

Bone Marrow Biopsies in Hematologic Cancers: A Systematic Review of Patient and Caregiver Burden

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Gregory Price, MPH¹, Nick Paciaroni, PhD², Nuno Barbosa de Carvalho, PhD³, Christian Suharlim, MD, MPH¹

¹ Thermo Fisher Scientific, Waltham, Massachusetts, USA; ² The Binding Site, part of Thermo Fisher Scientific, San Diego, CA, USA; ³ The Binding Site, a part of Thermo Fisher Scientific, Birmingham, UK

Introduction

- Bone marrow aspiration and biopsy (BMAB) is a cornerstone of diagnosis and monitoring in hematologic malignancies.
- Despite its clinical importance, BMAB imposes substantial physical, emotional, and logistical burden on patients and caregivers. Diagnostic limitations (e.g., dry taps, hemodilution, inadequate samples) may require repeat procedures, increasing burden and delaying care.
- These challenges may limit access for frail patients, impact adherence to monitoring and influence participation in clinical trials.
- This review synthesizes evidence on patient and caregiver burden associated with BMAB and highlights opportunities for more patient-centered, less invasive diagnostic approaches.

Methods

- PRISMA-guided PubMed systematic review (2010–2025)
- Studies in adult hematologic malignancy populations undergoing BMAB that reported patient or caregiver burden were included.
- A snowball search supplemented results.
- Data were extracted across physical, emotional, procedural, and logistical burden domains using a multi-label framework.
- Findings were synthesized narratively to characterize burden and identify opportunities to reduce reliance on invasive procedures.

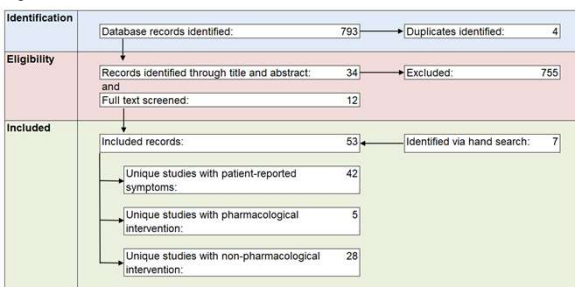
Table 1: Inclusion and Exclusion Criteria

| PICOS | Inclusion | Exclusion |
|------------------|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Population | Adult (>=18 years) hematologic cancer patient | Patients <18 years |
| Intervention | Bone marrow aspiration or biopsy | |
| Comparator | No restrictions | |
| Outcome | Patient and caregiver-related burden | |
| Study design | Clinical trials, pooled analyses, real-world observational (prospective and retrospective), SLR | Individual case report |
| Publication type | Peer-reviewed articles | Abstracts, Conference posters, Expert opinion, Guidelines |
| Language | English | non-English studies |
| Timeframe | Published between 1January2010 and 31Dec2025 | Published before 2010 |

Table 2: Search Criteria

| Search | Query |
|--------|---------------------------------------------|
| 1 | hematologic malignancies |
| 2 | bone marrow examination; bone marrow biopsy |
| 3 | patient |
| 4 | caregiver |
| 5 | inadequate biopsy; hemodilution |
| 6 | frailty |
| 7 | 1 and 2 and 3 |
| 8 | 1 and 2 and 4 |
| 9 | 1 and 2 and 5 |
| 10 | 1 and 2 and 6 |

Figure 1. PRISMA



Results

- Across 53 included studies, BMAB burden was consistently multidimensional, encompassing physical, emotional, procedural, and logistical domains.
 - Primary burden: **procedural pain and anxiety**, with emotional distress closely linked to pain experience.
 - Procedural limitations** (e.g., dry taps, hemodilution, inadequate samples) often require repeat biopsies, increasing burden and delaying care.
 - Caregiver burden** and diagnostic alternatives were infrequently studied, highlighting important evidence gaps.
- Burden mitigation strategies (non-pharmacologic, pharmacologic, and device-based) showed mixed effectiveness.
 - Patient experience improvements not always accompanied with pain reduction. **Limited studies on diagnostic alternatives**, a key gap.

Discussion

- BMAB burden extends beyond **procedural pain** to include psychological, procedural, and system-level factors.
 - Anxiety** consistently emerges as a key driver of patient experience, amplifying perceived burden beyond physical symptoms.
 - Procedural inefficiencies** (e.g., repeat biopsies, inadequate samples) represent an underrecognized contributor to burden.
- Despite multiple interventions, no standardized approach to mitigating BMAB burden. **Improvements in experience ≠ reduced pain.**
- Important gaps: caregiver burden, frailty, and diagnostic alternatives

Figure 2. Key Themes and Frequency

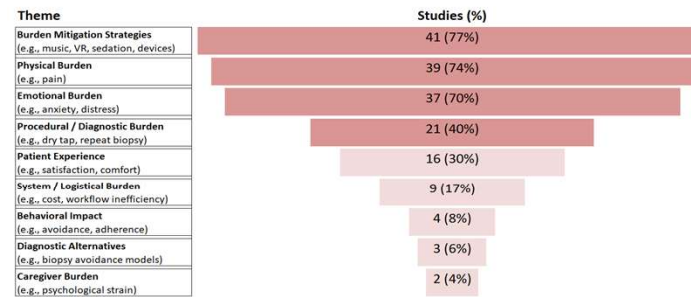


Figure 3. Study Type and Themes

| Study Type | Article Count | Physical | Emotional | Procedural/Diagnostic | Patient Experience | Optimization | System/Logistical | Behavioral | Caregiver | Diagnostic Alternatives |
|----------------------|---------------|----------|-----------|-----------------------|--------------------|--------------|-------------------|------------|-----------|-------------------------|
| RCT | 23 | 21 | 14 | 5 | 11 | 23 | 0 | 0 | 0 | 0 |
| Observational | 18 | 9 | 9 | 10 | 1 | 6 | 4 | 2 | 1 | 1 |
| Review/meta | 5 | 5 | 4 | 4 | 1 | 5 | 2 | 1 | 0 | 0 |
| Qualitative/mixed | 2 | 1 | 2 | 0 | 1 | 1 | 0 | 2 | 1 | 0 |
| Survey/QI | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 0 | 0 | 0 |
| Interventional/pilot | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| Diagnostic/model | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |

