

Ergonomic Risk During Bedside Clinical Procedures: A Pilot Study of Emergency Department Clinicians

Moaddel V, Leach E, Rezmer B, Trop B, Sena A, Khalil F, Kuk C, Gagrica M and Jones JS*

Michigan State University College of Human Medicine; Corewell Health - Michigan State University Emergency Medicine Residency Program, Grand Rapids, MI, USA

Citation: Moaddel V, Leach E, Rezmer B, et al. Ergonomic Risk During Bedside Clinical Procedures: A Pilot Study of Emergency Department Clinicians. *Medi Clin Case Rep J* 2026;4(3):1949-1952. DOI: doi.org/10.51219/MCCRJ/Jeffrey-Jones/519

Received: 19 August, 2026; **Accepted:** 24 August, 2026; **Published:** 26 August, 2026

*Corresponding author: Jeffrey Jones, MD, 15 Michigan St NE Suite 736A, Grand Rapids, MI 49503, United States of America, Tel: +1-(616)-648-5384, Email: Jeffrey.Jones@corewellhealth.org

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ABSTRACT

Introduction: Ergonomic analyses are widely used in industry to reduce musculoskeletal injuries yet remain largely absent from healthcare settings. Clinicians performing bedside procedures across acute and ambulatory settings face sustained awkward postures, repetitive movements, and workspaces not designed around procedural ergonomics. Emergency departments may amplify these hazards because of time pressure, variable patient acuity, and constrained workspace. This study aimed to characterize ergonomic risk factors during routine bedside clinical procedures, using ED clinicians as a high-volume, heterogeneous procedural cohort.

Methods: his prospective, blinded, observational study was conducted over 4 months at two academic medical centers. Trained raters observed ED clinicians (faculty, residents, and advanced practice providers [APPs]) using the validated Rapid Entire Body Assessment (REBA) tool, which rates musculoskeletal risk from 1 (negligible) to 15 (very high). Clinicians were blinded to the study purpose. One-way ANOVA and chi-squared tests compared REBA scores across provider types.

Results: Eighty-nine providers performed 100 clinical procedures (e.g., laceration repair, intubation), including residents (39.3%), APPs (34.8%), and faculty (25.9%). Most procedures were performed while standing stationary (57.0%) or sitting without back support (40.0%). REBA scores did not differ significantly by training level (faculty 6.1 ± 0.9 ; residents 6.4 ± 1.0 ; APPs 5.9 ± 0.8). Overall, 40.4% of providers were at high risk (REBA >7) and 44.9% at medium risk (REBA 4–7), placing 85.3% in the medium-to-high risk range. The most frequent contributors to postural stress were awkward posture or movement (43%), suboptimal stretcher height (40%), and static positioning for more than one minute (27%).

Conclusions: Ergonomic risk during ED clinical procedures is prevalent across all provider types, regardless of training level. Sustained awkward postures increase the risk of fatigue, pain, and musculoskeletal injury. Most identified risk factors are modifiable through improvements in workspace design and targeted provider education.

Keywords: Musculoskeletal disorders; Occupational health; Ergonomics; Emergency medicine; REBA; Physician wellness; Prospective

Introduction

Ergonomics - the scientific study of people at work - aims to prevent soft-tissue injuries and musculoskeletal disorders (MSDs) caused by prolonged or sudden exposure to force, vibration, repetitive motion, and awkward posture¹. Some jobs are harder on the body than others. Workers in these environments report localized fatigue, persistent discomfort, and pain that a night's sleep does not relieve². OSHA has found that formal ergonomics programs reduce workers' compensation costs, increase productivity, and lower employee turnover³.

Across healthcare settings, clinicians who perform bedside or procedural work are exposed to ergonomic hazards that can contribute to musculoskeletal disorders. Hospitalists, intensivists, outpatient proceduralists, surgeons, dentists, therapists, nurses, and emergency medical services personnel commonly work in environments that require repetitive movements, sustained static positions, bending, reaching, and other awkward postures^{2,3}. These exposures are often compounded by patient-related factors, time constraints, fixed equipment, and limited ability to optimize work height or positioning. Although the specific tasks differ across specialties, the underlying ergonomic risks are shared and may contribute to fatigue, discomfort, injury, and loss from clinical practice.

Most published work on healthcare ergonomics focuses on nurses. Work-related injuries drive up to 20% of nurses out of direct care roles⁴. Back injuries alone cost the healthcare sector an estimated \$20 billion annually. Low-back pain is the most common occupational musculoskeletal complaint among healthcare workers. EMS personnel report similar injury patterns, largely linked to patient handling and body mechanics during transport⁵. Procedural ergonomics among nonoperative physicians and advanced practice providers remains comparatively understudied.

This pilot study aimed to assess the prevalence of ergonomic risk factors among ED clinicians during routine clinical procedures. We hypothesized that awkward procedural postures would be common across all provider types and that risk would not differ meaningfully by training level.

