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# Investigation of a Novel Activity-Based Checks (ABC) Functional Pain Scale in the Post-Operative Urologic Surgery Patient

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## ABSTRACT

**Introduction.** The authors investigated a novel functional pain scale, the Activity-Based Checks (ABCs) of Pain, following open urologic surgery. The primary objectives were to establish the strength of the correlation between the ABCs and the numeric rating scale (NRS) and determine the impact of functional pain on the patient's opioid requirements. We hypothesized that ABC score would correlate strongly with NRS and that the ABC score during hospitalization would be more closely correlated with the number of opioids prescribed and used.

**Methods.** This prospective study included patients at a tertiary academic hospital undergoing nephrectomy and cystectomy. The NRS and ABCs were collected pre-operatively, during the inpatient stay, and at the one-week follow-up. Milligrams of morphine equivalents (MMEs) prescribed at discharge and the MME reportedly taken during the first post-operative week were recorded. Spearman's Rho was used to assess the correlation between scale variables.

**Results.** Fifty-seven patients were enrolled. The ABCs correlated strongly with the NRS at baseline and post-operative appointments ($r = 0.716$, $p < 0.001$ and 0.643, $p < 0.001$). Neither the NRS nor the composite ABCs score was predictive of outpatient MME requirements; the ABCs function, "Walking outside the room" significantly correlated to MMEs taken after discharge ($r = 0.471$, $p = 0.011$). The greatest predictor of MMEs taken was the number of MMEs prescribed (0.493, $p = 0.001$).

**Conclusions.** This study highlighted the importance of post-operative pain assessment that takes functional pain into consideration to evaluate pain, inform management decisions, and reduce opiate reliance. It also emphasized the strong relationship between opioids prescribed and opioids consumed. ***Kans J Med 2023;16:35-40***

## INTRODUCTION

While patients may not anticipate significant pain following surgery, it is an expected part of the healing process.[1] In response to concerns regarding the undertreatment of pain, the Joint Commission, a non-profit organization that accredits healthcare organizations and programs, recognized pain as a fifth vital sign in 2001. Routine assessment of pain and prompt treatment quickly became an expectation and metric of health care quality.[2]

Many see the Joint Commission's paradigm shift on pain and the ensuing reliance on numeric pain scales as one catalyst of the current opioid epidemic in the United States.[2,3] A recent study found that 76% of patients in the U.S. who received low-risk procedures filled a prescription for opioids within seven days of the operation.[4] Approximately 6% of opioid naïve patients become new persistent opioid users after post-operative opioid usage, and evidence suggested that 67% to 92% of the opioids prescribed in the post-operative setting go unused.[5,6] In the last 20 years, the number of overdose deaths involving prescription opioids has increased five-fold.[7] As post-operative opioid prescription could lead to new persistent users and increase the overall burden of opiates in the community, the surgical setting should be a key area of focus in attempts to counter the current epidemic.

The most-prominent scale for measuring pain is the 10-point numeric rating scale (NRS).[8] Its use is nearly ubiquitous in the health care setting. This type of scale has been validated and is easy to use. Unfortunately, the simple NRS often lacks the depth necessary for meaningful pain assessment, as an individual's knowledge and beliefs, including expectations of pain, desire to avoid being labeled a "complainer", wanting to be a "good patient", or anticipation of undertreatment, often influence a patient's reported pain level.[9] Without functional or objective markers, pain measurement is at the mercy of these subjective factors and individual variation.[10]

The Activity-Based Checks of Pain Functional Pain Assessment Tool (ABCs) was developed to address the need for pain assessment that is linked to meaningful perioperative metrics. This highly visual, infographic-based tool links functional measures to felt pain. The purpose of this study was to pilot the ABCs in perioperative urologic surgery patients and evaluate its use in clinical practice. Of note, a similar study using a modified ABCs tool was conducted at the same institution in a hip arthroplasty cohort.[11] The primary objective of our study was to establish the strength of the correlation between the ABCs and NRS. A secondary objective was to determine if pain with specific activities, lying down, sitting up, walking inside the room, impacted outpatient opioid requirements.

