Identifying Baseline Pain Indicators for Phantom Limb Pain in Amputee Patients

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Abstract

Background: Phantom limb pain (PLP) is a complex condition that frequently affects amputees and is associated with chronic pain and reduced quality of life. Despite its prevalence, documentation of PLP in clinical settings remains inconsistent, which limits comprehensive assessment and the integration of emerging treatments, such as virtual reality (VR).

Objective: This quality improvement project aimed to identify documentation gaps in assessing PLP among amputee patients and establish baseline indicators to inform future VR-based interventions.

Methods: A retrospective chart review was conducted at a large tertiary hospital in the Pacific Northwest. Thirty-two inpatient charts of adults with traumatic or elective limb amputations between January and April 2023 were analyzed. Extracted data included PLP diagnosis documentation, pain scale usage, descriptors, psychological conditions, and opioid use, measured in morphine milligram equivalents (MME) across postoperative days one through six.

Results: PLP was missing from the diagnosis list in 91% of charts, although it appeared in progress notes in 75%. Pain scales were used in 97% of cases, but 84% were incomplete. Only 16% of charts included psychological diagnoses, and no documentation addressed PLP's impact on daily functioning. Average MME was 76.9 for days one to three and 66.4 for days four to six, with no significant difference noted.

Conclusion: Documentation gaps demonstrated a lack of assessment for PLP. These findings highlight the need for standardized, multidimensional pain assessment tools and electronic health record enhancements to support individualized PLP care and evaluate treatments like VR.

Keywords: phantom limb pain, documentation, virtual reality, pain assessment, opioid use, quality improvement, amputation, electronic health record

Introduction

Problem Description

Phantom limb pain (PLP) is the sensation of pain perceived in a limb that has been amputated despite the absence of the limb itself (Hali et al., 2024). The pain, described as electric shocks, stabbing, burning, sharp, dull, cramping, or shooting, may start shortly after amputation or emerge years later, often persisting as a chronic condition (Hali et al., 2024; Kaur & Guan, 2018; Urits et al., 2019). The varying onset, duration, severity, quality, and location of pain in phantom limb syndrome can complicate its management. This pain arises from neurological mismatches, where the brain continues to receive signals from nerves once connected to the amputated limb, creating sensory conflicts and maladaptive neuroplasticity (Ambron et al., 2023; Erlenwein et al., 2021). The absence of visual feedback further exacerbates the problem, as the brain struggles to reconcile the missing limb with the expected sensory inputs, leading to persistent pain. Psychological stress also contributes to the overall pain experience (Culp & Abdi, 2022).

PLP affects many patients and significantly impacts their quality of life, posing therapeutic challenges in medicine. In the United States, more than 30,000 amputations are conducted annually for various reasons, such as diabetes, vascular disease complications, trauma, tumors, and infection (Hanyu-Deutmeyer et al., 2024). In Oregon, from 2000 to 2013, 24,514 amputations were performed, showing a 38.87% increase over the entire period (Amputee Coalition, 2019). Limakatso et al. (2020) found that 64% of individuals with amputations experienced PLP. Pharmacological interventions (e.g., anticonvulsants, antidepressants, opioids) are often the initial choice for PLP but face drawbacks like side effects and high costs for prolonged usage (Culp & Abdi, 2022; Kaur & Guan, 2018; Urits et al., 2019). Other treatments, including surgical options such as targeted muscle reinnervation and non-pharmacological therapies like mirror therapy, generally show limited efficacy (Annapureddy et al., 2023; Hagiga et al., 2023). Virtual reality (VR) has emerged as a promising treatment for PLP by providing

visual and sensory feedback, promoting positive neuroplastic changes, and offering immersive distraction (Wittkopf et al., 2020). By creating visual representations of the missing limb, engaging patients in interactive tasks, and simulating mirror therapy, VR helps the brain resolve sensory conflicts, reduces maladaptive neuronal activity, and alleviates pain (Wittkopf et al., 2020). Additionally, VR-based therapies can improve motor function and coping strategies, enhancing the overall quality of life for individuals with PLP (Culp & Abdi, 2022; Hali et al., 2024; Rutledge et al., 2019; Wittkopf et al., 2020).

This quality improvement project aimed to identify and measure baseline indicators of phantom limb pain in amputees, identify documentation gaps that limit effective assessment, and provide recommendations to improve documentation practices.

