



Quality Improvement

"Transforming Care at the Bedside: The Impact of the Medicine Bedside Procedure Service on Resident Training and Patient Outcomes"

Adrian P Umpierrez, MD¹, Sheila Swartz², Joseph Puetz², Lara Voigt³, Devin Madenberg², Ricardo Franco Sadud⁴

¹ Department of Medicine, Emory University,

² Department of Medicine, Medical College of Wisconsin,

³ Department of Medicine, The University of Texas at San Antonio,

⁴ Department of Medicine, Naples Community Hospital Healthcare System

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Abstract

Background: Hospitalized patients frequently require various medical procedures, including lumbar punctures, paracenteses, and pulmonary drains, with significant annual volumes in the U.S. While bedside procedures are generally safe, their complication rates range from 0.1% to 3%, depending on the procedure. The Medicine Bedside Procedure Service (MBPS) at the Medical College of Wisconsin/Froedtert Health System was established as a standalone service in 2015 to enhance the training of Internal Medicine (IM) residents in common bedside procedures and Point of Care Ultrasound (POCUS), while also aiming to reduce patient wait times for procedures and length of hospital stays. **Objective:** The study aimed to evaluate the development and implementation of the MBPS, focusing on the characteristics of the first 12,000 procedural encounters, the educational impact on IM residents, and the service's effects on patient outcomes. **Methods:** This retrospective study analyzed 12,387 procedural encounters involving 6,942 unique patients from September 2015 to June 2022. Patient demographics were assessed, including age, sex, race, language, payer status, and comorbidities. Descriptive statistics were utilized to summarize the data, including means and standard deviations for continuous variables and frequencies for categorical variables. **Results:** The patient demographic indicated a predominance of males (53.1%), non-Hispanic Whites (68.8%), and a significant portion covered by Medicaid (71.6%). The average patient age was 64.7 years. The MBPS performed an average of 5.2 procedures per day, with paracentesis (34.6%), thoracentesis (27.3%), and lumbar puncture (21.1%) being the most common procedures. The overall complication rate was low at 0.3%, with the majority of complications occurring in thoracentesis (56%). **Conclusions:** The MBPS has contributed to the educational development of IM residents, evidenced by their increased proficiency and procedural certification rates, while also improving patient outcomes, including reduced lengths of stay and hospital costs. The service has optimized patient flow and increased satisfaction through timely and safe procedural care. Despite challenges in fostering a supportive culture for bedside procedures and ensuring effective communication with interventional radiology, the MBPS exemplifies the advantages of bedside procedures. Moving forward, plans include expanding into outpatient settings and incorporating advanced POCUS capabilities to enhance diagnostic and therapeutic decision-making at the bedside. Limitations of this single-center study and lack of comparative groups suggest the need for further research to validate these findings across diverse healthcare settings.

INTRODUCTION

Hospitalized patients often require various medical procedures, with the United States seeing over 300,000 lumbar punctures, more than 150,000 paracenteses, and over 130,000 pulmonary drain placements annually.¹⁻⁴ Bed-

side procedures are generally regarded as safe, with complication rates for paracentesis, thoracentesis, central lines, and pulmonary drains ranging from 1% to 3%.⁵⁻⁸ In contrast, bone marrow biopsies and lumbar punctures report even lower complication rates of 0.1% and less than 0.1%, respectively.^{9,10}

The incorporation of ultrasound in many bedside procedures has become the standard of care, enhanced safety and reducing costs.^{6,11} For instance, one study found that thoracentesis procedures had an average hospital cost of \$11,786 when performed with ultrasound, compared to \$12,408 when done without it, due to a higher risk of pneumothorax as a complication. Similarly, utilizing ultrasound for paracentesis reduced hospitalization costs from \$9,848 to \$8,761 by decreasing complications.⁶

Many procedures that were once standard practice for general internists have shifted to specialists such as radiologists.¹² This trend is highlighted by a study by Kay et al., which indicated that 84% of common bedside procedures, including paracentesis, thoracentesis, and lumbar punctures, were referred to external services rather than performed by the primary care team. This shift has systemic implications, leading to a 41% increase in the average time required to complete procedures when performed by radiology instead of at the bedside, as well as an average cost increase of 56%.¹³