## METHODS

This study was a single-institution, prospective, observational cohort study to field test the ABCs in patients undergoing open urologic surgery. All study activities were approved by the study site's Institutional Review Board.

**Setting and Population.** This study was conducted in an urban, academic hospital. All patients between the ages of 18 and 90, scheduled to undergo nephrectomy or cystectomy, and fluent in English, were eligible for inclusion. Nephrectomy and cystectomy were chosen because they are analogous procedures and were hypothesized to produce similar amounts and types of pain. Exclusion criteria consisted of baseline Eastern Cooperative Oncology Group (ECOG) performance status ≥ 3 (incapable of all self-care activities)[12] and history of known pain disorders, chronic pain medication abuse, dementia, neurocognitive disorders, and diagnosis of depression or anxiety. Patients also were excluded if they were unable/unwilling to provide accurate pill counts of outpatient pain medications used, as required by the study protocol. As this was a pilot study, no formal sample size calculation was performed, and enrollment goals were based on feasibility.

**Scale Formation.** Two authors (DW and JAV) developed the visual representation of the scale. The creation of the ABCs scale was informed by theories on cognitive load and dual code.[13,14] The scale assesses functional ability and associated pain levels for eight different post-operative activities. To establish face validity, a convenience sample of clinical faculty of the general surgery (n = 3), urologic surgery (n = 2), orthopedic surgery (n = 1), and otolaryngology departments (n = 4) assembled to determine post-operative priorities regarding functional recovery. After discussion, a consensus was achieved among the group with respect to key functional activities and modifications needed for procedures occurring at different anatomic subsites. The functions included were oriented such that tasks were easier at the top of the scale and increased in difficulty as they progressed down the page. The order of the functions was determined by the surgeons. The authors then calculated a composite numeric score for the completed scale; individual scores for each specific function also were calculated to determine correlations between specific actions and MME taken. Figure 1 is a graphic representation of the ABCs scale used for the urology cohort. Pain scores are recorded from 1-5. Numbers were intentionally left out to avoid biasing response. Instead, anchors were given such as: "No pain", "Worst Pain Before", and "New Worst Pain".

The visual nature of the ABCs was intended to maximize information uptake, limit literacy bias, and allow for a more precise assessment of pain. Tools that include visual aids transcend language and cultural barriers to limit this literacy bias.[15] Pictographs improve patient comprehension and yield better outcomes when incorporated into discharge instructions,[16] informed decision-making,[17] and medication adherence.[18]

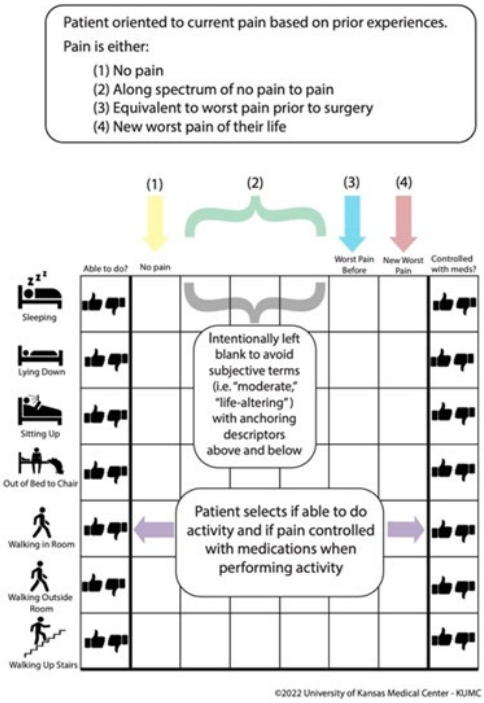


Figure 1. Annotated Activity-Based Checks (ABCs) of Pain.

