1:1 into having the surgeon verbally indicate equipment needs compared to using the whiteboard. These procedures were assessed for objective accuracy of equipment, case length, case cost, and number of interruptions. All outcomes were compared between groups using two-sided T-tests and Fisher's exact tests.

**KEY MESSAGES**

- We developed an equipment checklist whiteboard for use in ureteroscopy to improve communication and reduce surgical interruptions and procedural costs.
- OR staff confidence in equipment preparation and perceptions surrounding communication were significantly improved following whiteboard implementation.
- The number of equipment-related surgical interruptions was significantly reduced with whiteboard implementation, and equipment-related procedural costs were decreased by 25% on average.

**Results:** From the questionnaires, we found significant increases with the whiteboard in confidence equipment was in the room (p<0.001, confidence interval [CI] -5.386, -3.621), confidence required equipment was opened (p<0.001, CI -4.956, -3.015), and confidence nothing unnecessary was opened (p<0.001, CI -5.432, -3.393). Furthermore, we found significant improvements in objective equipment accuracy scores (p<0.001, CI -3.982, -1.618), a significant reduction in interruptions (p=0.001, CI -1.147, -0.293), and an average 25% decrease in equipment-related procedural costs (p=0.018, CI 30.661, 313.099).
**Conclusions:** Implementation of an equipment whiteboard for ureteroscopy was effective for improving OR staff confidence in equipment choices and perceptions of communication. Furthermore, the whiteboard improved equipment accuracy while reducing interruptions and procedural costs.

## INTRODUCTION

Communication essential within the operating room (OR) where individuals from varying degrees of procedure specific experience must act as a cohesive unit in order to achieve optimal patient outcomes.[1,2] Given the diversity of experience brought by each individual, knowing the equipment requirements of each procedure and patient context is unreasonable for many OR staff including nurses and trainees. As such, it falls to the surgical team to communicate these equipment needs to the rest of the team, however this critical communication step may be ineffective or missed impacting the efficiency of the procedure.[3,4] Ineffective communication could impact patient outcomes, lead to cost inefficiencies which is a particular challenge in a publicly funded healthcare system with resource limitations.[4,5]

In recent years, several efforts have been made to attempt to reduce these inefficiencies both from a patient safety perspective and a cost perspective, including surgical checklists, team huddles, and whiteboards.[6–8] The use of surgical equipment whiteboards in percutaneous nephrolithotomy (PCNL) significantly improved both staff confidence in equipment selection and true equipment accuracy.[9] PCNL was chosen for this type of quality improvement study because it is a procedure with highly variable equipment needs, often leading to miscommunication regarding those needs within the OR.[10] Ureteroscopy is similarly a highly variable procedure with drastically altered equipment needs based on the specific case and surgeon preference.[11] Ureteroscopy is a widely accepted procedure for ureteral calculi, nephrolithiasis, investigating filling defects, and biopsy or removal of malignancies, among other indications.[12] Due to the wide array of indications, ureteroscopy is one of the most commonly done and variable procedures in urology leading to a high potential for waste burden from miscommunications regarding equipment in the OR.[13]

As such, in this study we created a whiteboard checklist adapted from previous use in PCNL to apply to ureteroscopy cases which would communicate equipment needs for each case

to the entire surgical team. We then sought to evaluate the efficacy of this whiteboard in communicating equipment needs by using care provider surveys to assess confidence in meeting the equipment needs of the case. We also assessed communication through an equipment accuracy score assessed during cases both with and without the whiteboard including the number of surgical interruptions due to equipment errors and time taken to complete each case.