Methods

Study design and setting

We conducted a prospective, blinded, pilot observational study over four months at two academic medical centers in West Michigan: a children's tertiary care facility and a university-affiliated adult ED. Medical students conducted observations as part of a structured research program. The Corewell Health Institutional Review Board (IRB) reviewed and approved the protocol. Because we did not perform any interventions on patients or providers, the study was deemed minimal risk.

Participants

We observed ED clinicians performing routine procedures during the observation period. This included faculty, residents at any postgraduate year, and advanced practice providers (APPs-nurse practitioners and physician assistants). Providers were observed during naturally occurring procedures. They knew observation was occurring but were not told that ergonomics was the focus. No one was excluded based on specialty, gender,

or seniority. Patients were not study subjects, and no patient data were collected.

Ergonomic assessment tool

Trained student observers used the Rapid Entire Body Assessment (REBA) to score each procedure. Developed by Hignett and McAtamney (2000), the REBA is a validated tool that rates posture-related musculoskeletal risk across the neck, trunk, legs, upper arms, lower arms, and wrists⁶. It captures both static and dynamic postures. Scores range from 1 to 15: 1 is negligible risk, 2-3 low, 4-7 medium, 8-10 high, and 11-15 very high. A score above 7 calls for prompt corrective action. The REBA worksheet and step-by-step guide to the REBA tool can be downloaded here.

Before entering the clinical setting, observers completed training that covered REBA scoring criteria and practiced with reference images and case vignettes. Observations were nonconsecutive and spanned shift types and procedure categories.

Data collection

For each procedure, the observer recorded provider type, procedure type, body position (standing stationary, sitting with back support, sitting without back support, or other), and the completed REBA checklist. Contributors to postural stress were logged against a predefined list of eleven ergonomic risk categories^{1,2,7}. One investigator met frequently with the students to ensure consistent abstraction and coding.

Statistical analysis

The primary outcome was the REBA score for each observed procedure, compared across provider types (faculty, residents, and APPs) using one-way ANOVA. Secondary outcomes included: (1) the proportion of providers scoring as medium (REBA 4-7), high (REBA 8-10), or very high risk (REBA 11-15); (2) the distribution of body positions during procedures; and (3) the frequency of individual ergonomic risk contributors, as categorized on the REBA checklist.

We determined the sample size a priori using Cochran's formula for proportions, assuming a conservative 50% prevalence. We needed approximately 75 participants to achieve 95% confidence that the true value falls within $\pm 10\%$ of the measured value. Categorical variables were compared across provider groups using chi-squared tests. Continuous data are reported as mean $\pm$ SD. A p-value below 0.05 was considered statistically significant.

Results

Provider and Procedure Characteristics

We observed 89 providers performing 100 procedures. The group included residents (39.3%), APPs (34.8%), and attending faculty (25.9%). Procedures spanned common ED tasks, including laceration repair, incision and drainage, lumbar puncture, vascular access, airway management, and tube thoracostomy (**Table 1**). Most clinicians remained stationary at the bedside (57.0%) or sat without back support (40.0%) throughout their procedure. Sitting with lumbar support was rare, consistent with typical ED room layouts.

Table 1: Distribution of Observed Bedside Clinical Procedures.

Procedure category	n (%)
Laceration repair	31 (31%)
Airway management/intubation	17 (17%)
Vascular access/central line placement	17 (17%)
Incision and drainage	12 (12%)
Pelvic examination	8 (8%)
Lumbar puncture	4 (4%)
Tube thoracostomy	3 (3%)
Hip reduction	2 (2%)
Arthrocentesis	1 (1%)
Other bedside procedures	5 (5%)

REBA Scores by Provider Type

REBA scores did not differ significantly by provider type. Faculty averaged 6.1 (SD 0.9), residents 6.4 (SD 1.0), and APPs 5.9 (SD 0.8), all within the medium-risk range (**Table 2**). In total, 40.4% of providers were at high risk (REBA >7) and 44.9% at medium risk (REBA 4–7), placing 85.3% in the medium-to-high range. Few providers were in the low-risk category.

Table 2: Mean REBA Scores by Provider Type

Provider Type	n (%)	Mean REBA Score (± SD)	Risk Category
Faculty	23 (25.9%)	6.1 ± 0.9	Medium
Residents	35 (39.3%)	6.4 ± 1.0	Medium
Advanced Practice Providers	31 (34.8%)	5.9 ± 0.8	Medium

No statistically significant difference in REBA scores among groups (one-way ANOVA, $p > 0.05$)

Contributors to postural stress

We categorized contributors to postural stress across 11 pre-specified domains (**Table 3**). Awkward posture or movement was most common (43%), followed by stretcher height problems (40%) and static positioning for more than one minute (27%). Waist twisting and bending occurred in 24% of observations, and poor patient positioning contributed to 23%. Sitting without lumbar support appeared in 15% of cases. Repetitive movements (12%), effortful motions (5%), hard contact surfaces (2%), and pushing or pulling equipment (1%) were less common. Patient lifting was not observed.

Table 3: Frequency of Ergonomic Risk Contributors During Clinical Procedures.