Available Knowledge

A literature search was conducted using PubMed and CINAHL databases. Search terms included "phantom limb pain," AND "virtual reality," AND "treatment." Various combinations with all or a few of these terms were used. The search yielded 77 relevant articles, of which six applied to measuring baseline pain indicators.

Emerging evidence highlights the importance of evaluating key variables—such as pain intensity and duration, impact on daily functioning, psychological factors, and medication usage—to better understand and optimize VR treatments for PLP (Annapureddy et al., 2023; Eldaly et al., 2024; Kulkarni et al., 2020; Lendaro et al., 2018). Measuring pain intensity and duration is crucial in evaluating the effects of VR interventions. Tools such as the McGill Pain Questionnaire (MPQ) and the Questionnaire for Phantom Limb Pain (Q-PLP) offer a multidimensional assessment of sensory, affective, and evaluative pain components (Lendaro et al., 2018). Four studies emphasized the importance of assessing how VR treatments affect activities of daily living, sleep quality, and overall quality of life, finding significant improvements in these areas (Ambron et al., 2023; Annapureddy et al., 2023; Lendaro et al., 2018; Rutledge et al., 2019). Psychological factors, including anxiety, depression, and pain catastrophizing, are

vital components of PLP management (Ambron et al., 2023; Lendaro et al., 2018; Rutledge et al., 2019). The six studies evaluated had limitations on VR for PLP, such as small sample sizes and highly variable subject populations, highlighting the need for more extensive randomized controlled trials (Ambron et al., 2023; Annapureddy et al., 2023; Eldaly et al., 2024; Hali et al., 2024; Kulkarni et al., 2020; Rutledge et al., 2019). None of the studies discussed reduction in medication use as a variable. Including reduction in medication use as a variable in research studies could provide insights into the benefits of alternative treatments and minimize side effects (Kaur & Guan, 2018; Urits et al., 2019). The synthesis of recent studies identifies several critical variables for continued research: pain intensity and duration, impact on daily life, psychological well-being, long-term efficacy, and interference in daily activities. Addressing these variables can enhance the understanding and optimization of VR treatments for PLP, ultimately improving patient outcomes and quality of life.

Rationale

A root cause analysis identified incomplete pain assessment documentation and missing baseline indicators for PLP, including documentation of its presence and impact on daily life. This deficiency results in inadequate methods for assessing PLP. This lack of effective pain assessment can lead to ineffective pain management, causing prolonged patient suffering, increased treatment costs, and a diminished quality of life for amputees.

This project was guided by the Institute of Healthcare Improvement (IHI) Model for Improvement (MFI). The IHI MFI offers a systematic approach to change, emphasizing clear objectives, identifying areas for improvement, and implementing effective changes (Institute for Healthcare Improvement [IHI], n.d.). Utilizing the Plan-Do-Study-Act (PDSA) cycle, this model ensures that improvement efforts are purposeful, evidence-based, and adaptable. This validated tool will help identify key components and accelerate improvement in healthcare settings, supporting efforts to identify baseline indicators of PLP and enhance its management.

This project aimed to improve the quality of PLP management by identifying and measuring baseline indicators critical for applying and assessing the efficacy of future VR therapy, while also providing recommendations to enhance the assessment and documentation process. Collecting baseline data on pain intensity, quality, duration, impact on daily activities, sleep quality, psychological well-being, and medication requirements will enable clinicians to evaluate the benefits and limitations of VR therapy for PLP in the future. By standardizing the documentation and measurement of these variables, this quality improvement project seeks to optimize the evaluation of VR treatments for PLP, ultimately enhancing patient outcomes and the quality of life. The findings from this project may contribute to new recommendations or confirm existing best practices in PLP management.

Specific Aims

This quality improvement project aimed to evaluate current documentation practices of PLP in amputee patients to inform and enhance the future implementation of VR-based therapy. Through better-documented and measurable interventions, the results may improve PLP management, reduce patient suffering, and enhance the quality of life for individuals with amputations**.**

Methods

Context

This quality improvement project was conducted at a large tertiary hospital in the Pacific Northwest, involving patients from the orthopedic, vascular, plastic, and trauma services. The project involved a retrospective chart review of patients diagnosed with either traumatic or elective limb amputation, utilizing data from the hospital's Electronic Health Record (EHR) system. The data spanned from January to April 2023, with collection and analysis occurring between February and March 2025. The objective was to evaluate how PLP is documented in the inpatient setting and to identify gaps in its reporting. Patients under 18 were excluded.