## METHODS

### Overall study design

This quality assurance (QA) prospective cohort study was approved by the University of Calgary Ethics Review Board (REB25-0739). OR staff at Rockyview General Hospital (Calgary, Alberta, Canada) were asked to complete a QA survey based on experiences with surgeons using a 14-item whiteboard to indicate equipment preferences for ureteroscopy cases from June 2025 to September 2025. This whiteboard was developed in collaboration with practicing endourologists and other OR staff including nursing staff and required surgeons to indicate if commonly used ureteroscopy equipment should be opened or in room but not opened as well as indicating the type of equipment needed when necessary (Supplementary Figure 1). In practice this whiteboard was printed, laminated, and left in the dedicated endourology OR suites at Rockyview General Hospital so that it could be written on and then erased between each procedure. Given that the whiteboard had been previously implemented in some ORs at this site, staff completing the questionnaire were dichotomized into those who had not previously used the whiteboard and those who had previously used the whiteboard. Those with no prior experience were asked to complete the survey both before and after whiteboard use while those with prior experience were only asked to complete the survey sections pertaining to after the whiteboard had been used.

Fifty ureteroscopy cases during the same period were also divided into two groups – one where the attending urologist used the whiteboard and one where the attending urologist did not use the whiteboard. These cases were randomly chosen by the attending surgeon from days when at least two ureteroscopy procedures were being performed, with one control and one whiteboard case being done on each of these days in random order (chosen through coin flip). Only two cases were randomized with each group of OR staff to limit the effects of improvement on subsequent cases due to familiarity. On days when the attending surgeon was on-call and working with two groups of OR staff it was possible for 4 cases to be randomized. In each case the attending urologist completed an equipment accuracy form which assessed 3 primary categories (Supplementary Figure 2). The first of these was whether the equipment was correctly absent, present but unopened, or present and opened in the room. The second of these was whether the equipment present was the correct type for the case. The last of these was whether any of the equipment present was extraneous or unneeded in the case. Additionally, the attending urologist was asked to report the number of equipment related interruptions for each procedure, the procedural time for each case, and the case cost.

**Participants**

Thirty-three urology nurses (RN and LPN), urology fellows, and attending urologists completed the survey with those who had not used the whiteboard before completing both a pre-whiteboard and post-whiteboard and those who had used the whiteboard just completing the post-whiteboard survey. Additionally, the fifty ureteroscopy cases where we assessed equipment accuracy were randomly selected from 115 ureteroscopies performed during the study period. These cases were all performed by a single fellowship trained endourologist (Mark Assmus (MAA)).

**Outcome measures**

The non-validated QA survey administered to each healthcare provider was a 6-item survey that was adapted from a prior study assessing whiteboard usage in PCNL that was set at a grade 7-8 reading level (Supplementary Figure 3).[9] The survey contained a pre-operative section with 4 questions and a post-operative section with 2 questions which assess confidence in the correct surgical equipment being present on a 9-point Likert scale from 1-10. The exact same survey was re-administered in staff who had not used the whiteboard prior once they had used the whiteboard. Demographic information such as type of staff member, number of ureteroscopy cases participated in, years in urology, and years in current role.

The accuracy questionnaire is split into 5 equipment categories which include ureteroscope, wire, access sheath, ureteral catheter, and basket. For each of these categories a point is given for whether the equipment is correctly present or absent (ie. is a basket there if a basket was asked for), for whether the correct type of equipment is present (ie. sensor wire or amplatz wire), and for whether there is any extraneous equipment present (ie. two different types of wires when only one was asked for). This results in three different scales which have maximal scores of 5 and a total maximal score of 15. The attending surgeon completed the accuracy questionnaire at the end of each case included in the accuracy analysis.

Reported costs were based on charges for materials used in each case which were reported through Epic electronic health record software (Epic Systems; Verona, Wisconsin, USA). All costs were reported in Canadian dollars and only consisted of items that were opened, items brought into the OR but unopened were not included in case costs as these items were restocked. Implant costs (consisting of only stent-related costs), supply costs (consisting of all other case related costs), and total costs (consisting of implant costs and supply costs) were all reported. Similarly, procedural time was also ascertained from Epic electronic health record software. Interruptions were reported by the attending surgeon at the end of each cases and consisted of: 1) When the surgeon indicated a specific item should be opened prior to starting the case and the wrong item was opened 2) When the surgeon asked for an item to be available but unopened and upon requesting this item is opened it was the wrong item 3) When the surgeon asked for an item to be present in the room but it was not present when asked for 4) When the surgeon asked for an item to be retrieved from the supply area and the wrong item was retrieved.

