Tolerability and the Accelerome: Wrist-Worn Open-Source Accelerometry Tracks Symptom Burden in Androgen-Ablated Older Men with Metastatic Prostate Cancer

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Background
Metastatic prostate cancer (mPC) disproportionately affects older adults and produces pain, fatigue, and urinary dysfunction that erode quality of life and independence. Clinic-based symptom assessments miss fluctuations that occur between visits. Low-cost, wrist-worn accelerometers and open-source analytics could deliver continuous, objective digital biomarkers to complement patient-reported outcomes.

Methods
We performed a retrospective secondary analysis of the Geriatric Remote Initiative pilot. Ten men ≥ 65 years with mPC wore a Bangle.js 2 smartwatch (KX022-1020 triaxial accelerometer, ± 8 g, 4 096 counts/g) on the non-dominant wrist and completed weekly tablet-based surveys for 12 weeks. Each survey captured a single-item self-rated-health score (SRH, 1–5) and four PRO-CTCAE items (fatigue, pain, urinary frequency, hot flashes; 0–3 severity). Scores were combined into a Symptom-Burden + Self-Rated-Health Index (SBSI; higher = worse). Raw 10 Hz acceleration was down-sampled to 1-min epochs, summarized as counts-per-minute (CPM) and vector-magnitude change (VMC), and partitioned into valid wear intervals ≥ 12 h. Ninety-eight time-, frequency-, entropy-, and distribution-based features were extracted. Accelerometry–SBSI associations were examined with linear mixed-effects models, Spearman correlations across five 30-day bins, mixed-effects LASSO, and a 500-tree random forest.

Results
Overall, ten men (mean age 72.7 ± 4.8 y) comprised the cohort; 55 % were White, half held advanced degrees and worked full-time, and 60 % lived with a partner. Prior prostatectomy, radiation, or androgen suppression each occurred in 40 %. Comorbidity burden was high (60 %), polypharmacy common (70 %), but no baseline functional impairment was observed. After wear-time filtering, 44 monitoring windows (14–48 h; median 5 per participant) from nine evaluable patients covered the 120-day study period. Three spectral features showed strong monotonic relations with SBSI across bins: CPM_top_15_freq3 (third CPM peak; $\rho = +0.95$), CPM_median_freq (median CPM frequency; $\rho = -0.88$), and VMC_top_15_fft3 (third VMC peak; $\rho = -0.90$) (all $p < 0.05$). Mixed-effects LASSO and random-forest ranking converged on CPM_top_15_freq3 and CPM_median_freq as independent predictors. Within-patient analyses confirmed that higher CPM_top_15_freq3 (reflecting 10–30 s postural shifting) and lower CPM_median_freq (global activity slowing) aligned with higher weekly symptom burden.

Conclusions
In this older mPC cohort, two data-driven wrist-accelerometer features—third CPM spectral peak and median CPM frequency—were reproducibly linked to weekly symptom burden over three months. These preliminary findings support periodic capture of movement-based phenotypes as passive, objective monitors of symptom trajectories during androgen-deprivation therapy. Prospective, adequately powered studies should validate these digital biomarkers and define actionable thresholds for clinical intervention.

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