To address these issues, the Medicine Bedside Procedure Service (MBPS) was established as a standalone service in 2015. The service was developed with two main objectives: to enhance the educational experience of Internal Medicine residents in performing common bedside procedures and using Point of Care Ultrasound (POCUS), and to reduce the time from patient admission to procedure, thereby shortening the length of stay in hospitalist-run services. The MBPS is designed to meet these objectives while maintaining excellent patient outcomes, including low rates of complications, readmissions, and mortality. This paper aims to describe the development and implementation of the MBPS, as well as the characteristics of its first 12,000 procedural encounters.

METHODS

History of the Medical Bedside Procedures Service

The Medical College of Wisconsin (MCW) provides hospitalist services at Froedtert Memorial Lutheran Hospital, a large tertiary care teaching hospital with approximately 990 beds located in Milwaukee, Wisconsin. The Medical Bedside Procedures Service (MBPS) was established as a standalone service in 2015 by a group of hospitalists. Prior to those hospitalists performed procedures while managing direct patient care. By 2015, the MBPS had evolved into a standalone service, with all participating physicians trained in internal medicine. The original MBPS physicians independently developed their proficiency in performing procedures and utilizing ultrasound. Physicians who joined the MBPS after 2015 underwent a standardized onboarding process lasting 6 to 8 weeks. This training included two weeks of working

with an experienced proceduralist for hands-on training on all procedures, with direct supervision for all procedures performed by junior faculty; two weeks of supervised procedures where senior faculty were present during all procedures performed by junior faculty; and two weeks of near-independent practice, with a senior faculty member available on call for support.

Over time, the MBPS has expanded its scope beyond its initial focus on inpatient hospitalized patients. The service now also performs procedures in the emergency department, observation unit, and the “Day Hospital” in the Cancer Center. Initially limited to procedures typical for internal medicine-trained physicians—such as thoracentesis, paracentesis, lumbar puncture, and arthrocentesis using ultrasound guidance—the service has since adapted to hospital needs by adding the placement of central venous catheters (including both triple-lumen and non-tunneled hemodialysis/apheresis catheters) for patients not requiring intensive care unit (ICU) admission. In 2015, the MBPS established a partnership with the Cardiothoracic Surgery Service to place non-tunneled small bore chest tubes (ranging from 8.5 F to 14 F). In 2016, with training from the Hematology/Oncology services, the MBPS began performing bone marrow biopsies and aspirations.

Currently, the MBPS team includes a procedure-trained hospitalist, two internal medicine residents, two third-year medical students, and a physician assistant student. Since its inception in 2015, MBPS physicians have been on call from Monday to Friday from 8 AM to 5 PM, and available from 8 AM to 11:30 AM on weekends and holidays. There is no daily cap on the number of procedures the service can perform. Additionally, the MBPS serves as an elective for internal medicine residents, medical and physician assistant students, providing education in ultrasound and procedural skills.

Statistical Analysis

This retrospective, observational, single-center study reviews internally collected data on MBPS procedures performed from September 2015 to June 2022. Institutional Review Board (IRB) approval for this study was obtained from the MCW/Froedtert Health IRB (#5) on August 11, 2021 (#PRO00041313). Data describing MBPS procedures by patient and encounter were summarized using descriptive statistics, including means and standard deviations for continuous variables and frequencies and percentages for categorical variables.

Patient-level variables were extracted from EPIC-Clarity and included age (continuous), sex (female, male), race/ethnicity (Hispanic, non-Hispanic Black, non-Hispanic Other, non-Hispanic White), county of residence (other Wisconsin county or out of state, Milwaukee, Waukesha, Washington/Ozaukee, Racine/Kenosha), language (English, Spanish, Other/Unknown), whether an

interpreter was used during the encounter (yes/no), payor (managed care, Medicaid, other, self-pay), current patient status (alive, deceased), comorbidities (0, 1, 2, 3 or more), needle passes (continuous), hemoglobin (continuous), platelets (continuous), creatinine (continuous), International Normalized Ratio (INR) (continuous), and prothrombin time (PT) (continuous). Additional descriptive statistics included the mean and standard deviation of the number of procedures performed per day and per month, as well as frequencies and percentages of complications by procedure type. Complications were divided into major and minor. Major complication examples for pleural procedures would be any pneumothorax, hemothorax or lung parenchymal injury. Minor complication examples would be ascites leak for paracentesis or post procedural headache after a lumbar puncture. Also, any need for ICU transfer within 24 hours post procedure or need for additional interventions. Each procedure was tracked by the performer for 24 hours and at the end of the block by the Medical Director. Statistical analyses were conducted using R version 4.0.3 (R Core Team, R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

From September 2015 to June 2022, a total of 12,387 procedures were conducted involving 6,942 unique patients. Patient data is summarized in **Tables 1 and 2**. The average age of patients during these encounters was 64.7 years, with a standard deviation of 15.9. The patient demographic was predominantly male (53.1%), non-Hispanic White (68.8%), English-speaking (97.9%), and covered by Medicaid (71.6%), with over half (54.1%) having three or more comorbidities.

On average, the service performed 5.2 procedures per day (± 2.5) and 151.1 procedures per month (± 27.5) throughout the study period. The three most common procedures were paracentesis (34.6%), thoracentesis (27.3%), and lumbar puncture (21.1%). Each encounter involved slightly more than one needle pass on average (mean: 1.2, standard deviation: 0.54), and there were only 41 reported complications, representing a 0.3% complication rate over the study duration. Among these complications, 56% ($n=23$) were related to thoracentesis, primarily involving pneumothorax, while 24% were associated with vascular access.

Notably, approximately 40% of the procedures were performed by trainees. Residents demonstrated increased proficiency, successfully completing a greater number of procedures, which has contributed to a higher rate of procedural certification among them. Despite the substantial involvement of trainees, the service maintained a remarkably low complication rate of just 0.3%.

Table 1. Descriptive Characteristics of Medicine Bedside Procedure Service Patients (September 2015 – June 2022).

Characteristics	Mean $\pm$ Standard Deviation or Percent n=6,942
Age	64.7 $\pm$ 15.9
Sex	
Female	46.9
Male	53.1
Race/Ethnicity	
Hispanic	4.5
Non-Hispanic Black	23.8
Non-Hispanic Other	2.9
Non-Hispanic White	68.8
County of Residence	
Other county/Out of State	19.2
Milwaukee	52.7
Waukesha	13.9
Washington/Ozaukee	6.6
Racine/Kenosha	7.6
Language	
English	97.9
Spanish	1.8
Other/Unknown	0.3
Interpreter	
No	97.4
Yes	2.6
Payor	
Managed Care	18.0
Medicaid	71.6
Other	2.6
Self-pay	7.8
Current Patient Status	
Alive	50.9
Deceased	49.1
Comorbidity Count	
0	22.6
1	11.1
2	12.2
3+	54.1

Table 2. Needle passes, complications, procedures data for encounters of Medicine Bedside Procedure Service (September 2015 – June 2022).

Needle Passes mean (sd)	1.2 $\pm$ 0.54
Complications (%)	
Yes	0.3
No	99.7
Average number of procedures per day mean (sd)	5.2 (2.5)
Average number of procedures per month mean (sd)	151.1 (27.5)

DISCUSSION

The Medicine Bedside Procedure Service (MBPS) was established to enhance the education of Internal Medicine (IM) residents in essential bedside procedures and Point of Care Ultrasound, while also attempting to reduce the length of hospital stays for patients. Over time, the MBPS has alleviated the workload for various subspecialty services at our institution, including Cardiothoracic Surgery, Transplant Surgery, Hematology-Oncology, and Interventional Radiology.

Although there is limited research supporting the effectiveness of medical bedside procedural services for hospitalized Internal Medicine patients, it remains uncertain whether these procedures consistently lower complication rates, readmission rates, and mortality across diverse patient populations. Since its inception in September 2015 until June 2022, the MBPS at the Medical College of Wisconsin completed 12,387 procedures. The patient demographic primarily consisted of males, non-Hispanic Whites, English-speaking individuals, Medicaid recipients, and patients with three or more comorbidities. Notably, the complication rate over the past seven years was a remarkably low 0.3%.