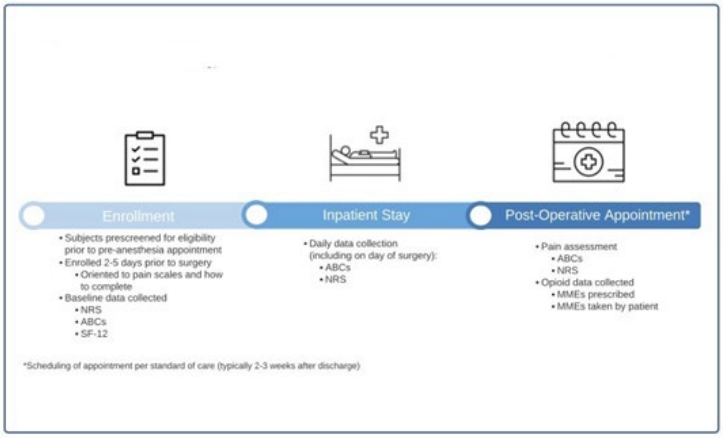


Figure 2. A visual representation of the timeline of events from patient enrollment to final postoperative appointment [PACU, pre-anesthesia care unit; NRS, numeric rating scale; MME, milligram morphine equivalents].

**Enrollment Process.** Eligible patients were identified and enrolled at their pre-operative appointments. The ABCs were reviewed with the subject in detail during this appointment to ensure patient understanding and proper completion throughout the study. At this visit, each subject completed the SF-12 Health Questionnaire, the 0-10 NRS, and the ABCs assessment. The SF-12 was used as a standard marker of overall health, while the NRS and ABCs were used to establish a pre-operative pain baseline.

**Hospital Stay.** The ABCs and NRS pain levels were collected for research purposes once daily until discharge. The natural history of post-operative pain during admission and pain during the 24 hours preceding discharge were collected. The treating surgical team was blinded to the ABCs data to avoid biasing treatment. Pain data collection for the purposes of this study was done by research personnel and not available for clinical review. Pain data, per standard of care practices, remained available for surgical teams to view in the electronic medical record.

**Post-operative Appointment.** Patients were scheduled for a post-operative follow-up visit per the treating surgeon's standard protocol. This universally occurred within 1-3 weeks of discharge. The ABCs and NRS pain scales were administered at this follow-up visit. Postoperative, opioid-based analgesic medications prescribed (name and dose), the MMEs prescribed, and the number of pills taken were recorded. Patients were asked to bring prescription bottles back and the number of pills was calculated based on missing pills. If the patients forgot to bring the pill bottle back, verbal responses were accepted.

**Data Analysis.** Study data were collected and managed using REDCap® electronic data capture tools hosted at the University of Kansas Medical Center.[19,20] Data were analyzed using SPSS Version 26 (Armonk, NY). Correlation of NRS and ABCs was assessed at preoperative and post-operative appointments. Additionally, correlations of specific ABCs functions and prescribed/taken MME were assessed for pre-operative, day of discharge, and post-operative appointment data. This analysis was repeated with post-operative functions with regard to MMEs prescribed and taken. All correlations were performed using Spearman's rho. Lastly, patients were categorized into high and low pain groups (High: > 6; Low: < 6). This grouping was based on the work of Hernandez-Boussard et al.[21] Patient age and SF-12 scores between pain groups were compared using Mann-Whitney U-tests. Significance was set a priori at $p < 0.05$.

## RESULTS

Seventy-three patients were enrolled in this study; 57 patients completed all surveys. The 16 patients lost to follow-up were not included in any data analysis. The median age of the patients was 67 years. Sixty-one percent of the patients were male, and 84% were white. The average length of stay was 3.81 days; all patients had at least 2 inpatient data points. Sixty percent of patients had a nephrectomy, and 40% had a cystectomy (Table 1).