**Statistics**

A sample size calculation was performed based on detecting a 1-point change between the groups with 80% power and an alpha value of 0.05. Based on this and the 1:2 ratio for pre: post-whiteboard surveys we found a sample size of 12 pre-whiteboard and 24 post-whiteboard surveys was required.[14] A similar method was applied for the accuracy scores except with a 1:1 ratio and found that 15 scores from each group would be needed.

Demographic information, survey confidence scores, and accuracy scores were reported through descriptive statistics and frequency distributions. Demographics and survey confidence scores were compared between the two groups (previously used the whiteboard vs. never used the whiteboard) using two-tailed t-tests for quantitative data and Fisher's exact tests or Chi-squared tests for qualitative data. Meanwhile, demographic information, survey confidence scores, and accuracy scores were also compared between pre-whiteboard and post-whiteboard using two-tailed t-tests with Cohen's *d* testing of effect sizes for quantitative data and Fisher's exact or Chi-squared tests for qualitative data. All hypothesis tests used an *a priori* alpha value of 0.05, these tests were performed using R version 4.3.3 (R Foundation for Statistical Computing, Vienna, Austria) in the Rstudio 2024.04.0 environment (Posit PBC, Boston, MA, USA).

**RESULTS**

Of the thirty-three OR staff who completed the survey, eighteen had never used the whiteboard before and of those sixteen completed both the pre-whiteboard and post-whiteboard surveys. Fifteen OR staff who had used the whiteboard before completed the post-whiteboard survey. In total, eighteen pre-whiteboard responses were collected, and thirty-one post-whiteboard responses were collected. The sample consisted of 30 nurses, 1 fellow, and 2 attending physicians with a combined average of 6.79 ± 7.15 years working in their current role and 7.41 ± 7.07 years working in urology or ureteroscopy. Furthermore, 6 participants had been involved in <100 ureteroscopy cases, 5 had been involved in 100-500 cases, 9 had been involved in 500-1000 cases, and 11 had been involved in >1000 cases. Demographic variables between those with no prior use and those with prior whiteboard use were also evaluated statistically, the groups were statistically equivalent apart from average years in current role ($p = 0.047$, CI[-10.389, -0.078]) (Table 1).

Of the 50 ureteroscopy cases evaluated for equipment accuracy, all procedures were performed for the primary indication of stone removal and none of the cases required pre-stenting. In the whiteboard group 32% were bilateral and 24% in the control group were bilateral ($p = 0.754$, CI[0.363, 6.338]). A ureteral access sheath was used in 88% of whiteboard cases and 76% of non-whiteboard cases ($p = 0.464$, CI[0.062, 2.398]. Additionally, for the whiteboard group 24% of the cases were done with a rigid ureteroscope and 88% were done with a flexible ureteroscope while in the non-whiteboard group 32% were done with a rigid and 76% were done with a flexible ($p = 0.547$, CI[0.385, 6.415].

For the QA survey administered both pre- and post-whiteboard, there were significant improvements on each question (Table 2). For the first question (assessing pre-operative

confidence that all possibly used equipment was in the room), there was an average 4.50-point increase from pre- to post-whiteboard (Cohen's $d = 0.545$, $p < 0.001$, CI[-5.386, -3.621]). For the second question (assessing pre-operative confidence that all required open equipment is present on the surgical table), there was an average 3.99-point increase from pre- to post-whiteboard (Cohen's $d = 0.052$, $p < 0.001$, CI[-4.956, -3.015]). For the third question (assessing pre-operative confidence that nothing unnecessary has been opened), there was an average 4.41-point increase from pre- to post-whiteboard (Cohen's $d = 0.287$, $p < 0.001$, CI[-5.432, -3.393]). For the fourth question (assessing pre-operative efficacy of surgeon communication regarding what is required for the procedure), there was an average 3.74-point increase from pre- to post-whiteboard (Cohen's $d = 0.107$, $p < 0.001$, CI[-4.638, -2.868]). For the fifth question (assessing post-operative efficacy of surgeon communication), there was an average 3.35-point increase from pre- to post-whiteboard (Cohen's $d = 0.043$, $p < 0.001$, CI[-4.099, -2.600]). Lastly, for the sixth question (assessing what extra measures can be taken to improve communication of equipment needs), there was a significant difference in the distribution of suggestions with far more staff suggesting no changes are needed from pre- to post whiteboard ($p = 0.001$).