Interventions

Current Procedural Terminology (CPT) codes (see Appendix A) related to amputations were utilized to identify patient Medical Record Numbers (MRNs). The patient charts were manually reviewed for data identifying a PLP diagnosis, the type of pain assessment tool used, the completeness of these tools, the identification of missing components, pain scores, intensity, duration, reported impacts on daily life, psychological well-being, and opiate usage during the postoperative days of one through six. All patient information was kept confidential, accessible only to authorized personnel, and anonymized to protect privacy.

Measures

The primary outcome measure of this project was to evaluate the compliance with and efficacy of baseline pain assessment tools for measuring PLP in amputees. The quantitative analysis included assessing the completeness of pain assessment tools on postoperative day one (POD 1), identifying gaps in these tools, determining the prevalence of PLP diagnoses, calculating average pain intensity scores, and categorizing pain duration as days, months, or years. The analysis also involved reviewing whether a designated field existed in the chart to document the impact of pain on daily activities. Psychological diagnoses were noted as present or absent based on chart documentation. An evaluation of MME usage across postoperative days 1–3 and 4–6 was conducted to determine whether there was a significant decrease in usage over time.

Analysis

The data was categorized to include confirmation of PLP diagnosis, usage of pain assessment tools, completeness of pain scales, and their missing components on POD 1, along with recorded pain intensity and descriptions. It also included the duration of pain, its impact on daily activities, psychological diagnoses, and opioid usage, comparing consumption between postoperative days one to three and four to six.

Ethical Considerations

This project received a non-human subject research designation from the Institutional Review Board and did not require informed consent, as it did not involve direct patient interaction. Patient data were anonymized, and individuals were represented solely by numerical identifiers ranging from 1 to 32 to ensure privacy and omit personal details. The study's retrospective nature and lack of direct interaction with patients precluded any risk of physical or psychological harm.

Results

A total of 32 patient charts were manually reviewed for documentation of PLP. The diagnosis of PLP appeared in the diagnosis list in 9% (n=3) of charts, was recorded in progress notes in 75% (n=24), and was absent in 16% (n=5) of the charts (see Appendix B). Pain assessments employed various scales: 97% (n=31) of charts utilized the numerical pain scale, 34% (n=11) combined numerical and nonverbal pain scales, 6% (n=2) used a mix of numerical, nonverbal, and other scales, while 3% (n=1) relied solely on the Critical-Care Pain Observation Tool (CPOT). Notably, 27 charts exhibited incomplete pain scales, with only five documenting complete information.

Analysis of the missing components in the numerical pain scale revealed specific deficiencies: location was missing in 13% (n=4), side/orientation in 13% (n=4), a pain descriptor in 25% (n=8), pain radiation in 75% (n=24), nonverbal signs in 53% (n=17), pain severity in 16% (n=5), interventions performed in 3% (n=1), and responses to interventions in 13% (n=4) (see Appendix C). The mean pain score was 6/10 (standard deviation = 3).

Four charts included "phantom pain" within the pain assessment tool, though it was not documented as a formal diagnosis. Twenty charts used other pain descriptors, while eight lacked any descriptors entirely. The duration of pain was reported as follows: 14 charts indicated pain over days, eight over weeks, four over months, and six over years. Notably, no charts documented the impact of

PLP on daily life. Psychological diagnoses such as anxiety, depression, and substance use were not recorded in 44% of the charts, whereas 56% recorded one or more psychological conditions.

Opioid management revealed that 38% of patients had a home opioid prescription before admission, while 63% lacked documentation of home opioids. MME usage averaged 76.9 (standard deviation = 76.5) from postoperative days one to three and 66.4 (standard deviation = 91) from days four to six. A t-test was performed comparing opioid use between these intervals ($p=0.25$), showing no difference in the timeframe.

Discussion

Summary

This quality improvement project uncovered documentation gaps in the management of PLP among amputees. In a review of 32 patient charts, instances of PLP were often absent from diagnosis lists and noted only in progress notes. Pain assessments were frequently incomplete, lacking detail on pain descriptors and treatment responses. These findings underscore the need for standardized, systematic documentation to support the effective use and evaluation of emerging therapies, such as VR. This project lays the groundwork for future efforts to enhance PLP management by improving documentation and integrating innovative treatments.