**Table 1. Demographics.**

| Demographic Feature | No. (%), n = 57 |
|---|---|
| Median age, years, range | 67 (29-89) |
| Sex | |
| Male | 35 (61%) |
| Female | 22 (39%) |
| Ethnicity | |
| White | 48 (84%) |
| Black | 2 (3.5%) |
| American Indian | 5 (9%) |
| Other | 2 (3.5%) |
| Procedure Type | |
| Nephrectomy | 34 (60%) |
| Cystectomy | 23 (40%) |

The ABCs of Pain cumulative score was highly correlated to the NRS pain scale at baseline ($r = 0.716$, $p < 0.001$) and at the post-operative appointment (0.643, $p < 0.001$). The correlation between the two scales was correlated only moderately at the final inpatient measurement ($r = 0.331$, $p = 0.017$).

Neither the NRS nor the composite ABCs correlated with MMEs used following discharge. However, the last recorded inpatient score for the ABCs function, "Walking outside room", correlated significantly with MME taken ($r = 0.471$, $p = 0.011$). Age and SF-12 scores showed no correlation to pain medication use.

The greatest association of pain medication usage was the number of medications prescribed ($r = 0.493$, $p = 0.001$). The baseline ABCs functions titled "Sleeping" and "Out of Bed to Chair" showed a significant correlation to the MME prescribed by providers (Sleeping: $r = 0.285$, $p = 0.041$; Out of Bed to Chair: $r = 0.285$, $p = 0.038$). Additional data showing correlations between pain scales, specific functions, and MMEs prescribed and taken are displayed in Table 2 and Figure 3.

**Table 2. The Correlation Coefficients for Milligrams of Morphine Equivalents (MMEs) taken at follow-up appointment.**

| Variable | Correlation Coefficient |
|---|---|
| Age | -0.272 (p=0.085) |
| Physical SF-12 | -0.092 (p=0.579) |
| Mental SF-12 | 0.065 (p=0.695) |
| Follow-up ABCs Score | 0.192 (p=0.229) |
| Follow-up NRS Score | 0.141 (p=0.427) |
| MME Prescribed | *0.493 (p=0.001) |

*Statistical significance.

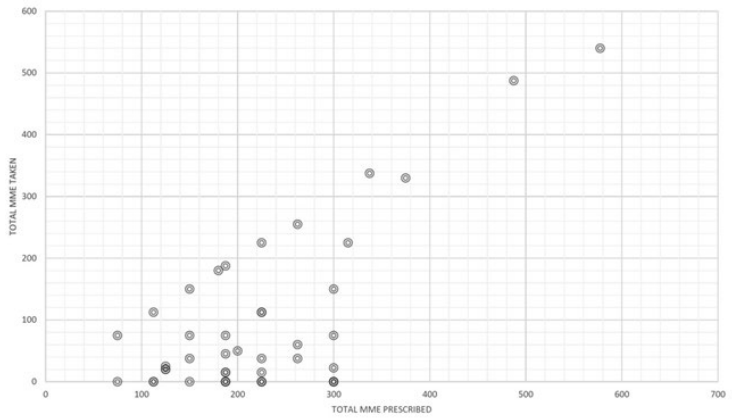


Figure 3. Total MME Prescribed vs. Total MME taken.

The median baseline scores were 0.00 and 0.663 for the NRS and ABCs, respectively. Median discharge scores were 3.00 (NRS) and 2.54 (ABCs). While the highest reported discharge score for the ABCs was 8.52, seven patients recorded an NRS score of > 8 at discharge. Additional pain data is displayed in Table 3.