The increasing focus on healthcare accountability has driven efforts to optimize inpatient resources. The MBPS contributes to several key objectives, including reducing costs associated with common bedside procedures that often require transfer to interventional radiology suites—incurring higher operational costs and facility fees. Ritter et al showed that bedside procedure services can decrease the time from admission to paracentesis thus decreasing hospital length of stay. A study by Swartz et al showed it can provide a safe training environment for internal medicine residents without compromising patient safety.^{14,15} Procedures performed by the MBPS also adhere more closely to best practice safety measures compared to those conducted by primary services.¹⁶⁻¹⁸

Residents have reaped significant benefits from the MBPS implementation, as patients receiving care from this service have experienced shorter procedural wait times, reduced hospital costs, decreased lengths of stay, and lower readmission rates.^{13-15,18-23} The MBPS has achieved a significant milestone, conducting over 12,000 procedures with a dedicated team of 5-6 faculty members focused on resident education, utilizing ultrasound for improved patient outcomes. This accomplishment has not only optimized patient flow and reduced lengths of stay but has also led to higher patient satisfaction within the Oncology service, particularly for intrathecal chemotherapy administration without the need for additional radiation and bedside bone marrow biopsies. Palliative procedures, such as large-volume paracentesis and thoracentesis, have further enhanced patient satisfaction during vulnerable moments, often at the end of life.

Establishing the MBPS has presented several institutional challenges, particularly in fostering a culture that supports bedside procedures. Performing these procedures with minimal disruption to nursing responsibilities was delicate. Currently, procedures can be conducted at the bedside with limited nursing involvement. Effective management of complications has been critical, requiring strong communication with support services like interventional radiology for referrals in case of unsuccessful procedures or complications. Building a trusting relationship with these services was both necessary and challenging. We have also established standardized safety guidelines, including acceptable PT/INR levels for each procedure, to promote a culture of safety and evidence-based blood product use.²⁴

Looking ahead, the MBPS is considering expanding its services to the outpatient setting. Offering short-term follow-up appointments for diagnostic or therapeutic procedures could potentially reduce readmissions and emergency department visits. The future of the MBPS may also involve the integration of clinical point-of-care ultrasound into its services. As portable ultrasound devices become more available, it is essential to train faculty and residents in their effective use. This will enhance patient triage for procedures and facilitate real-time diagnostic and therapeutic decisions at the bedside. Limitations of this study include its retrospective nature, its focus on a single center's experience, and the absence of a comparative group.

CONCLUSION

The Medical Bedside Procedure Service (MBPS) at the Medical College of Wisconsin has successfully enhanced the training of Internal Medicine residents while simultaneously improving patient care by reducing the length of hospital stays and associated costs. With a low complication rate and a significant volume of procedures performed, the MBPS exemplifies the benefits of bedside procedures, including increased patient satisfaction and streamlined workflows. Despite the challenges in fostering a culture conducive to bedside interventions and ensuring effective communication with support services, the program has achieved noteworthy milestones. Moving forward, the MBPS aims to expand its offerings to outpatient settings and incorporate advanced point-of-care ultrasound, positioning itself to further enhance patient triage and procedural efficacy. Limitations of the study suggest a need for further research, particularly in diverse settings, to validate the findings and support the ongoing optimization of bedside procedural care.

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Author Contributions

All authors have reviewed the final manuscript prior to submission. All the authors have contributed significantly to the manuscript, per the International Committee of Medical Journal Editors criteria of authorship.

- Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
- Drafting the work or revising it critically for important intellectual content; AND
- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Disclosures/Conflicts of Interest

The authors declare they have no conflicts of interest

Corresponding Author:

Adrian P. Umpierrez, MD
Emory University School of Medicine & Grady Memorial Hospital
80 Jesse Hill Jr Dr SE., Atlanta, GA 30303
E-mail: aumpier@emory.edu



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