Interpretation

Identified deficiencies in the assessment of PLP among amputees emphasize the need to enhance documentation practices. Improving these practices is vital for accurately assessing and evaluating innovative treatments, such as VR, which promise new pathways for effectively managing PLP. The findings align with Xu et al. (2024), indicating that detailed and systematic pain documentation is essential for improving patient outcomes through more precise diagnoses and tailored treatment plans. There is no universally recommended tool for documenting PLP (Bressler et al., 2022; Mioton et al., 2020). However, multidimensional pain scales, such as the Phantom Phenomena Questionnaire and

the Short-Form McGill Pain Questionnaire (SF-MPQ), can better capture the complexity of PLP (Jiang et al., 2021; Prahm et al., 2025). The SF-MPQ offers a brief, validated option that captures both the sensory quality and emotional impact of pain, and can be feasibly integrated into routine inpatient workflows (Prahm et al., 2025). Future research is essential for developing and standardizing a comprehensive documentation tool for PLP. Such efforts could enhance clinical efficiency and support more effective, personalized treatment strategies, ultimately leading to improved outcomes in PLP management.

While this project found no statistically significant difference in opioid use between postoperative days one to three and four to six, MME usage remained elevated, averaging 76.9 and 66.4, respectively, alongside high pain scores. In contrast, Camazine et al. (2023) reported lower opioid use among 2,399 lower extremity amputation patients, with an average of 59.5 MME on postoperative day one, tapering to 17.6 MME per day by discharge. This disparity may reflect greater immediate postoperative pain management needs in the current cohort, potentially influenced by chronic opioid use at home and the corresponding need for higher inpatient MME dosing. Variations may also be explained by the heterogeneity of the study populations and the unaccounted use of epidurals or peripheral nerve blocks for pain control. These findings emphasize using multidimensional pain assessment tools to guide individualized pain management strategies.

Discrepancies in pain documentation may stem from several systemic barriers, including entrenched clinical workflows, provider training variability, and inconsistent pain management prioritization across healthcare systems (Rababa et al., 2021; Xu et al., 2024). These challenges highlight the complexity of integrating new documentation protocols into established practices. One potential solution is the implementation of automated prompts triggered by the documentation of an amputation, which could standardize the assessment of PLP. Such prompts could direct clinicians to assess key dimensions of PLP, including its impact on daily functioning, psychological well-being, and characteristic neuropathic descriptors—such as burning sensations, pins and needles, or pain perceived

in the absent limb. Embedding these multidimensional assessments into routine clinical workflows may improve the precision of PLP documentation and facilitate more personalized pain management strategies.

Strategic resource allocation must balance investments in improving documentation practices with advancing treatment technologies. Although initial costs, such as staff training and system modifications, can be substantial, they are offset by long-term benefits, including enhanced PLP management, decreased reliance on pharmacologic interventions, and better clinical outcomes (Xu et al., 2024). These improvements could be applied to other populations experiencing complex pain. Without accurate documentation, data-driven therapies such as VR may be underutilized or misapplied (Teh et al., 2024).

Limitations

Given its limited population focus, this quality improvement project, conducted at a single tertiary hospital in the Pacific Northwest, lacks generalizability. The retrospective chart review might introduce selection and information biases due to non-random selection and potential inaccuracies in medical records. Confounding factors, such as the severity of amputation and concurrent treatments, were not controlled, which affected internal validity. A standardized chart review protocol was employed to mitigate these issues, and data were stratified by patient characteristics where feasible. Although these measures enhanced the study's reliability, future research should be expanded to multiple settings, include a larger sample size, and employ a prospective design to strengthen the findings and their applicability in clinical practice.

Conclusion

This quality improvement project has identified the need for standardized documentation practices to enhance the assessment and management of PLP. Implementing a standardized PLP assessment tool, provider education, and automated Epic prompts can improve early recognition and

guide appropriate interventions. While future research should aim to develop a universally accepted documentation tool, the SF-MPQ can serve as a validated, multidimensional interim measure to improve current assessment practices. By strengthening baseline pain documentation and addressing current gaps, this work supports more informed clinical decision-making and prepares for the integration of emerging therapies, such as VR. Ongoing refinement of documentation practices will be essential to improve care quality and outcomes for individuals with PLP.