Post-whiteboard responses were also compared among those with no prior whiteboard use and those with prior whiteboard use to ensure that there were no differences between the study groups in assessing whiteboard efficacy. There were no significant differences between the groups in terms of post-whiteboard QA survey responses (Supplementary Table 1).

Surgical accuracy outcomes were compared between 25 cases without whiteboard use and 25 cases with whiteboard use (Table 3). The overall equipment accuracy score had an average 2.80-point increase in procedures with the whiteboard compared to procedures without (Cohen's $d = 1.350$, $p < 0.001$, CI[-3.982, -1.618]). Furthermore, the sub-score for required equipment being correctly present or absent had an average 0.72-point increase in procedures with the whiteboard compared to procedures without (Cohen's $d = 0.802$, $p = 0.007$, CI[-1.230, -0.210]). The sub-score for the correct equipment type being present had an average 1.32-point increase in procedures with the whiteboard compared to procedures without (Cohen's $d = 1.280$, $p < 0.001$, CI[-1.905, -0.735]). The sub-score for extraneous equipment being present had an average 0.72-point increase in procedures with the whiteboard compared to procedures without (Cohen's $d = 0.959$, $p = 0.001$, CI[-1.147, -0.293]). Additionally, the number of equipment-related interruptions was an average 0.72 greater in procedures without the whiteboard compared to those with the whiteboard (Cohen's $d = -0.917$, $p = 0.002$, CI[0.273, 1.167]). Case costs were reduced in procedures with whiteboard use with a 25% decrease in overall costs (supply + implant costs) with whiteboard use (Cohen's $d = 0.692$, $p = 0.018$, CI[30.661, 313.099]). There was a 27% decrease in supply costs with whiteboard use (Cohen's $d = 0.689$, $p = 0.019$, CI[28.161, 295.119]) but no significant difference in implant costs. Lastly, there was also no significant difference in average case time between the groups.

## DISCUSSION

This study assessed the efficacy of integrating an equipment whiteboard in ureteroscopy with respect to OR staff opinions of efficacy, objective accuracy scores, and case costs. We found significant improvements in pre-operative and post-operative measures of OR staff confidence and feelings surrounding the efficacy of communication with the whiteboard compared to without the whiteboard. Equipment accuracy was also improved with the whiteboard and there were fewer interruptions and decreased case costs.

Improved OR staff communication has been shown to positively improve patient satisfaction, physical health outcomes, and mental health outcomes.[15] Our findings with respect to OR staff perceptions surrounding whiteboard use are consistent with prior research on whiteboard use in both surgical and non-surgical settings. Several prior studies on whiteboard use in surgical settings have reported significant positive outcomes with respect to outcomes surrounding efficacy of interdisciplinary communication, case flow, and case preparedness.[9,16,17] Furthermore, whiteboards established for communication purposes in other settings such as emergency rooms and during transitions of care have further shown significant positive outcomes with regards to interdisciplinary communication and overall staff satisfaction with transfers of care.[18,19] Our study findings support the prior literature and demonstrate the efficacy of whiteboard use in a high volume academic OR environment with highly variable equipment needs from case to case.

Few studies have evaluated objective accuracy of patient care outcomes with respect to whiteboard use for communication. Equipment accuracy is an example of a measure that has been suggested in prior literature to be associated with better patient outcomes.[20] One such study by Guo et al. similarly demonstrated in the setting of PCNL that whiteboard use significantly improved equipment accuracy, however, these findings were only significant when all accuracy measures were combined.[9] Our findings further demonstrated that in the context of ureteroscopy, sub-scores of equipment accuracy were also significantly improved in addition to overall equipment accuracy – likely owing to the variability of ureteroscopy equipment requirements and small sample size of the prior study. Outside of surgical settings, prior research has shown improvements in patient outcomes with respect to fertility clinic and inpatient management settings when communication tools are used.[21–23] Our study demonstrated that there are benefits with regard to equipment accuracy. While the study was not adequately powered to detect changes in operative time future studies could be conducted to evaluate this outcome given the reduction in case interruptions and improved equipment accuracy.