**Table 3. Comparative Ranges of the Numeric Rating Scale (NRS) and Activity Based Checks (ABCs) at different time points in the study.**

| | Baseline Median (IQR)* | Discharge Median (IQR)* |
|---|---|---|
| NRS | 0.00 (IQR: 0.0-2.5) | 3.00 (IQR: 1.0-6.0) |
| ABCs | 0.663 (IQR: 0.0-2.3) | 2.54 (IQR: 1.6-4.2) |
| | Baseline Minimum | Baseline Maximum |
| NRS | 0 | 8 |
| ABCs | 0 | 10 |
| | Discharge Minimum | Discharge Maximum |
| NRS | 0 | 10 |
| ABCs | 0.21 | 8.52 |

*Median Interquartile Range.

Patients who reported "high pain" (NRS ≥ 6) at baseline were significantly younger and reported lower Mental SF-12 scores than those with "low pain". However, the last post-operative inpatient score revealed that the patients who reported "high pain" (NRS ≥ 6) were most distinguished by their significantly lower baseline Physical SF-12 score (Table 4). At follow-up, no patients reported "high pain."

**Table 4. Key differentiators between 'Low Pain' and 'High Pain' groups at baseline and before discharge.**

| Baseline | Age1 | Physical SF-121 | Mental SF-121 |
|---|---|---|---|
| "Low Pain" (NRS < 6) | 68.00 | 43.92 | 50.95 |
| "High Pain" (NRS > 6) | 56.00 | 34.51 | 33.22 |
| | p = 0.035* | p = 0.402 | p = 0.021* |
| **Pre-Discharge** | **Age** | **Physical SF-12** | **Mental SF-12** |
| "Low Pain" (NRS < 6) | 68.00 | 47.85 | 50.20 |
| "High Pain" (NRS > 6) | 63.00 | 35.40 | 52.94 |
| | p = 0.124 | p = 0.013* | p = 0.682 |

[1]Values based on Median Interquartile Range.
*Significant results.

## DISCUSSION

Current, commonly employed methods for pain assessment, such as the Wong-Baker Faces pain scale or NRS are unidimensional and provide practitioners with limited data to inform clinical decisions. This study was the continuation of a multi-branch study to investigate the ability of a novel, infographic-based, functional pain scale, the Activity Based Checks of Pain (ABCs), to measure peri-operative pain. Prior studies have investigated its use in orthopedic and general surgical patients.[11,22] In this study focusing on urologic patients, the ABCs correlated to the NRS scale at baseline and post-operative appointments. While neither scale displayed a significant correlation to MME prescribed or MME taken, specific functions (ABCs), such as "Walking outside the room", correlated significantly with MME prescribed and taken. Additionally, MMEs prescribed correlated strongly with MMEs taken, indicating that prescribing patterns may influence patient behavior. These findings were similar to those published previously from the ABCs studies.[11,22]

While there is growing recognition regarding the importance of functional pain assessment, there are no clear guidelines for which functions to include or how to assess them, particularly in the peri-operative setting.[3,23] Functions like "sitting up" and "ambulation" elicit dynamic pain that may be directly relevant to post-operative recovery; these functions cannot be specifically captured by the NRS.[23,24] This study illustrated the point in the observed correlation between the measured function, "Walking outside room", and patient MME needs.

In response to this shortcoming of commonly used scales, several functional measures have been proposed previously. One of the more-cited scales is the Brief Pain Inventory (BPI). The BPI is a prompt-based questionnaire, the style of which limits its practicality in a post-operative setting.[25] The Functional Pain Assessment Scale[26] asks non-specifically about "activities [which] pain limits you from doing", but the vague nature of the questions does not allow for pain to be assessed in a standardized manner. It also features written prompts, which may not be ideal depending on the context in which the assessment is used. Many other functional pain scales only assess for one specific type of pain. These scales inherently are restricted in their ability to address more generalized procedures. The conjunction of this study with a recent publication of the ABCs in a hip arthroplasty cohort demonstrated the versatility, practicality, and uniformity of the ABCs scale.[11]