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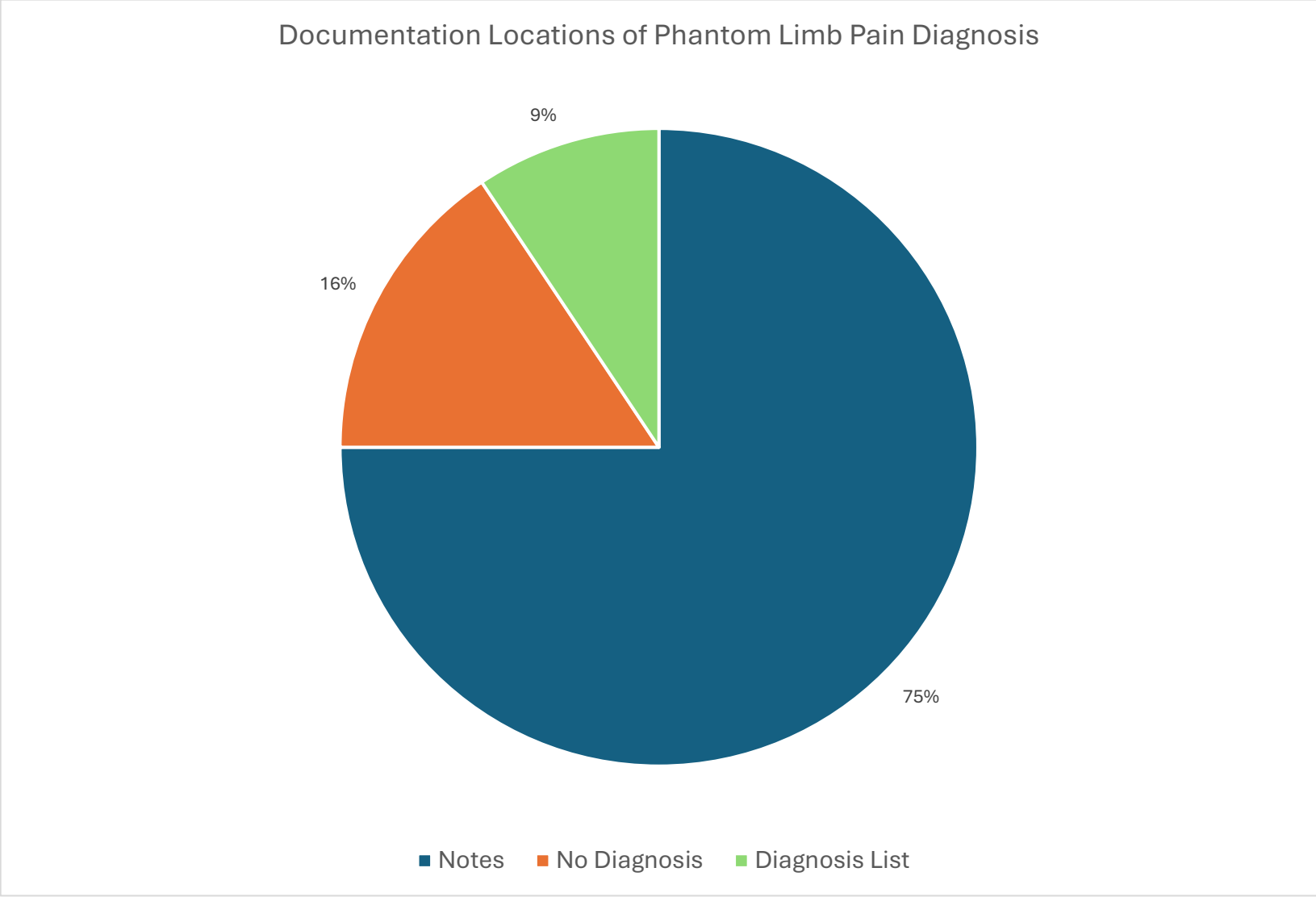
Appendix A