Risk Factor	Frequency (%)
Awkward posture or movement	43%
Stretcher height (non-adjustable or not adjusted)	40%
Static position for >1 minute	27%
Twisting at the waist and bending	24%
Suboptimal patient positioning	23%
Sitting without lumbar support	15%
Repetitive movements	12%
Exertion required for particular motions	5%
Excessive contact between body and surfaces	2%
Pushing/pulling heavy objects (e.g., stretcher)	1%
Lifting patients or managing uncooperative patients	0%

Data derived from REBA checklists completed during observations.

Discussion

More than 85% of clinicians observed during routine bedside procedures had REBA scores in the medium-to-high risk range. Although this pilot study was conducted in emergency departments, the findings may be relevant across clinical settings where clinicians perform procedures under time constraints and with limited control over workspace design. The most common contributors to postural strain-awkward posture or movement, suboptimal stretcher height, and prolonged static positioning—may occur in inpatient, ambulatory, critical-care, and specialty procedural environments^{2,3}. The ED provides a useful setting for evaluating these hazards because clinicians perform a wide range of time-sensitive procedures among patients of varying size, mobility, and acuity⁷; however, these findings should be considered hypothesis-generating and evaluated in diverse clinical settings.

This study extends the procedural-ergonomics literature to a high-acuity, high-turnover setting that includes physicians and advanced practice providers. The absence of meaningful differences in REBA scores by provider type suggests that clinical experience alone may not protect against ergonomic risk. Rather, these risks may reflect features of the procedural environment, such as equipment configuration, patient positioning, workspace constraints, and limited ergonomic training^{4,5}.

Several relatively simple workspace modifications may reduce these risks. Height-adjustable stretchers or examination surfaces, supply carts organized to minimize unnecessary reaching, and adjustable chairs with lumbar support could promote more neutral working postures during seated and standing procedures^{5,8,9}. Institutions should incorporate ergonomic principles into the design and routine setup of bedside procedural spaces and evaluate whether these changes improve clinician comfort, posture-based risk scores, and musculoskeletal outcomes¹⁰.

Provider education is also important. The absence of a training-level effect suggests that ergonomic awareness does not reliably develop from experience alone. Undergraduate, graduate, and continuing professional education programs should incorporate practical instruction in procedural ergonomics, particularly for clinicians who frequently perform bedside interventions¹¹. Training could emphasize preparing the procedural workspace, adjusting work height, positioning the patient and equipment, recognizing sustained awkward postures, and briefly repositioning during longer procedures^{4,5,8}. These strategies are low-cost and potentially scalable, though their effectiveness should be evaluated prospectively.

The occupational implications are substantial. Work-related musculoskeletal disorders are a major source of pain, functional limitation, disability, and workforce loss among healthcare personnel¹¹. Repeated exposure to awkward postures, static loading, and poorly configured clinical workspaces may contribute to cumulative physical discomfort over a clinician's career⁷. Ergonomic risk should therefore be addressed as part of clinician well-being, workplace safety, and retention efforts rather than as a peripheral operational concern⁹.

Several limitations should be considered. REBA scoring entails observer judgment, and interrater reliability was not formally assessed in this cohort, despite structured observer

training and investigator oversight. Observations were nonconsecutive, introducing potential selection bias, and the relatively small faculty sample limited power to detect differences among provider groups. The study was conducted at two academic sites in a single geographic region, which may limit generalizability. In addition, clinicians who recognized the observers may have modified their posture or behavior. Finally, this study did not measure self-reported symptoms, diagnosed musculoskeletal disorders, lost work time, or longitudinal injury outcomes; thus, it cannot establish a direct relationship between observed REBA scores and clinical harm^{12,13}.

Future studies should use larger, geographically diverse samples and standardized or stratified observation methods across multiple clinical settings. Comparing EDs with inpatient units, intensive care units, ambulatory clinics, and specialty procedure areas would help determine how well these findings generalize beyond emergency medicine. Formal assessment of interrater reliability, combined with clinician-reported pain and functional outcomes, would strengthen the validity and clinical relevance of future work¹³. Intervention studies evaluating workspace redesign, stretcher-height protocols, equipment placement, ergonomic education, or multimodal programs are needed to determine whether reducing posture-based risk translates into improved clinician comfort, lower musculoskeletal injury rates, and better workforce retention.

Conclusions

Awkward postures and other ergonomic risk factors were common during observed ED bedside procedures across faculty, resident, and advanced practice provider groups. REBA scores did not differ significantly by provider type, suggesting that clinical experience alone may not be sufficient to mitigate posture-related risk. Although this study did not measure musculoskeletal symptoms or injury outcomes, repeated exposure to awkward and sustained postures may contribute to fatigue, discomfort, and work-related musculoskeletal disorders.

Many identified risk factors are potentially modifiable. Adjusting stretcher height before a procedure, providing lumbar support for seated tasks, and organizing procedure carts to reduce unnecessary reaching are practical interventions that warrant prospective evaluation. Incorporating ergonomic principles into procedural education may help clinicians recognize and address modifiable risks during routine care. This pilot study provides a foundation for larger, multisite investigations and supports formal ergonomic assessment of bedside procedural environments, beginning with the ED.

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