The conventional NRS dictates that a pain level of eight or greater is considered severe and in need of intervention. In our study, seven patients were discharged with a last-recorded pain score > 8 without proportionately higher MMEs prescriptions. These findings were in agreement with prior studies demonstrating that post-operative pain is not managed adequately in up to 80% of patients.[27,28] Many post-surgical pain management guidelines developed in the past five years are procedure-specific; they do not incorporate patient pain data into their recommendations. The Michigan Open database simply recommends prescribing 0 - 75 MMEs following prostatectomy.[29] This information was concerning for multiple reasons. High pain levels at discharge are associated with increased readmissions. In a study by Hernandez-Boussard et al.[21], patients discharged with NRS pain levels > 6 were four-fold more likely to have pain-related readmission. They also experienced a 50% increased risk of readmissions for any other reason or emergency department visits. Patients reporting high pain levels often have expectations for treatment or harbor concerns that should be addressed.[30] Tano et al.[31] reported that "Inadequate assessment and management of post-operative pain can cause sleep disturbances and mobilization difficulties, restlessness, irritability, aggression...which in turn hinders patients' satisfaction of pain management." More meaningful pain assessment may reduce the medicolegal risk of discharging a patient with a high NRS pain level, particularly if functional data is reassuring.

Overall well-being influences patient pain experience. This was evidenced by the correlation between low baseline physical SF-12 scores and higher pain levels at discharge found in this study. This correlation of higher pain with lower overall physical and mental health has been demonstrated consistently in other studies.[32,33] Pain assessment should incorporate both functional and overall well-being metrics.

**Limitations.** This study was conducted at a single academic institution and included a relatively small number of participants. One limitation was that the pain scales were not able to be collected at a uniform time of the day (i.e., consistently before or after pain medication, before or after activity such as physical therapy). The amount of opioids taken was measured by the difference between the number of pills prescribed and the number left in the bottle at the post-operative appointment. If the bottle was left at home, a patient verbal count was used. This could introduce some errors to the calculation of total opioids taken.

A power analysis was not performed based on general guidelines for pilot studies, particularly when there is no true "gold standard" against which to compare a new tool or intervention.[34] These factors may limit overall generalizability. The study population was skewed towards men, which is reflective of the overall population presenting for the target surgical procedures. Additional studies will be needed to replicate these findings in women. Additionally, this study lacked other methods for validation, such as test-retest and interrater reliability. The performance of these procedures was not feasible given the low levels of baseline pain and the constantly changing nature of post-operative

pain, which would have confounded attempts at establishing test-retest reliability. To enhance the reliability of results, all administrators of the scale were trained.

**Future Directions.** This study aimed to address the need for clinically meaningful pain metrics with specific peri-operative clinical correlations. Future studies should include focus groups with patients and physicians. A key factor in better pain assessment is the ability to measure what the patient and physician consider important. Additional studies with larger sample sizes also need to be performed following this pilot study. This should be done to validate the ABCs of Pain and explore the other factors that contribute to post-operative medication consumption. Finally, the ABCs should be piloted in various other settings to determine the efficacy of their transfer to a broad variety of specialties and procedures.

## CONCLUSIONS

Pain assessment is a critically important and highly nuanced element of the post-operative period. This study and others published as part of the larger study demonstrated variability in clinician MME prescribing patterns as well as patient utilization of these medications. This study showed that the NRS scale and ABCs were highly correlated at baseline and post-operative assessment. Interestingly, the strongest predictor of MMEs taken was MMEs prescribed, regardless of patient-reported pain via either scale. The ABCs functional measure "Walking outside room" on the day of discharge correlated with outpatient MME consumption. Taken together, these findings highlighted the importance of holistic patient assessment and clinician stewardship of opioids, along with the need to assess pain more meaningfully with improved tools, like the ABCs. This study also highlighted the importance of clinician prescribing patterns in how patients manage their pain following hospital discharge.

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The ABCs of Pain is the intellectual property of the first author and the senior author. However, the tool has not been monetized, and no financial gain has occurred. Dr. Villwock is support by an NIH KL2 award (KL2 TR002367).

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