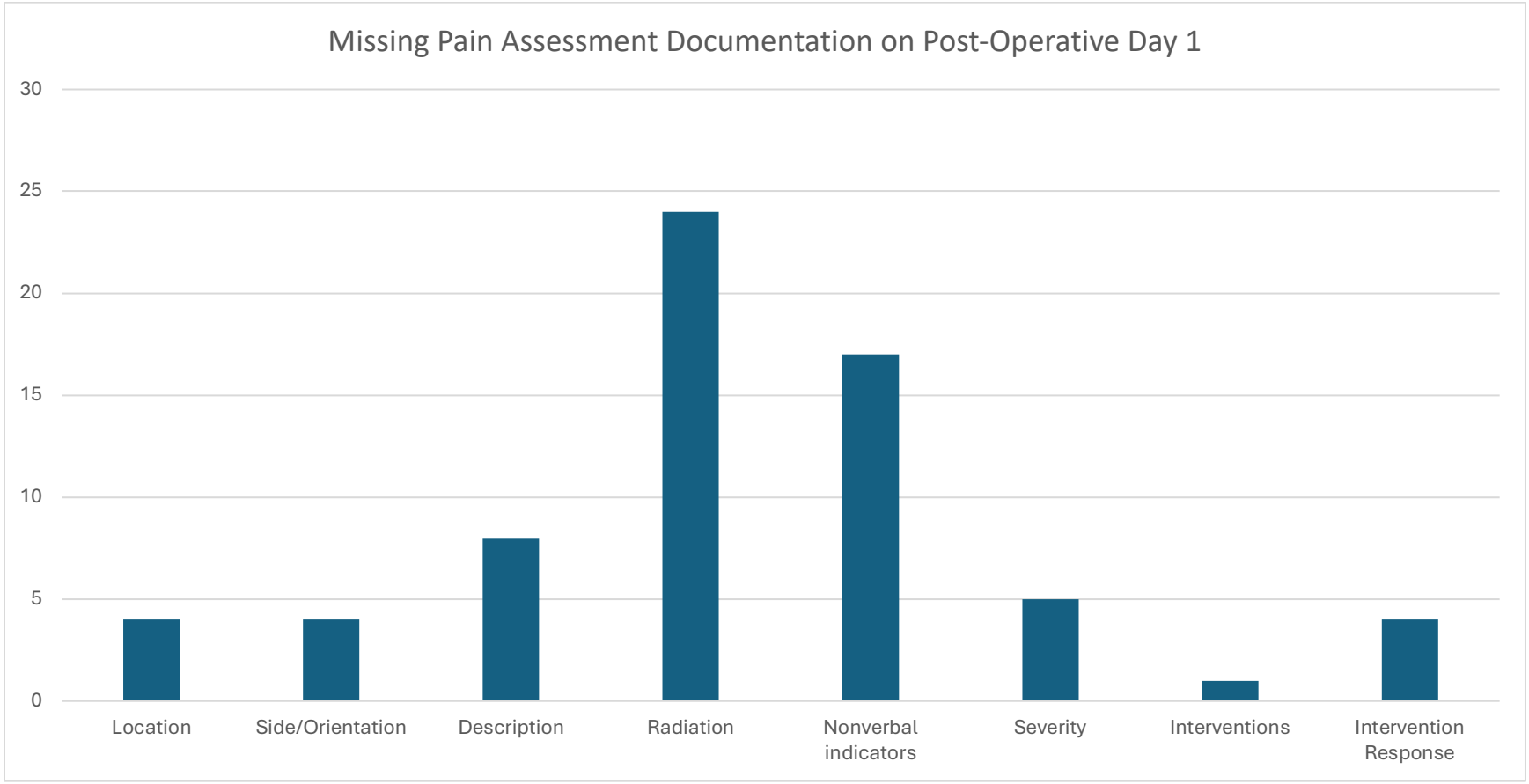
Upper and Lower Extremity Amputation Current Procedural Terminology (CPT) Code

Upper Extremities		Lower Extremities	
CPT Code	Description	CPT Code	Description
25900	Amputation, forearm, through radius and ulna	27590	Amputation, thigh, through femur (above knee)
25905	Amputation, forearm, through radius and ulna; re-amputation	27591	Amputation, thigh, through femur (above knee); immediate fitting
25920	Amputation, forearm, through humerus (below elbow)	27592	Amputation, thigh, through femur; re-amputation
25922	Amputation, arm, through humerus (below elbow); re-amputation	27594	Amputation, hip disarticulation
25927	Amputation, upper arm (through humerus)	27596	Amputation, hemipelvectomy
25928	Amputation, upper arm (through humerus); re-amputation	27880	Amputation, leg, through tibia and fibula (below knee)
25931	Disarticulation at shoulder.	27881	Amputation, leg, through tibia and fibula (below knee); re-amputation
25935	Amputation, shoulder; interscapulothoracic	27882	Amputation, leg, through tibia and fibula (below knee); immediate fitting
		27888	Amputation, ankle disarticulation (Syme amputation)

Appendix B


Documentation Locations of Phantom Limb Pain Diagnosis
9%
16%
75%
Notes
No Diagnosis
Diagnosis List

Appendix C


Missing Pain Assessment Documentation on Post-Operative Day 1
30
25
20
15
10
5
0
Location
Side/Orientation
Description
Radiation
Nonverbal indicators
Severity
Interventions
Intervention Response