Managing case costs is a critical healthcare system issue whether you are working within a public or private healthcare system. The limited resources of many public healthcare systems including Canada's have been associated with poor patient outcomes and influence patient perspectives on receiving timely surgical care.[24,25] As such, several prior studies have evaluated the use of cost-saving interventions – particularly in the context of surgical care. One such prior study in a pediatric urology setting demonstrated cost reductions associated with decreased

equipment waste of 39%.[26] In addition, a prior ureteroscopy study demonstrated a $440 reduction in case cost by safely reducing case duration.[27] By comparison, cost savings associated with whiteboard integration were quite modest but required limited change to patient care processes minimizing risks to patients.

Despite the positive findings of our study in favour of whiteboard usage in the OR, the study had several limitations. Foremost was the sample utilized, although we intended for a variety of OR staff to complete the QA survey most responses came from nursing staff alone. As such, the results are not generalizable to all health care providers (residents, fellows, and attending physicians). Adding to this, there is a potential learning effect from case to case for OR staff who were a part of numerous study cases and limited ability to conceal the group allocation for each case from OR staff. There was also a significant difference between those who had prior whiteboard use and those who did not with regards to the number of years in their current role and therefore the two groups were not completely equivalent in terms of key demographic variables and familiarity with ureteroscopy. Additionally, we used non-validated qualitative surveys. Further studies would be needed to validate these surveys for generalizing the findings to other centers. Furthermore, the accuracy scores were also an unvalidated measure and were completed by the attending surgeon which introduced expectancy bias. Another confounder is the degree of variability between ureteroscopy cases. Since we were only able to collect accuracy, cost, interruption frequency, and case time data from 50 total procedures it was not possible to control or match for the types of cases (i.e distal stone vs. proximal), patient specific factors (type of stone formed), and other confounding factors in the analysis. Additionally, both paired and unpaired samples were included in the unpaired analysis. However, due to the potential sample available at a single site (ie. only a limited number of OR staff working in urology) it was not possible to generate a sufficient sample to separate these analyses into paired and unpaired. The sample size calculation was also performed in an unpaired fashion. A final major challenge was the fact that the whiteboard had already been integrated into practice at our institution. As such we compared two different samples in analyzing the change from pre- to post-whiteboard and while analysis was done to ensure this did not significantly influence results there may be some preconceived perceptions on the whiteboard usage prior to having used it.

## CONCLUSIONS

We implemented a ureteroscopy equipment whiteboard for use in urology OR settings to improve efficacy of communication and reduce costs and interruptions associated with equipment inaccuracies. Through QA survey's given to OR staff, an equipment accuracy measure, and case data we found that the whiteboard significantly improved OR staff confidence, perceptions of communication, and objective equipment accuracy. It further reduced the number of equipment related interruptions throughout the procedure and reduced case costs. As such, integration of ureteroscopy equipment whiteboards were an effective modality for improving OR communication and efficiency at our center.

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## FIGURES AND TABLES

| Table 1. Demographics for prior use of whiteboard and no prior use of whiteboard | | | | |
|---|---|---|---|---|
| **Demographic variable** | **No prior whiteboard use (n=18)** | **Prior whiteboard use (n=15)** | **p** | **95% CI[a]** |
| **Staff role** | | | | |
| Nurse | 15 | 15 | 0.489 | NA |
| Fellow | 1 | 0 | | |
| Attending | 2 | 0 | | |
| Average number of years in current role (± SD)[b] | 4.27±9.27 | 9.04±6.79 | **0.047*** | [-10.389, -0.078] |
| Average number of years in urology/ ureteroscopy-related surgery (± SD)[b] | 5.80±3.69 | 9.27±9.00 | 0.209 | [-8.674, 1.989] |
| **Number of previous ureteroscopy procedures previously involved with[c]** | | | | |
| <100 | 5/17 (29%) | 1/14 (7%) | 0.245 | NA |
| 100−500 | 2/17 (12%) | 3/14 (21%) | | |
| 500−1000 | 6/17 (35%) | 3/14 (21%) | | |
| >1000 | 4/17 (24%) | 7/14 (50%) | | |

[a]95% confidence interval only possible for continuous variables. [b]Not all respondents completed this question (3 with no prior whiteboard use and 1 with prior whiteboard use did not complete). [c]Not all respondents completed this question (1 with no prior whiteboard use and 1 with prior whiteboard use did not complete). *p<0.05, **p<0.01, ***p<0.001. CI: confidence interval; SD: standard deviation.

| Table 2. Quality assessment survey results with and without whiteboard | | | | |
|---|---|---|---|---|
| **Survey question** | **Without any prior whiteboard use (n=18)** | **With whiteboard use (n=31)** | **p** | **95% CI[a]** |
| **Preoperative questions (mean ± SD)** | | | | |
| 1. How confident are you that all equipment potentially required for the procedure is present in the operating room (1-10) | 4.72±1.96 | 9.22±1.10 | **<0.001*** ** | [-5.386, -3.621] |

| | | | | |
|---|---|---|---|---|
| 2. How confident are you that all required open equipment is present on the surgical table (1-10) | 5.11±2.03 | 9.10±1.33 | **<0.001***** | [-4.956, -3.015] |
| 3. How confident are you that nothing unnecessary has been opened on the surgical table (1-10) | 4.56±1.95 | 8.97±1.53 | **<0.001***** | [-5.432, -3.393] |
| 4. How well did the surgeon communicate what equipment was required (1-10) | 5.67±2.20 | 9.41±0.83 | **<0.001***** | [-4.638, -2.868] |
| **Postoperative questions (mean ± SD, %)** | | | | |
| 1. Do you think the surgical team communicated what equipment was required to a satisfactory level (1-10) | 6.17±1.82 | 9.52±0.76 | **<0.001***** | [-4.099, -2.600] |
| 2. What can be done to improve the accuracy of equipment in these cases (select all that apply) | | | | |
| No change needed | 4/18 (22%) | 17/31 (55%) | | |
| Whiteboard with list of supplies for each case | 12/18 (67%) | 17/31 (55%) | | |
| Team huddle with entire OR team at start of day | 13/18 (72%) | 3/31 (10%) | **0.001**** | NA |
| Team huddle before each case | 11/18 (61%) | 6/31 (19%) | | |
| Other | 1/18 (6%) | 1/31 (3%) | | |

[a]95% confidence interval only possible for continuous variables. *p<0.05, **p<0.01, ***p<0.001.
CI: confidence interval; SD: standard deviation.

**Table 3. Surgical accuracy outcomes with and without whiteboard**

| **Outcome** | **Without whiteboard use (n=25)** | **With whiteboard use (n=25)** | **p** | **95% CI[a]** |
|---|---|---|---|---|
| Average total score on equipment accuracy tool (/15) | 10.96±2.54 | 13.76±1.48 | **<0.001***** | [-3.982, -1.618] |
| Average score on equipment correctly present or absent (/5) | 3.88±1.09 | 4.60±0.65 | **0.007**** | [-1.230, -0.210] |
| Average score on correct equipment type (/5) | 3.12±1.27 | 4.44±0.71 | **<0.001***** | [-1.905, -0.735] |

| | | | | |
|---|---|---|---|---|
| Average score on extraneous equipment present (/5) | 4.00±0.91 | 4.72±0.54 | **0.001**** | [-1.147, -0.293] |
| Average number of interruptions | 1.08±0.95 | 0.36±0.57 | **0.002**** | [0.273, 1.167] |
| Average case time | 28.6±16.17 | 26.2±14.78 | 0.587 | [-6.411, 11.211] |

[a]95% confidence interval only possible for continuous variables. *p<0.05, **p<0.01, ***p<0.001.
CI: confidence interval; SD: standard deviation.